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Federal Highway Administration
North Carolina Division

Administrative Action

Final Environmental Impact Statement and Section 4(f) Evaluation

Volume 1

US Department of Transportation, Federal Highway Administration
North Carolina Department of Transportation

NC 12 Replacement of Herbert C. Bonner Bridge

(Bridge No. 11) over Oregon Inlet

Federal-Aid No. BRS-2358(15)
NCDOT Project Definition: 32635
TIP Project No. B-2500
Dare County, North Carolina

Submitted Pursuant to the National Environmental Policy Act 42 USC 4332(2)(c) and 49 USC 303

Cooperating Agencies
US Coast Guard/US Army Corps of Engineers
US Fish and Wildlife Service/National Park Service

9/11/08
Date

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The proposed project is the construction of a bridge to replace Herbert C. Bonner Bridge in Dare County and demolition and removal of Bonner Bridge and improvements to NC 12 between the community of Rodanthe and Oregon Inlet. This FEIS documents the purpose and need for the project; describes existing and projected conditions in the project area; identifies seven alternatives in two corridors; and assesses the direct, indirect, and cumulative impacts of these alternatives, including community, visual, cultural resource, natural resource, and environmental quality considerations. Public and government agency comments on the SDEIS and SSDEIS also are addressed in this document.

Comments on this FEIS are due by ______________ and should be sent to Gregory J. Thorpe, Ph.D. at the above address.

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Summary

S.1 Federal Highway Administration

Administrative Action Environmental Impact Statement

( ) Supplemental Draft (x) Final

(x) Final Section 4(f) Evaluation

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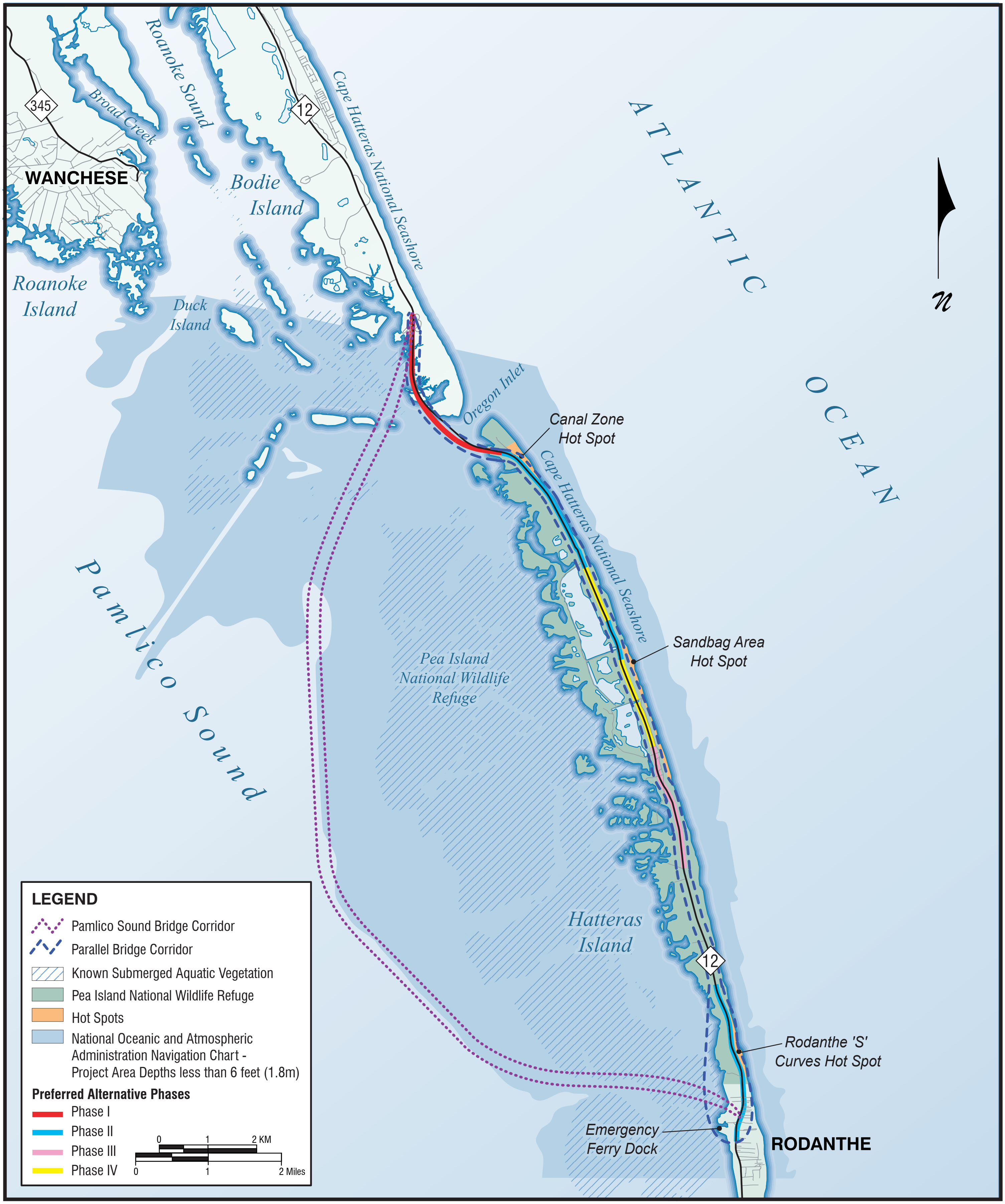
S.3 Brief Description of the Project

The North Carolina Department of Transportation (NCDOT) proposes to replace the Herbert C. Bonner Bridge across Oregon Inlet in Dare County. Bonner Bridge, built in 1962, is approaching the end of its reasonable service life. Bonner Bridge is a part of NC 12 and provides the only highway connection between Hatteras Island and Bodie Island. The replacement structure would serve the same function. The project also includes NC 12 between the community of Rodanthe and Oregon Inlet, an area that is at risk because of shoreline erosion. This project proposes to provide a long-term approach to minimizing that risk through 2060.

Two replacement bridge corridors are assessed in this Final Environmental Impact Statement (FEIS): the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor with NC 12 Maintenance. The proposed corridors are illustrated in Figure S-1. The alternatives associated with each corridor are:

- Pamlico Sound Bridge Corridor.
  - With Curved Rodanthe Terminus.
  - With Intersection Rodanthe Terminus.
- Parallel Bridge Corridor.
  - With Nourishment.



REPLACEMENT BRIDGE CORRIDORS AND PREFERRED ALTERNATIVE

Figure S-1

- With Road North/Bridge South.

- With All Bridge.

- With Phased Approach/Rodanthe Bridge (Preferred).

- With Phased Approach/Rodanthe Nourishment.

The Pamlico Sound Bridge Corridor contains a proposed Pamlico Sound bridge that would be approximately 17.5 miles (28.2 kilometers) in length. The total project length would be 18 miles (29.0 kilometers), including the bridge, as well as the approach roads at the northern and southern ends. The southern terminus of the project would be within the community of Rodanthe on Hatteras Island. Two possible termini design options are being evaluated in Rodanthe. With the Curved Rodanthe Terminus, the proposed bridge would end in a curve that would connect the bridge directly to NC 12. With the Intersection Rodanthe Terminus, the proposed bridge would end with a signalized intersection at NC 12. The bridge would extend north from Rodanthe into Pamlico Sound as much as 5 miles (8 kilometers) west of Hatteras Island. The project would end at the northern terminus of the Bonner Bridge on Bodie Island, within the Cape Hatteras National Seashore (the Seashore).

The typical section for a Pamlico Sound bridge would provide two 12-foot (3.6-meter) travel lanes and two 8-foot (2.4-meter) shoulders. This bridge's Oregon Inlet navigation spans would provide a minimum navigation opening of 200 feet (61 meters) horizontally and 75 feet (23 meters) vertically. The navigation zone (area with spans of the navigation span height and width) would be 1,600 to 2,000 feet (488 to 610 meters) long. The proposed typical bridge span outside the navigation zone would be 140 to 150 feet (42.7 to 45.7 meters) long. The location(s) of navigation span(s) would be considered when designing for potential vessel collision. Outside the navigation zone, the vertical clearance of the bridge currently is proposed to be approximately 10 feet (3.1 meters) above mean high water. A project in the Pamlico Sound Bridge Corridor would cost approximately $1.3 to $1.8 billion (including construction cost, right-of-way cost, operation and maintenance costs until 2060, and other highway-related costs in 2006 dollars) by 2060, with the initial bridge costs ranging between $929.1 million and $1.4 billion.

The Parallel Bridge Corridor (including the Preferred Alternative) contains a proposed Oregon Inlet bridge that would be up to 3.2 miles (5.1 kilometers) in length. The NC 12 maintenance component would keep NC 12 open from the community of Rodanthe to the Oregon Inlet bridge's southern terminus, a distance of approximately 12.5 miles (20.1 kilometers). The NC 12 maintenance component would pass through the Pea Island National Wildlife Refuge (the Refuge), which has shared jurisdiction with the Seashore.

The Nourishment Alternative assumes that NC 12 would remain in its current location, and beach nourishment combined with dune enhancement would be used to maintain an adequate beach and dune system. The total length of beach requiring regular nourishment would be approximately 6.3 miles (10.1 kilometers). Nourishment would occur in four locations, likely repeated at four-year intervals.

With the Road North/Bridge South Alternative, NC 12 would be placed on a bridge west of Hatteras Island beginning at a new intersection in Rodanthe and continuing to a point approximately 2 miles (3.2 kilometers) north of the Refuge's southern boundary where the project would meet existing NC 12. NC 12 would then remain unchanged for 2.6 miles (4.2 kilometers). Beginning at a point approximately 1.3 miles (2.1 kilometers) south of the Refuge's ponds, NC 12 would be relocated to a point 230 feet (70.1 meters) west of the forecast 2060 high erosion shoreline. This relocation would continue 7.1 miles (11.4 kilometers) north until the relocated NC 12 would meet the Oregon Inlet bridge. Three 10-foot-high (3-meter-high) dunes, totaling 2,100 feet (640 meters) in length would be built adjacent to the relocated road, but not immediately. They would be built when needed as the shoreline erodes towards the relocated road. The first one is not expected to be needed until 2030.

The All Bridge Alternative would include the same bridge in the Rodanthe area as the Road North/Bridge South Alternative. In the central and northern part of the Refuge, NC 12 would be constructed on a bridge to the west of the existing road. Two road segments would be included in this relocation, one near Oregon Inlet and one just north of the Refuge's ponds, where access from NC 12 to the Refuge would be provided. Access to the Refuge also would be available in a 1.8-mile (2.9-kilometer) section of NC 12 that would be left unchanged between the Rodanthe area bridge and the beginning of the next bridge section south of the ponds. The bridges associated with this alternative would span the five potential storm-related island breach locations.

The Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) assume an Oregon Inlet bridge, as well as elevating portions of NC 12 through both the Refuge and northern Rodanthe within the existing NC 12 easement. The alternatives would be built in four phases, with the first phase being the bridge across Oregon Inlet. Additional phases would be built as necessitated by coastal conditions. Two southern termini are considered: the Phased Approach/Rodanthe Bridge Alternative (Preferred) and Phased Approach/Rodanthe Nourishment Alternative. With the Phased Approach/Rodanthe Bridge Alternative (Preferred), the bridge in the existing NC 12 easement would begin in Rodanthe just north of Sudie Payne Road (see Figure 2-21) and extend north to Oregon Inlet except for the 2.1 mile (3.4-kilometer) length of NC 12 in the southern half of the Refuge that would not be threatened by erosion prior to 2060. Access to properties adjacent to the bridge in Rodanthe would be provided by a one-lane, one-way frontage road on each side of the NC 12 bridge. The Phased Approach/Rodanthe Nourishment Alternative would be similar, except the southern end of the NC 12 bridge would begin 0.3 mile (0.5 kilometer) south of the Refuge/Rodanthe border. Beach nourishment would be used to protect NC 12 in Rodanthe.

The typical section for the Oregon Inlet bridge in the Parallel Bridge Corridor (including the Preferred Alternative) would provide two 12-foot (3.6-meter) travel lanes and two 8-foot (2.4-meter) shoulders. The bridge would include a series of navigational spans across Oregon Inlet. This "navigation zone" for three of the Parallel Bridge Corridor alternatives would be up to 5,000 feet (1,524 meters) long, with a vertical clearance of approximately 75 feet (22.9 meters); however, the two Phased Approach alternatives (including the Preferred Alternative) include a navigation zone 3,300 feet (1,006 meters) in length. The shorter distance with the two Phased Approach alternatives (including the Preferred Alternative) is necessitated by the inclusion of ramps to provide access to the north end of Hatteras Island from the alternatives' bridges. Spans within the navigation zone would provide 200 feet (61 meters) of horizontal clearance.

The bridges associated with the Road North/Bridge South Alternative, the All Bridge Alternative, and the Phased Approach alternatives (including the Preferred Alternative) would provide two 12-foot (3.6-meter) travel lanes and two 8-foot (2.4-meter) shoulders. The typical bridge span would be 100 to 120 feet (30.5 to 36.6 meters). The vertical clearance of bridges over land to the west of existing NC 12 with the Road North/Bridge South and All Bridge alternatives is assumed to be a minimum of approximately 10 feet (3.1 meters) above mean high water. The vertical clearance with the two Phased Approach alternatives (including the Preferred Alternative) is assumed to be 25 feet (7.6 meters) above mean high water. This height assumes the flat storm surge elevation, plus the wave height, plus some additional clearance. The typical section of relocated roadway (for the Road North/Bridge South and All Bridge alternatives) would have two 12-foot (3.6-meter) travel lanes with 8-foot (2.4-meter) shoulders (4-foot [1.2-meter] paved). The total costs through 2060 (including construction, right-of-way, operation and maintenance, and other) (in 2006 dollars) for the alternatives in the Parallel Bridge Corridor would be an estimated: $671.8 to $970.4 million (Nourishment), $602.2 to $740.2 million (Road North/Bridge South), $1.1 to $1.4 billion (All Bridge), and $1.1 to $1.5 billion (Phased Approach, including the Preferred Alternative). These costs include a range of $260 to $347 million for an Oregon Inlet bridge. Cost estimates will be revisited in the context of design prior to the implementation of each phase.

Bonner Bridge would be demolished at an estimated cost of about $4 million (2006 dollars).

Full descriptions of the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor alternatives (including the Preferred Alternative) are presented in Sections 2.9 and 2.10, respectively. Cost estimates for all alternatives and other associated public costs are presented in Section 2.12.

On August 27, 2007, representatives of NCDOT, the Federal Highway Administration (FHWA), the US Army Corps of Engineers (USACE), and the North Carolina Department of Environment and Natural Resources (NCDENR) identified the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) as the Least Environmentally Damaging Practicable Alternative (LEDPA) for this project as part of the interagency National Environmental Policy Act (NEPA)/Section 404 Merger Process. The LEDPA was adopted as the project's Preferred Alternative (see Figure S-1). The Phased Approach/Rodanthe Bridge Alternative (Preferred) proposes replacing the Bonner Bridge with a bridge parallel to and west of Bonner Bridge, as well as maintaining NC 12 from the community of Rodanthe to Oregon Inlet by building additional bridges as needed within the existing NC 12 easement. This decision was based on: the ability of the alternatives considered to meet the project's purpose and need; environmental consequences; opportunities available to mitigate impacts; cost; public and agency comment on the findings of the Supplemental Draft Environmental Impact Statement (SDEIS) and the 2007 Supplement to the Supplemental Draft Environmental Impact Statement (SSDEIS); and other findings presented in this FEIS.

S.4 Other Proposed Actions

This project is included as TIP Project No. B-2500 in the NCDOT's *2009 to 2015 State Transportation Improvement Program* (TIP) covering the period from Federal Fiscal Year (FFY) 2009 (October 2008) through FFY 2015 (September 2015). The additional transportation projects that are near the proposed project are depicted in Figure 1-1 and listed below:

Project R-3116A	Planning for interim measures to protect NC 12 from sand and ocean overwash at Ocracoke Island.
Project R-3116B	Planning for interim measures to protect NC 12 from sand and ocean overwash at Hatteras Village.

Project R-3116D*	Relocation of NC 12 from north of Rodanthe to south of the Refuge Boundary (Rodanthe ‘S’ Curves Hot Spot) to protect roadway from sand and ocean overwash.
Project R-3116E*	Planning for interim measures to protect NC 12 from sand and ocean overwash at the Sandbag Area Hot Spot.
Project R-3116F*	Planning for interim measures to protect NC 12 from sand and ocean overwash at the Canal Zone Hot Spot. (This project is combined with Project R-3116E for planning purposes.)
Project R-3116H	Planning and environmental studies for the long-term maintenance of NC 12 from Ocracoke Island to the southern terminus of Bonner Bridge. A joint NCDOT/USACE feasibility study (Hatteras and Ocracoke islands, NC) was underway but is currently not funded by the US Congress.
Project R-4070B	Planning and environmental studies for maintaining NC 12 from Buxton to Avon. Programmed for planning and environmental studies only.
Project B-5014	Repairs to Bridge No. 11 (Bonner Bridge over Oregon Inlet) in FFY 2007 and FFY 2008.

* Project not listed in the TIP and is currently unfunded. Planning studies were underway, but they are currently (2008) on hold and are not expected to be implemented given that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is a long-term solution to protecting NC 12 from sand and ocean overwash.

The replacement of Bonner Bridge is not dependent on the completion of any of the above projects.

S.5 Other Alternatives Considered

Six alternatives studies were completed over the course of the project, which ultimately yielded the seven alternatives evaluated in detail in the SDEIS (five alternatives), SSDEIS (two alternatives), and this FEIS. This section lists those studies, the alternatives considered, and their outcome. Full descriptions of each study are presented in Chapter 2 of this FEIS in the sections indicated below. The studies were:

- 1991 Feasibility Study and 1993 Draft Environmental Impact Statement Alternatives. This work considered the following alternatives:
  - Transportation Systems Management (TSM);
  - Rehabilitate Existing Bridge;
  - Ferry;
  - Tunnel;
  - East Bridge Corridor;

- West Bridge Corridor; and

- Parallel Bridge Corridor.

The 1993 Parallel Bridge Corridor was assessed in the 1993 DEIS as the preferred corridor and was selected by the NCDOT as the preferred alternative for implementation following public hearings in February 1994. See the full discussion of this study in Section 2.2.

Beach erosion, however, increased problems with ocean overwash along NC 12 south of Bonner Bridge, and regulatory requirements for the Refuge changed in accordance with the National Wildlife Refuge System Improvement Act of 1997 (see Section 3.5). Thus, the 1993 Parallel Bridge Corridor is now being considered in conjunction with a long-term strategy for NC 12 maintenance through the Refuge.

- 2002 Corridor Alternatives Study. Additional replacement bridge corridor alternatives were studied in 2002 because of the changed conditions in the project area and changed regulatory requirements. Alternatives assessed involved several different ending points on Hatteras Island and different corridor locations in Oregon Inlet and Pamlico Sound. Alternative 4 (redesignated the Pamlico Sound Bridge Corridor) was selected for detailed study in the SDEIS and this FEIS in the context of this study. The other alternatives studied were:

  - Alternative 1a;
  - Alternative 1b (wide);
  - Alternative 1b (close);
  - Alternative 1c;
  - Alternative 2 (wide);
  - Alternative 2 (close);
  - Alternative 3 (wide); and
  - Alternative 3 (close).

  See the full discussion of this study in Section 2.3.

- 2003 Alignment Alternatives Study. Bridge alignment alternatives within the Pamlico Sound Bridge Corridor were studied in 2003. They varied by their position in Pamlico Sound and the manner in which they terminated in the community of Rodanthe on Hatteras Island. Of the alternatives studied, Alignments A and C were selected for detailed study in the SDEIS and FEIS and were redesignated as the Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus Alternative and the Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus Alternative, respectively. Other alternatives studied were:

  - Alignment B;
  - Alignment D;

- Alignment E; and
- Alignment F.

See the full discussion of this study in Section 2.4.

- 2004 Additional Replacement Bridge Scenarios. The Dare County Commissioners indicated concerns about the implementation of a Pamlico Sound Bridge Corridor Alternative, preferring a replacement bridge that ends near the south terminus of Bonner Bridge and connects to existing NC 12. They also requested the consideration of long span bridges. Five additional replacement bridge scenarios using long span bridges were considered:

  - Multiple Cable-Stayed;
  - Single Span Cable-Stayed;
  - Suspension; and
  - Multiple Arch Bridges.

  None of these alternatives were selected for detailed study in the SDEIS and FEIS. See the full discussion of this study in Section 2.5.

- 2005 Parallel Bridge Corridor with NC 12 Maintenance Alternative Studies. In 2005, it was decided to evaluate the Parallel Bridge Corridor with NC 12 Maintenance Alternative in detail in the SDEIS and this FEIS. These alternatives end the replacement bridge at the north end of Hatteras Island and include long term solutions to keeping NC 12 open from the community of Rodanthe to Oregon Inlet through 2060. In the context of this study, the Parallel Bridge Corridor with Road North/Bridge South (called Relocate Road North [West of 2060 Shoreline]/Bridge South in this study), All Bridge, and Nourishment alternatives were selected for detailed study. Other alternatives examined during this study were:

  - Nourishment North/Bridge South;
  - Relocate Road North (West of Ponds)/Bridge South; and
  - Relocate Road North (West of 2060 Shoreline)/Interim Road then Bridge South.

  See the full discussion of this study in Section 2.6.

  2006 Parallel Bridge Corridor with Phased Approach Alternatives Studies. Two detailed study alternatives— Phased Approach/Rodanthe Bridge Alternative (Preferred) and Phased Approach/Rodanthe Nourishment—came out of this study. No other alternatives were considered during this study. See the full discussion of this study in Section 2.7.

S.6 Major Environmental Impacts and Costs

A detailed presentation of the environmental impacts of the alternatives selected for detailed study is presented in Chapter 4. A full description of the existing community, visual, cultural, natural, and other resources in the project area is presented in Chapter 3, including graphics that illustrate the resources' locations in the project area. The following sections summarize the major environmental impacts associated with the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor with NC 12 Maintenance (including the Preferred Alternative). Key differences are summarized in Table S-1.

Community

The Pamlico Sound Bridge Corridor with the Curved Rodanthe Terminus would displace six businesses and six homes. The Pamlico Sound Bridge Corridor with the Intersection Rodanthe Terminus would displace one business and five homes. The Parallel Bridge Corridor with Nourishment and the Phased Approach/Rodanthe Nourishment alternatives would result in no displacements, while the Road North/Bridge South and All Bridge alternatives would displace no businesses and two homes. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would displace two homes and a commercial building that contains a business and a residence. Based on coordination with Realtors in the project area, adequate relocation housing and business sites exist. In addition, the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would displace the gas pumps closest to NC 12 at the Liberty service station, as well as the gas pumps at the North Beach Beach Mart and Campground convenience store in Rodanthe.

The Pamlico Sound Bridge Corridor alternatives would be consistent with the *Dare County Land Use Plan* and zoning, the Coastal Area Management Act (CAMA), and National Park Service (NPS) plans. Although the Pamlico Sound Bridge Corridor alternatives would bypass the portion of the Seashore north of Rodanthe and the Refuge, the USFWS and the NPS have indicated that they would intend to maintain some type of access within the Refuge and this portion of the Seashore for recreational users. However, the method of access likely would be something different than a paved road between Rodanthe and Oregon Inlet that is desired by Dare County officials. The *Pea Island National Wildlife Refuge Comprehensive Conservation Plan* indicates that this circumstance may necessitate changes in the current plan.

The Parallel Bridge Corridor alternatives (including the Preferred Alternative) would be consistent with the *Dare County Land Use Plan* and zoning. However, the two Phased Approach alternatives (including the Preferred Alternative) may not be compatible with the principles of CAMA because they require the construction of permanent bridges in locations that are projected to eventually be on the beach and in the ocean. The NPS and US Fish and Wildlife Service (USFWS) will be responsible for determining whether or not the Phased Approach/Rodanthe Bridge Alternative (Preferred) is consistent with NPS plans and the Refuge's *Comprehensive Conservation Plan*, respectively. The Refuge's *Comprehensive Conservation Plan* assumes a bridge over Oregon Inlet and a maintained road in the existing NC 12 easement in the Refuge pending NCDOT's decisions on the replacement of Bonner Bridge and the long-term maintenance of NC 12. With the two Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) and the Nourishment Alternative, NC 12 would be retained in its existing easement through the Refuge, as assumed in the *Comprehensive Conservation Plan*.

With the exception of the Phased Approach/Rodanthe Bridge Alternative (Preferred), the alternatives in the Parallel Bridge Corridor could occur only if the USFWS concluded that alternative is compatible with the April 1938 Executive Order 7864, which reserved the Refuge to advance the purposes of the Migratory Bird Conservation Act, and the National Wildlife Refuge System Improvement Act of 1997. Without such a compatibility determination, the USFWS could not issue a permit for the construction of a project on new alignment within the Refuge or a long-term beach nourishment program. The Phased Approach/Rodanthe Bridge Alternative (Preferred), however, remains within the existing NC 12 easement. A compatibility determination is not required since the Preferred Alternative falls within the terms of the easement permit.

Table S-1. Comparison of Alternatives

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge Alternative (Preferred)	Phased Approach/ Rodanthe Nourishment
Community and Visual Impacts							
Residential Relocations	6	5	0	2	2	3	0
Business Relocations	6	1	0	0	0	1 plus two partially affected	0
Anticipated Need for Refuge Compatibility Determination	No Compatibility Determination required.		Compatibility Determination expected (for all alternatives that use Refuge lands outside the existing NC 12 easement).			No Compatibility Determination required.	Compatibility Determination expected (for all alternatives that use Refuge lands outside the existing NC 12 easement).
Economic Impact of a Breach in Hatteras Island	Not applicable.		Economic impact (reduction in retail sales) of a breach open for three months would be $5.7, $46.3, and $146.7 million in the off-peak, middle, and peak season; jobs and tax revenue also would be lost.				
Rodanthe Community Cohesion, and Accessibility	No impact.					1 mile (1.6 kilometers) of bridge would bisect community; access more circuitous.	0.3 mile (0.5 kilometer) of bridge would bisect community; access more circuitous.
Utilities Cost to Relocate (in millions)	$53.9		$12.1	$15.0	$17.4	$17.4	$17.4
Visual Impact	Views of Pamlico Sound from homes along shoreline in Rodanthe would be affected.		None	Views of Pamlico Sound from homes along shoreline in Rodanthe would be affected.	Sizable visual intrusion into the landscape of the Refuge; views of Pamlico Sound from homes along shoreline in Rodanthe would be affected.	Sizable visual intrusion into the landscape of the Refuge; views in Rodanthe affected.	Sizable visual intrusion into the landscape of the Refuge; views in Rodanthe near the Refuge affected.

Table S-1 (continued). Comparison of Alternatives

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	**Intersection Rodanthe Terminus**	**Nourishment**	**Road North/ Bridge South**	**All Bridge**	**Phased Approach/ Rodanthe Bridge Alternative (Preferred)**	**Phased Approach/ Rodanthe Nourishment**
Cultural Resource Impacts							
Cultural Resources with Adverse Effect	1 – (former) Oregon Inlet US Coast Guard Station			3 – Refuge, (former) Oregon Inlet US Coast Guard Station, and Rodanthe Historic District and Chicamacomico Life Saving Station			2 – Refuge and (former) Oregon Inlet US Coast Guard Station
Section 4(f) Resources Affected							
• (Former) US Coast Guard Station	No use.						
• Seashore on Bodie Island	7.3 acres (3.0 hectares) used		6.3 acres (2.6 hectares) used				
• Seashore on Hatteras Island and Refuge	No use.		19.9 acres (8.1 hectares) used primarily for new dunes plus periodic nourishment of 6.3 miles (10.1 kilometers) of seashore.	93.4 acres (37.8 hectares) used primarily for new highway easement.	92.2 acres (37.3 hectares) used primarily for new highway easement.	No use, project contained within existing highway easement.	Minor amount used for periodic nourishment of 1,500 feet (457 meters) of seashore; generally contained within existing highway easement.
• Rodanthe Historic District	No use.		No use.	Will use land from district passing 14 feet (4.3 meters) and 320 feet (97.5 meters) away from two contributing structures.		No use, contained within existing highway right-of-way within the district.	No use.

Table S-1 (continued). Comparison of Alternatives

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge Alternative (Preferred)	Phased Approach/ Rodanthe Nourishment
Parks and Recreation Impacts							
General Refuge Access	Likely loss of the paved road within the Refuge. USFWS would need to provide alternate access.		Little change in access. Refuge facilities protected from future beach erosion.	Paved road access maintained but with some changes.	Access focused on three points; direct access to some Refuge facilities lost.	Access focused on two points; direct access to some Refuge facilities lost.	
Refuge Fishing Access	No fishing catwalks at north end of Hatteras Island. No paved road access to other fishing locations in Refuge.		No fishing catwalks; alternate access possible; beach fishing access unaffected.	No fishing catwalks; alternate access possible; beach fishing access maintained except at southern end.	No fishing catwalks; alternate access possible; beach fishing access limited to 3 locations.	No fishing catwalks; alternate access possible; beach fishing access limited to 2 locations.	
Coastal Conditions Impacts							
Terminal Groin	Not needed for bridge protection.		Retain				
Potential for Breach and Need for Closing Breach to Maintain NC 12	Eliminates breach concerns by bypassing the Refuge. No need to close future breaches.		Nourishment would reduce the risk of a breach. Any breaches through the Refuge would need to be closed.	Breaches in northern portions of the Refuge would need to be closed; a deep breach near the terminal groin could be difficult to fill with sand.	Potential breach areas bridged. No need to close future breaches.	Potential breach areas bridged. Phases II and III may need to be accelerated, if a breach occurred before all four phases are completed.	

Table S-1 (concluded). Comparison of Alternatives

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge Alternative (Preferred)	Phased Approach/ Rodanthe Nourishment
Natural Resources Impacts							
Biotic Communities Impacts, acres (hectares)							
• Submerged Aquatic Vegetation (SAV)	0.31 (0.13)	0.30 (0.12)	0.20 (0.08)	1.40 (0.56)	1.40 (0.56)	0.20 (0.08)	0.20 (0.08)
• Wetlands	1.84 (0.74)	1.18 (0.48)	1.68 (0.68)	50.74 (20.54)	6.68 (2.71)	0.47 (0.19)	0.44 (0.18)
• Uplands – Natural & Man Dominated	7.97 (3.22)	6.66 (2.70)	20.30 (8.22)	13.45 (5.44)	4.89 (1.98)	13.13 (5.31)	6.45 (2.61)
• Impoundments	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	22.11 (8.95)	0.43 (0.17)	0.00 (0.00)	0.00 (0.00)
• Aquatic Bottom	2.69 (1.09)	2.70 (1.09)	2.40 (0.97)	3.90 (1.58)	3.82 (1.55)	2.44 (0.99)	2.44 (0.99)
• Total	12.81 (5.18)	10.84 (4.39)	24.58 (9.95)	91.60 (37.07)	17.22 (6.97)	16.24 (6.57)	9.53 (3.86)
Allow for Natural Shoreline Movement	Yes		No	Generally except for groin retention and some dunes.	Yes, except for groin retention.	Yes, once all phases are complete, except for groin retention.	Generally, once all phases are complete, except for groin retention and some nourishment.
Protected Species Adversely Affected							
• Piping Plover	Not likely to adversely affect.		Likely construction/demolition disturbance to nesting; potential nesting, foraging, and roosting habitat lost.				
• Leatherback Sea Turtle/Green Sea Turtle/Loggerhead Sea Turtle	Not likely to adversely affect.		Likely disturbance to nesting on beach; not likely to adversely affect in ocean.				
• Seabeach Amaranth	Not likely to adversely affect.		Beach nourishment could impact habitat.	Not likely to adversely affect.			Beach nourishment could impact habitat.

The Coastal Barrier Resources Act (CBRA) withdraws federal assistance for infrastructure in areas deemed "undeveloped" in 1982. Coastal Barrier Resources System (CBRS) Unit L03 is on Hatteras Island (near Avon and Buxton), but the replacement bridge corridor alternatives (including the Preferred Alternative) are not within an area included in the CBRS. In addition, because the proposed project would consist of the replacement of an existing bridge, as well as an existing road in the case of the Parallel Bridge Corridor, project area development trends would not be altered; therefore, the project would not encourage development in a CBRS area.

The purchase of right-of-way in Rodanthe with any of the alternatives except for those involving nourishment would reduce Dare County's tax base by a fraction of one percent. The replacement of paved road access to the Refuge with an alternative form of access with the Pamlico Sound Bridge Corridor would not likely have a major economic impact on the Outer Banks/Dare County area. Some individual businesses, however, would be more directly affected, and could suffer serious losses.

The formation of a breach in Hatteras Island at the southern end of the Refuge is possible. With the Parallel Bridge Corridor with Nourishment Alternative and the Phased Approach/Rodanthe Nourishment Alternative, a breach in this location would temporarily cut off access (except for limited ferry service) to Hatteras Island to the south of the breach, including both private and public tourism destinations. The economic impact (measured as a reduction in retail sales) of a breach open for three months would be $5.7, $46.3, and $146.7 million in the off-peak, middle, and peak season, respectively. A six month breach covering the middle and peak six months would result in reductions in retail sales of $193.0 million. Jobs and tax revenue would be lost.

The replacement bridge corridor alternatives would not substantially affect community services. Replacing Bonner Bridge with a 17.5-mile (28.2-kilometer) long structure in the Pamlico Sound Bridge Corridor would increase emergency vehicle (ambulances and fire trucks) travel distance to the mainland from Rodanthe and points further south by 2.0 miles (3.2 kilometers) and travel time by approximately two minutes. The time it currently takes emergency vehicles to go this distance would not change with the Parallel Bridge Corridor (including the Preferred Alternative). A new access road to both the Rodanthe-Waves-Salvo Community Center and the emergency ferry dock would be built with the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives. With the Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative), access would be altered in northern Rodanthe, where two one-way frontage roads would be provided to maintain access to homes and businesses in the area where NC 12 is placed on a bridge. The change would be the greatest with the Phased Approach/Rodanthe Bridge Alternative (Preferred). Utility services would not be lost or interrupted with the replacement bridge corridor alternatives, although the cost of some services could increase in order to cover the cost of moving utility lines. The cost of moving utility lines would be greatest with the Pamlico Sound Bridge Corridor at $53.9 million. These costs would range from $12.1 to $17.4 million with the Parallel Bridge Corridor (including the Preferred Alternative at $17.4 million).

Charter fishing boats operating out of the Oregon Inlet Marina and Fishing Center would no longer be able to use an unmarked natural channel known as "the crack" to reach the ocean, adding approximately 30 minutes to their travel time each way with either corridor alternative.

The Pamlico Sound Bridge Corridor with the Curved Rodanthe Terminus would affect a portion of the Liberty service station, but none of its underground storage tanks (USTs) are within the area directly affected. Both terminus options for the Pamlico Sound Bridge Corridor would affect the automobile junkyard in the project area. Only one of the Parallel Bridge Corridor alternatives would affect any UST or hazardous waste sites.

The No-Action Alternative would limit the accessibility of Hatteras Island to residents, visitors, workers, and off-island goods and services once the Bonner Bridge reaches the end of its service life and is demolished. This lack of accessibility would adversely affect the economy of the island, as well as the provision of emergency medical services, fire and police protection, schools, solid waste disposal, and utility services.

Environmental Justice

There are no concentrations of any minority group or low-income populations within the project area. Thus, there is no evidence that the replacement bridge corridor alternatives would disproportionately affect low-income or minority households.

Visual

At Rodanthe, panoramic views of the Pamlico Sound from homes along the sound's shoreline would be changed with all alternatives except the Parallel Bridge Corridor with Nourishment Alternative and the two Phased Approach alternatives (including the Preferred Alternative). The location of the Pamlico Sound Bridge Corridor would minimize impacts to views by maintaining a predominantly straight and perpendicular final approach to land. The proposed bridge would not generally obscure the full panorama of the views of Pamlico Sound from homes along the shoreline, but only views to the immediate south or north depending on the location of the homes. For much of the panorama, the proposed bridge would present itself as a thin line on the horizon. The Rodanthe area bridge, included in two of the Parallel Bridge Corridor alternatives, would be closer to the shore over its full length than the Pamlico Sound Bridge Corridor bridge. The intactness and unity of the view would be split by the line of the Rodanthe area bridge across the full 180 degrees of the view.

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would have a sizable visual effect on Rodanthe, introducing into views an elevated roadway in Rodanthe for a distance of 1.1 miles (1.8 kilometers). The Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative would introduce an elevated roadway in Rodanthe for a distance of 0.3 mile (0.5 kilometer). The elevated roadway also would be introduced into views of the Refuge from Rodanthe. Views of Pamlico Sound from sound-side homes would not be affected.

In the Refuge, the Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) and the All Bridge Alternative would represent a sizeable intrusion into the landscape of the Refuge. The bridges would be a sizeable new linear man-made feature for approximately 7.5 to 10 miles (12.1 to 16.1 kilometers) through the Refuge. The visual impact of the other replacement bridge corridor alternatives would be low or nonexistent in the Refuge.

On Bodie Island, a replacement bridge in the Pamlico Sound Bridge Corridor or an Oregon Inlet bridge with any of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would be similar in appearance to Bonner Bridge.

With the No-Action Alternative, Bonner Bridge would be removed, so a bridge would no longer be an element of the visual setting of Oregon Inlet.

Cultural Resources

Section 106 of the National Historic Preservation Act of 1966 as amended (16 United States Code [USC] 470f) affords consideration of properties that are listed or eligible for listing on the National Register of Historic Places (NRHP). Section 4(f) of the US Department of Transportation Act of 1966, as amended (49 USC 303), protects publicly owned public parks, publicly owned recreation areas, wildlife and waterfowl refuges, and historic sites of national, state, or local significance from conversion to highway use using FHWA administered funds unless there is no alternative and unless all planning is done to minimize harm. In accordance with the requirements of Section 4(f), Section 106, and the NEPA, surveys were conducted to identify the cultural resources in the project area. There are four resources listed on or eligible for inclusion in the National Register in the project's Area of Potential Effect.

The Pamlico Sound Bridge Corridor would have the following effects on cultural resources:

- No Effect on the National Register-eligible Pea Island National Wildlife Refuge, since the alternative would not be in the Refuge and would not affect the properties that make the Refuge eligible;

- An Adverse Effect on the National Register-listed (former) Oregon Inlet US Coast Guard Station, because of the potential for loss of access (and loss of the ability to move the building to the north across Oregon Inlet), and the potential for removal of the terminal groin at the north end of Hatteras Island upon completion of the proposed project with the foreseeable consequences of erosion (loss of resource); and

- No Adverse Effect on the National Register-listed Chicamacomico Life Saving Station and the associated National Register-eligible Rodanthe Historic District because neither resource would be directly affected. However, the Pamlico Sound Bridge Corridor is within view of these resources.

The Parallel Bridge Corridor alternatives would have the following effects on these historic cultural resources:

- Pea Island National Wildlife Refuge

  – Nourishment Alternative—No Adverse Effect because the new dunes would be on the east side of NC 12 and the existing dikes and ponds would remain.

  – Road North/Bridge South Alternative—Adverse Effect because the relocation of NC 12 would intrude up to 700 feet (213 meters) into the existing dikes and ponds.

  – All Bridge Alternative—Adverse Effect because the elevation of NC 12 on a bridge would place NC 12 over the existing dikes and ponds.

  – The two Phased Approach alternatives (including the Preferred Alternative) —Adverse Effect because of the elevation of the bridge as it passes through the Refuge.

- (Former) Oregon Inlet US Coast Guard Station

  – Nourishment Alternative—Adverse Effect because of the greater height of the new Oregon Inlet Bridge (33.5 to 70 feet [10.2 to 21.3 meters]) compared to the Bonner

Bridge (up to 15 feet [11.1 meters]), which would alter the historic view, function, and setting of the station.

  - Road North/Bridge South Alternative—Adverse Effect because of the greater height of the new Oregon Inlet Bridge (33.5 to 70 feet [10.2 to 21.3 meters]) compared to the Bonner Bridge (up to 15 feet [11.1 meters]), as well as a potential new fishing pier, which would alter the historic view, function, and setting of the station.

  - All Bridge Alternative—Adverse Effect because of the greater height of the new Oregon Inlet Bridge (33.5 to 70 feet [10.2 to 21.3 meters]) compared to the Bonner Bridge (up to 15 feet [11.1 meters]), as well as a potential new fishing pier, which would alter the historic view, function, and setting of the station.

  - The two Phased Approach alternatives (including the Preferred Alternative)—Adverse Effect because of the greater height of the new Oregon Inlet Bridge (33.5 to 70 feet [10.2 to 21.3 meters]) compared to the Bonner Bridge (up to 15 feet [11.1 meters]), as well as a potential new fishing pier, which would alter the historic view, function, and setting of the station.

- The Chicamacomico Life Saving Station and the associated Rodanthe Historic District

  - Nourishment Alternative—No Effect because no component of the alternative would be in proximity to the resource.

  - Road North/Bridge South Alternative—Adverse Effect because the alignment would be within the historic district.

  - All Bridge Alternative—Adverse Effect because the alignment would be within the historic district.

  - Phased Approach/Rodanthe Bridge—Adverse Effect because of the change in the visual setting with a bridge and associated access roads passing through the district. Direct access across NC 12 within the district would be eliminated.

  - Phased Approach/Rodanthe Nourishment—No Effect.

The terms "No Effect", "Adverse Effect", and "No Adverse Effect" refer to the Section 106 process. The concurrence forms for these conclusions are included in Appendix E. No significant archaeological resources would be affected by the project alternatives. A Memorandum of Agreement with the State Historic Preservation Officer related to the Phased Approach/Rodanthe Bridge Alternative (Preferred) is being prepared and will be presented in the Record of Decision.

In addition to the historic resources listed above, the Cape Hatteras National Seashore also is a Section 4(f) resource in the project area. All of the detailed study alternatives would use land from the Seashore. That impact and the conclusion that there is no feasible and prudent alternative to the impact, and that all possible planning has been done to minimize harm is addressed in Chapter 5. The Parallel Bridge Corridor alternatives, except the Phased Approach/Rodanthe Bridge Alternative (Preferred), would use land from the Refuge. The Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives would use land from the Rodanthe Historic District.

Parks and Recreation

The replacement bridge corridor alternatives would be within the Seashore on the Bodie Island side of Oregon Inlet. The Seashore is a Section 4(f) resource. The Pamlico Sound Bridge Corridor would use approximately 7.3 acres (3.0 hectares) of the Seashore on Bodie Island. The Parallel Bridge Corridor (including the Preferred Alternative) would use approximately 6.3 acres (2.6 hectares). The Parallel Bridge Corridor also would be within the Refuge (in an area held in common with the Seashore) on Hatteras Island. The Refuge is also a Section 4(f) resource. The Parallel Bridge Corridor alternatives would use land from the Refuge as follows:

- Nourishment. 19.7 acres (8.0 hectares) associated with new dunes plus nourishment of 6.3 miles (10.1 kilometers) of the seashore within the Refuge. NC 12 would remain in its current easement. A new access road to the Oregon Inlet area parking lot would involve 0.2 acre (0.07 hectare) of new easement.

- Road North/Bridge South. 90.3 acres (36.6 hectares) of new 100-foot (30.5-meter) wide new easement would be used for the relocated NC 12 as a roadway and bridge. Approximately 2,961 feet (903 meters) of new bridge would be built over Refuge lands. A new access road to the Oregon Inlet area parking lot would involve 0.2 acre (0.07 hectare) of new easement. Ultimately, 2.9 acres (1.2 hectares) of area would be used by three new dunes, with the earliest built in 2030, assuming forecast high erosion trends.

- All Bridge. 89.6 acres (36.2 hectares) of new 100-foot (30.5-meter) wide easement would be used for the relocated NC 12 as a roadway and bridge. Approximately 7.6 miles (12.2 kilometers) of new bridge would be built over Refuge lands. A new access road to the Oregon Inlet area parking lot would involve 2.6 acres (1.1 hectares) of new easement.

- Phased Approach alternatives (including the Preferred Alternative). The total area of disturbance within the existing easement in the Refuge would be 3.7 acres (1.5 hectares) permanent and 48.5 acres (19.6 hectares) temporary. No new easement would be used in the Refuge, but with the Phased Approach/Rodanthe Nourishment Alternative, nourishment would occur on 1,500 feet (457.2 meters) of seashore within the Refuge.

With either the Pamlico Sound Bridge or Parallel Bridge corridors (including the Preferred Alternative), charter fishing boats operating out of the Seashore's Oregon Inlet Marina and Fishing Center no longer would be able to use the channel known as "the crack," adding about 30 minutes to their trip from the fishing center to the ocean.

With all alternatives, construction activities may require either dredging, a haul road, and/or work bridge within the portions of the Seashore in Pamlico Sound.

With the Pamlico Sound Bridge Corridor, NC 12 between Bodie Island and Hatteras Island no longer would pass through the Seashore and Refuge. Paved road access would continue in the Refuge with the Parallel Bridge Corridor. Access would focus on three points in the Refuge with the All Bridge Alternative and two points with the Phased Approach alternatives (including the Preferred Alternative). Access would be lost to the Refuge Visitor Center, headquarters, and North Pond Trail with the All Bridge and Phased Approach alternatives (including the Preferred Alternative).

The fishing catwalks on Bonner Bridge probably would not be placed on a new bridge with its assumed greater height and span lengths. For the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor with Road North/Bridge South, All Bridge, and Nourishment alternatives, options for retaining fishing opportunities offered by the catwalks include maintaining a part of Bonner Bridge as a fishing pier, or building a “boardwalk” on top of the riprap that currently blankets the northern shore of Hatteras Island. When Phase I of the Phased Approach alternatives (including the Preferred Alternative) – the new Oregon Inlet bridge – is complete, the temporary traffic maintenance bridge could be left in place as a fishing pier, replacing the catwalks. This also could occur with the Nourishment Alternative. The use of a traffic maintenance bridge is one option that could be considered for maintaining traffic at the south end of the new bridge where it is being constructed in the existing bridge easement. A traffic maintenance bridge is not needed with the other replacement bridge corridor alternatives, so leaving one in place is not an option with the other alternatives. Some government body or non-governmental organization would have to take responsibility for the operation, maintenance, and liability of any new fishing pier.

Unlike the other Parallel Bridge Corridor alternatives, the Phased Approach alternatives (including the Preferred Alternative) would directly affect activities on the beach front, including fishing, hiking, surfing, wind surfing, kite boarding, swimming, ocean kayaking, and birding. Bridge piles in the ocean could change the types of fish that congregate around the shore. To the extent that certain sections of the bridged roadway would be over the beach, beach activities would be affected, but not precluded, by the presence of the bridge and bridge piles. Once the Phased Approach alternatives’ bridge piles are in the ocean, the ability to surf in a particular area would be eliminated. The piles would change how and where the waves break, which would interfere with the swells in such a way that the waves would no longer be conducive to good surfing. In addition, the presence of bridge piles every 120 feet (36.6 meters), in areas where the bridges would be less than 150 feet (45.7 meters) from shore, would be a safety hazard to surfers and other recreational ocean users.

For recreational users of the Pamlico Sound, the Pamlico Sound Bridge Corridor would place an obstruction in the sound as the bridge moves from the shoreline at Rodanthe to a point approximately 5 miles (8 kilometers) west of Hatteras Island. The ability of recreational users to pass from one side of the bridge approach to the other would be limited by its 140 to 150 feet (42.7 to 45.7 meters) span length between piers and a vertical clearance of approximately 10 feet (3.1 meters) above mean high water (outside the navigation zone). A similar obstruction in Pamlico Sound would be placed immediately off-shore of Rodanthe with the Parallel Bridge Corridor with the Road North/Bridge South and All Bridge alternatives.

The No-Action Alternative, and the associated demolition and removal of Bonner Bridge, would also result in the demolition of the fishing catwalks on the bridge. No other parks or recreation resources would be affected, although access to recreation facilities within the Refuge would be limited.

Coastal Conditions

A bridge within the replacement bridge corridor alternatives would have a negligible effect on inlet migration, profile, and gorge alignment other than the continued effect of the presence of the terminal groin with the Parallel Bridge Corridor alternatives (including the Preferred Alternative). Flood levels under storm surge conditions would not increase with a replacement bridge in the Pamlico Sound Bridge or Parallel Bridge corridors. The performance of the terminal groin would not be affected by the construction of a bridge in the replacement bridge corridors. The groin would need to be retained with the Parallel Bridge Corridor’s bridge over Oregon Inlet. The new Oregon Inlet crossing with either corridor would make navigation channel dredging operations easier to undertake and could reduce the frequency and size of dredging operations from what is required today.

An ongoing Coastal Cooperative Research Program study found that there are five potential breach locations within the Refuge. The word “breach” is used rather than the word “inlet” because if a breach were to occur as the result of a storm, it would likely close eventually (although not necessarily immediately) and likely would not be a long-term phenomenon like Oregon Inlet. The one possible exception to this likelihood is the potential breach location at the southern end of the Refuge near Rodanthe. However, it would be of concern only with the Parallel Bridge Corridor with Nourishment Alternative if this potential breach were to remain open. Based on the 2003 experience at the Hatteras Village breach on Hatteras Island and the opinions of a panel of coastal experts, closure of a breach would take three months (with advanced planning) to six months and cost an estimated $7 to $11 million. The potential also exists for a deep breach near the terminal groin, resulting in part from soundside erosion. It would likely need to be closed with a bridge, such as the type included in the two Phased Approach alternatives (including the Preferred Alternative) and the All Bridge Alternative.

With the two Phased Approach alternatives (including the Preferred Alternative), the shoreline will naturally erode under the associated bridges. By 2060, because of this erosion most of the NC 12 bridges associated with these alternatives would be in the ocean rather than on the shore. When exposed to waves, tides, and storm events, the presence of bridge piles would alter the flow pattern around the piles, resulting in scour, effects on cross-shore transport during storm events, formation of additional rip currents, and changes in beach erosion and accretion patterns. Since the Phased Approach alternatives (including the Preferred Alternative) would be built in phases, storm-related NC 12 maintenance of the existing roadway within the 100-foot easement would continue in the three hot spots and likely increase in those areas until Phase II is completed. NCDOT intends to place a high priority on the implementation of Phase II as soon as it is practicable. The completion of Phase II would substantially decrease the amount of storm-related maintenance on the NC 12 roadway, but some would remain.

NCDOT also would not perform storm-related NC 12 maintenance work outside the existing easement in the Phase III, IV, and no action areas on NC 12 for the reason noted in the previous paragraph. Limiting the growth in the need for NC 12 storm-related maintenance in the Phase III and IV areas to the extent practicable given the availability of transportation funding and the efficient use of those funds also is considered desirable. In order to help accomplish that objective, NCDOT would implement a monitoring program, the particulars of which would be developed in consultation with representatives of the Refuge, including development of decision-making criteria for translating monitoring findings into a decision to move forward with an additional phase and how to refine the location of each phase to reflect actual future shoreline change.

Natural Systems

The Pamlico Sound Bridge Corridor and, to a greater extent, the Parallel Bridge Corridor would result in localized, construction-related changes in topography and soils, especially in low-lying areas. Temporary water quality impacts would result from construction barge traffic, fill and pile placement, and construction channel dredging. These activities would cause a temporary increase in turbidity and a potential decrease in dissolved oxygen levels associated with the re-suspension of sediment particles into the water column. Long-term impacts to water quality include runoff that may contribute pollution to nearby ecosystems. Highway runoff can contain varying amounts of heavy metals, nutrients, organic compounds, and particulates, all of which can degrade water quality and impact aquatic organisms. Bridge Stormwater Controls presented in NCDOT’s *Stormwater Best Management Practices Toolbox* (NCDOT, 2008), or proprietary devices applicable to controlling bridge deck runoff, would be considered for all bridge replacement segments traversing the receiving water bodies.

A bridge in the Pamlico Sound Bridge Corridor would permanently affect 10.8 to 12.8 acres (4.4 to 5.2 hectares) of biotic communities. Approximately half of this impact would be to man-dominated uplands. Section 404 (Clean Water Act) jurisdictional areas would comprise up to 4.8 acres (2.0 hectares), including 1.8 acres (0.7 hectare) of wetland and 3.0 acres (1.2 hectares) of open water in the affected area. The wetland loss would include less than 0.01 acre (0.01 hectare) of CAMA coastal wetlands with the Pamlico Sound Bridge Corridor alternatives. CAMA coastal wetlands are environmentally fragile and important land and water areas that are judged to be of greater than local significance according to the pertinent coastal county local land use plan. A permit is required from the NCDENR's Division of Coastal Management (DCM) for development activities that take place in CAMA coastal wetlands.

The Parallel Bridge Corridor with the Road North/Bridge South Alternative would fill the largest area of biotic communities at 91.6 acres (37.1 hectares), whereas the Phased Approach/Rodanthe Bridge Alternative (Preferred) would fill 16.2 acres (6.6 hectares), the Phased Approach/ Rodanthe Nourishment Alternative would fill 9.5 acres (3.9 hectares), the All Bridge Alternative would fill 17.2 acres (7.0 hectares), and the Nourishment Alternative would fill 24.6 acres (10.0 hectares). The Pamlico Sound Bridge Corridor alternatives would fill approximately 10.8 to 12.8 acres (4.4 to 5.2 hectares). Therefore, all of the alternatives, except the Parallel Bridge Corridor with Road North/Bridge South Alternative, would be of a similar order of magnitude in terms of permanent fill impacts, with a maximum difference between these alternatives of approximately 15.1 acres (6.1 hectares). The two Phased Approach alternatives (including the Preferred Alternative) also would have 48.5 acres (19.6 hectares) of temporary biotic community impact associated with temporary traffic maintenance roads.

With the Phased Approach alternatives (including the Preferred Alternative), the habitat affected by the completed bridges would change from what is described above over time as the shoreline erodes under the bridges. The maximum length of bridge over the ocean would be 8 miles (12.9 kilometers) in 2060. The maximum length of bridge over beach habitat would be 3.3 miles (5.3 kilometers) in 2020.

Section 404 jurisdictional impacts also would be greatest with the Road North/Bridge South Alternative at 78.2 acres (31.6 hectares), including 50.7 acres (20.5 hectares) of wetland and 27.4 acres (11.1 hectares) of open water. The jurisdictional impact of the other six alternatives would be at a comparable order-of-magnitude, with the All Bridge Alternative being the greatest (12.3 acres [5.0 hectares]) of the other six alternatives and the Phased Approach alternatives (including the Preferred Alternative) comprising the least (3.1 acres [1.3 hectares]).

Fill of CAMA coastal wetlands would be the greatest with the Road North/Bridge South Alternative at approximately 11.8 acres (4.8 hectares). The All Bridge Alternative would fill approximately 2.2 acres (0.9 hectare) of CAMA coastal wetlands, while the Nourishment Alternative would fill approximately 0.3 acre (0.1 hectare), and the two Phased Approach alternatives (including the Preferred Alternative) would fill 0.3 acre (0.1 hectare). The two Phased Approach alternatives (including the Preferred Alternative) also would have 12.5 acres (5.0 hectares) of temporary wetland impact, including 3.1 acres (1.3 hectares) of CAMA wetland impact. The other three Parallel Bridge Corridor alternatives would have 6.0 acres (2.4 hectares) of temporary wetland impact, including 1.1 acres (0.4 hectare) of CAMA wetland impact. Efforts were made to avoid and minimize wetland impacts in developing each of the alternatives. Opportunities for compensatory mitigation exist.

Pamlico Sound dredging would likely be needed for approximately 8.0 miles (12.8 kilometers) of the 17.5-mile (28.2-kilometer) length of the Pamlico Sound bridge. With the Parallel Bridge

Corridor, dredging would likely be needed just north of Hatteras Island for approximately 2,000 feet (610 meters) to build the Oregon Inlet bridge. No dredging is anticipated in areas where submerged aquatic vegetation (SAV) is present. On the Bodie Island side of Oregon Inlet, Parallel Bridge Corridor bridge construction would likely involve construction of a temporary haul road for approximately 2,400 feet (732 meters) immediately west of the new Oregon Inlet bridge. It would temporarily affect 6.5 acres (2.6 hectares) of biotic communities.

Temporary wetland impacts would occur with demolition and removal of Bonner Bridge. The extent of the impact would depend on the access technique used. NCDOT would coordinate with environmental resource and regulatory agencies prior to bridge demolition and removal to determine the most practicable construction access methodology for the demolition of Bonner Bridge.

The Pamlico Sound Bridge Corridor would not result in permanent disturbance to Significant Natural Heritage Areas (SNHA) identified by the North Carolina Natural Heritage Program (NCNHP). Construction of this bridge would disturb fish and shellfish resources in areas affected by pile placement and const biotic communities, as well ruction channel dredging. The Pamlico Sound Bridge Corridor would cross the northern end of Crab Slough, an area of high shellfish density. The construction of the Parallel Bridge Corridor would result in permanent and temporary disturbance to the Refuge, identified as a SNHA by the NCNHP, with all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative). Construction of these alternatives would disturb wetland as fish and shellfish resources, in areas affected by pile placement, construction channel dredging, and fill. The Parallel Bridge Corridor would cross Oregon Inlet just east of both Oregon Inlet Shoal and the rising shoals just north of Hatteras Island, important bird foraging habitat area.

Both replacement bridge corridor alternatives would produce turbidity, noise, and siltation resulting from construction, which in turn would create localized, short-term impacts to essential fish habitat (EFH) including estuarine emergent wetlands, oyster reef and shell bank, SAV beds, intertidal flats, and marine and estuarine water column. Although some small adverse impacts to EFH would occur during construction, the impacts would be temporary and are not expected to result in significant short-term or long-term adverse effects on managed species. Direct dredging-related impacts on marine EFH would result from noise and turbidity, sediment removal, and burial of organisms by fine sediments falling back to the sea floor. The result would be short-term adverse effects on biota and managed species that use benthic habitats, but long-term and permanent impacts to EFH and managed species are expected to be minimal. The extent of benthic community impacts are discussed below. If changes to benthic invertebrate communities do result, this does not necessarily mean EFH would be degraded or that negative impacts to managed species would result because most benthic communities are resilient and likely to recover quickly. Permanent loss or alteration of estuarine emergent habitat, seagrass, oyster reef and shell bank, and intertidal flats would result directly from shading and pile placement. Bridge and pile placement could result in several indirect impacts, including changes to: water flow; sediment grain size and topography; and light levels of the area underneath the bridge and for some distance surrounding the bridge. The changes described here are expected to have a minimal adverse effect on EFH and managed species.

Benthic communities would be affected primarily by fill impacts in open water (including SAV) and marsh communities (smooth cordgrass, black needlerush, salt flats, and brackish marsh). Both Pamlico Sound Bridge Corridor alternatives would result in pile fill of 2.7 acres (1.1 hectares) of open water and 0.3 acre (0.1 hectare) of SAV. Fill impacts to open water and marsh communities with the Parallel Bridge Corridor alternatives would be the greatest with the Road North/Bridge South Alternative at approximately 39.2 acres (15.8 hectares), whereas the All

Bridge Alternative would fill 7.9 acres (3.2 hectares), the Phased Approach alternatives (including the Preferred Alternative) would fill 3.0 acres (1.2 hectares), and the Nourishment Alternative would fill 2.9 acres (1.2 hectares).

In general none of the alternatives would cause changes to commercial fishing when compared to existing conditions. The two Phased Approach alternatives (including the Preferred Alternative) could result in some effect to inshore commercial fishing.

Wildlife and bird disturbances would be minimized with the Pamlico Sound Bridge Corridor since it would remove NC 12 from the Refuge. The Parallel Bridge Corridor alternatives (including the Preferred Alternative) would continue disturbances associated with road kill, noise, and habitat loss during construction and road operation. Disturbances associated with storm-related maintenance would continue with the Phased Approach alternatives (including the Preferred Alternative) until all phases are complete. The greatest period of these disturbances would be prior to the completion of Phase II.

The Pamlico Sound Bridge Corridor would allow the most natural shoreline movement to occur. This natural cyclic process, which includes allowing dunes to erode, storms to overwash the island, and washover deposits to remain in place, is thought to benefit the barrier island system by helping to maintain the natural ecological character and allowing the formation of ephemeral habitats (e.g., overwash fans, new inlets, and low sloping beaches that serve as habitat for avian species). The Parallel Bridge Corridor alternatives (including the Preferred Alternative), except for the Nourishment Alternative, also generally would allow long-term natural shoreline movement except for the retention of the terminal groin. Also, it is estimated that the Phased Approach alternatives (including the Preferred Alternative) would not be completed until at least 2030. Until all phases are complete, NC 12 maintenance in the incomplete sections could affect natural shoreline movement.

The Pamlico Sound Bridge Corridor would not likely result in adverse impacts to the 13 federally-listed threatened or endangered species in Dare County. With the Pamlico Sound Bridge Corridor, the biological conclusion for 10 of these species is "May Affect – Not Likely to Adversely Affect," and the biological conclusion for three species is "No Effect." With the Parallel Bridge Corridor, the biological conclusion for six of these species (five species with the Nourishment and Phased Approach/Rodanthe Nourishment alternatives) is "May Affect – Not Likely to Adversely Affect," the biological conclusion for three species is "No Effect," and the biological conclusion for four species (five species with the Nourishment and Phased Approach/ Rodanthe Nourishment alternatives) is "May Affect – Likely to Adversely Affect." The bald eagle, which was recently delisted, is not included as one of the 13 species listed above. The biological conclusion for the bald eagle, however, is "May Affect – Not Likely to Adversely Affect" for both the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor. Formal consultation was completed for the Phased Approach/Rodanthe Bridge Alternative (Preferred). Concurrence was obtained on biological conclusions from both the USFWS and National Marine Fisheries Service (NMFS). USFWS identified several conservation measures and reasonable and prudent measures to be implemented in association with the Phased Approach/Rodanthe Bridge Alternative (Preferred) by FHWA and NCDOT to minimize impacts to protected species. The NMFS asked that NCDOT comply with their March 23, 2006, *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006). FHWA and NCDOT will implement the measures requested by USFWS and NMFS.

With the No-Action Alternative, a small-scale ferry system would be instituted in the place of new bridge construction. Unlike the replacement bridge corridor alternatives, which would create primarily temporary construction impacts, the No-Action Alternative would create long-term adverse impacts to natural systems in the project area. The ferry system would necessitate extensive dredging to maintain its navigation channels across Oregon Inlet, potentially resulting in long-term disturbance to SAV beds, wetlands, and benthic communities. Also, wetland fill would be necessary if construction of a new ferry docking area were required.

Air Quality

A microscale air quality analysis was conducted to determine the potential effects of the replacement bridge corridor alternatives (including the Preferred Alternative) on local air quality. The "worst-case" project-level carbon monoxide (CO) concentrations were determined for the existing year (2002) and design year (2025). These CO concentrations were then compared to the National Ambient Air Quality Standards (NAAQS). The maximum one-hour and eight-hour CO levels predicted were below NAAQS maximum levels. Thus, the proposed project would not cause or exacerbate a violation of the NAAQS. The project is in Dare County, which has been determined to comply with National Ambient Air Quality Standards. The proposed project is in an attainment area; therefore, Title 40 *Code of Federal Regulations* Parts 51 and 93 are not applicable. This project is not anticipated to create any adverse effects on the air quality of this attainment area.

The No-Action Alternative assumes that Bonner Bridge is demolished at the end of its service life and not replaced. This likely would result in a dramatic but unknown decrease in traffic on NC 12, since limited ferry capacity would discourage both visitors to Hatteras Island, as well as future growth in the permanent population. Thus, No-Action Alternative CO levels could not be modeled for comparison with the replacement bridge corridor alternatives, as is customary for this type of analysis. CO levels were, however, modeled assuming 2025 traffic on NC 12 if Bonner Bridge were to remain in place.

Increases in the emission of Mobile Source Air Toxics (MSATs) are not expected with the replacement bridge corridor alternatives or the No-Action Alternative.

Noise

The noise level and abatement analysis for the replacement bridge corridor alternatives indicates that FHWA's Noise Abatement Criteria (NAC) would be approached or exceeded at three or four residences, depending on the Pamlico Sound Bridge Corridor Rodanthe terminus option implemented. In addition, a substantial increase in noise levels would occur at two residences with either Pamlico Sound Bridge Corridor terminus option. The NAC would be approached or exceeded at four residences with the Parallel Bridge Corridor with Nourishment Alternative, as well as with the Phased Approach/Rodanthe Nourishment Alternative. The NAC would be approached or exceeded at two residences with the other Parallel Bridge Corridor alternatives (including the Preferred Alternative). No reasonable or feasible opportunities exist to reduce noise levels at any of these residences.

The No-Action Alternative assumes that Bonner Bridge is demolished at the end of its service life and not replaced. This likely would result in a dramatic but unknown decrease in traffic on NC 12, since limited ferry capacity would discourage both visitors to Hatteras Island, as well as future growth in the permanent population. Thus, the No-Action Alternative noise levels could not be modeled for comparison with the replacement bridge corridor alternatives, as is customary for this type of analysis. Noise levels were, however, modeled assuming 2025 traffic on NC 12 if the Bonner Bridge were to remain in place.

Energy

The energy used in construction of any of the replacement bridge corridor alternatives would be greater than that required to build the small ferry service associated with the No-Action Alternative. This benefit, however, would be offset, at least in part, by the higher maintenance and operation energy use of the No-Action Alternative. A substantial difference in motor vehicle energy use would not be expected between the replacement bridge corridor alternatives and the No-Action Alternative.

Differences in energy use related to the construction and maintenance of the replacement bridge corridor alternatives are directly reflected in differences in their cost. The higher the cost, the more energy is expended. The relative energy use of the replacement bridge corridor alternatives based on their cost from greatest to least use would be:

1. Either Pamlico Sound Bridge Corridor Alternative (2.2 to 2.4 times the energy use of the least use alternative);

2. Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative (1.9 to 2.0 times the energy use of the least use alternative);

3. Parallel Bridge Corridor with All Bridge Alternative (1.8 to 2.0 times the energy use of the least use alternative);

4. Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) (1.8 to 1.9 times the energy use of the least use alternative);

5. Parallel Bridge Corridor with Nourishment Alternative (1.1 to 1.3 times the energy use of the least use alternative); and

6. Parallel Bridge Corridor with Road North/Bridge South Alternative (the least energy use alternative).

All alternatives would require demolition and removal of Bonner Bridge, but the energy use by equipment would be similar for all alternatives.

Indirect and Cumulative Impacts

Because the proposed project would consist of the replacement of an existing bridge, as well as an existing road in the case of the Parallel Bridge Corridor, indirect impacts would be minimal. The replacement bridge corridor alternatives would not alter area development trends.

From the perspective of cumulative impacts, the Pamlico Sound Bridge Corridor would support the desire of officials responsible for the Refuge and the Seashore to not stabilize the Outer Banks artificially, but rather to let natural processes take their course. The Parallel Bridge Corridor with All Bridge Alternative, as well as the two Phased Approach alternatives (including the Preferred Alternative), would support this desire, with the exceptions of the continued presence of the terminal groin and some nourishment associated with the Phased Approach/Rodanthe Nourishment Alternative. The Parallel Bridge Corridor with Road North/Bridge South Alternative also would generally support this desire. Exceptions would be the continued presence of the terminal groin, the eventual construction of three dunes, and any breach closure that may be needed to maintain the transportation corridor within the Refuge. The Parallel Bridge Corridor with Nourishment Alternative would not support this desire since it would maintain NC 12 by stabilizing the shoreline with nourishment and protecting NC 12 with dunes.

The Pamlico Sound Bridge Corridor, given that it would bypass the Refuge, could affect future decision-making related to:

- NC 12 maintenance in the Refuge;
- Access within the Seashore north of Rodanthe and the Refuge;
- Oregon Inlet dredging and associated impacts to the bottom of Pamlico Sound;
- The preservation and re-use of the (former) Oregon Inlet US Coast Guard Station at the north end of Hatteras Island; and
- The disposition of the terminal groin at the north end of Hatteras Island.

The specific direction these future decisions might take is not foreseeable. In all cases, however, appropriate planning and environmental studies would be conducted before any final decisions are made. The NCDOT will participate in those studies.

The Parallel Bridge Corridor (including the Preferred Alternative), which leaves NC 12 within the Refuge, would influence future dredging decisions from two perspectives.

1. The longer navigation zone of the Oregon Inlet bridge would allow the dredged channel to move with the natural gorge.
2. Some dredging spoils could be used as a part of the Nourishment Alternative.

The terminal groin must be retained with all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative). The retention of the groin would allow the (former) Oregon Inlet US Coast Guard Station to remain in its current location with access to NC 12, if desired by its owners.

All alternatives would affect future decisions related to the relocation of electrical and telephone utilities in response to shoreline erosion, as well as the associated impacts of such relocations to upland habitat and wetlands. It also is reasonably foreseeable that telephone and electrical lines along NC 12 would need to be moved one or more times between now and the design year of this analysis, 2060.

The Pamlico Sound Bridge Corridor alternatives would offer both the removal of NC 12 from the Refuge and removal of the disturbances to Refuge wildlife, including those disturbances from NC 12 storm maintenance and traffic operations. The Refuge contains almost all of the remaining undisturbed (i.e., not used for driving, or adjoining development or potential development) beach on the Outer Banks. The Nourishment Alternative and the Phased Approach alternatives (including the Preferred Alternative) would result in the greatest disturbance to that scarce resource. Beach erosion would result in portions of the Phased Approach alternatives (including the Preferred Alternative) eventually being over the beach and in the ocean. The presence of the bridge in this location would adversely impact the shoreline from the perspective of its natural appearance, recreational use, the outcome of coastal processes along the beach, and wildlife, including protected species that use beach habitat.

Construction

Construction of the proposed project in either replacement bridge corridor, as well as the demolition and removal of Bonner Bridge, would be governed by the NCDOT's *Standard Specifications for Roads and Structures* (NCDOT, July 2006, or as current at the time of construction), and the American Association of State Highway and Transportation Officials' (AASHTO) *Standard Specifications for Highway Bridges* (AASHTO, 2002, or as current at the time of construction).

Mechanisms would be put in place to maintain traffic flow; minimize air quality, noise, and construction lighting impacts; manage waste disposal; minimize construction access impacts; protect surrounding natural resources; control erosion; and handle any accidental waste spills. Affected geodetic survey markers in the project area would be properly relocated.

Costs

Costs through 2060 associated with the detailed study alternatives are shown in Table S-2. These costs include construction, operation and maintenance, right-of-way, Bonner Bridge demolition, and wetland mitigation (except SAV) costs. The alternatives that involve longer bridge components to the south of the Oregon Inlet area, including the Phased Approach/Rodanthe Bridge Alternative (Preferred), would be the most expensive.

Table S-2. Project Costs

Alternative	Total Highway Costs through 2060	
Pamlico Sound Bridge Corridor	**Low**	**High**
• Curved Rodanthe Terminus	$1,305,564,000	$1,797,564,000
• Intersection Rodanthe Terminus	$1,299,066,000	$1,788,066,000
Parallel Bridge Corridor		
• Nourishment	$671,835,000	$970,350,000
• Road North/Bridge South	$602,208,000	$740,208,000
• All Bridge	$1,107,683,000	$1,435,283,000
• Phased Approach/Rodanthe Bridge Alternative (Preferred)	$1,171,459,000	$1,497,113,000
• Phased Approach/Rodanthe Nourishment	$1,149,098,000	$1,524,350,000

S.7 Areas of Controversy

Environmental resource and regulatory agencies included on the NEPA/Section 404 Merger Team have indicated a strong preference for the Pamlico Sound Bridge Corridor because of its lower potential natural resource impacts. However, this alternative is not financially viable, in that adequate resources are not available to fund the initial bridge construction. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is financially viable in that it can be built in phases, spreading the cost out over a timeframe adequate for it to be funded with anticipated future tax revenues. It also would remain in the existing NC 12 easement within the Pea Island National Wildlife Refuge and, therefore, would not use lands from the Refuge.

S.8 Major Unresolved Issues with Other Agencies

The Assistant Secretary for Fish and Wildlife and Parks of the US Department of the Interior indicated (in a September 11, 2007 letter) that, based on the information that the USFWS had as of that date, it was unlikely that they could find the Preferred Alternative to be compatible with the purposes for which the Refuge was established, as required under the 1997 National Wildlife Refuge System Improvement Act, because the potential exists for NC 12 continued maintenance outside the existing NC 12 easement. However, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement. Because the Preferred Alternative would be confined to the existing NC 12 easement, FHWA and NCDOT have concluded that a determination of compatibility is not required.

S.9 Other Federal Actions Required for the Preferred Alternative

The following permits would be required from federal agencies for implementation of the Phased Approach/Rodanthe Bridge Alternative (Preferred):

- US Coast Guard Bridge Permit for the Oregon Inlet bridge (Phase I) component of the Preferred Alternative. An additional bridge permit might be needed when the shoreline erodes under the Preferred Alternative's bridges, thereby placing them in the ocean;

- US Army Corps of Engineers Sections 404 and 10 permits (waters of the United States fill and dredge permits) and perhaps a Section 103 Permit (ocean disposal of dredged material);

- National Park Service Special Use Permit; and

- New US Fish and Wildlife Service permit for the terminal groin and revetment (the existing permit states that the groin's intended use is only to protect the current Bonner Bridge).

These same permits would be required for the other Parallel Bridge Corridor alternatives; however, the following additional permits also would be required, as applicable, from the USFWS:

- Right-of-Way Permit (when leaving the current easement in the Refuge) and

- Special Use Permit (for temporary impacts because of construction, temporary detours, and beach nourishment within the Refuge).

The Pamlico Sound Bridge Corridor alternatives also would require a US Coast Guard Bridge Permit, US Army Corps of Engineers Sections 404 and 10 permits (and perhaps a Section 103 Permit), and a National Park Service Special Use Permit. However, no USFWS permits would be required with the Pamlico Sound Bridge Corridor alternatives.

No other federal actions would be required with any of the replacement bridge corridor alternatives (including the Preferred Alternative).

S.10 North Carolina Legislation Related to Bonner Bridge Replacement

During its 2005 Session, the North Carolina General Assembly passed legislation (House Bill 747) related to the replacement of Bonner Bridge. The bill calls for expediting and accelerating the efficient, cost-effective completion of the project; indicates a preference for a bridge replacement in proximity to Bonner Bridge; and requests the NCDOT to periodically report project status to the General Assembly.

NC 12 Replacement of the Herbert C. Bonner Bridge

(Bridge No. 11) over Oregon Inlet

Federal-Aid No. BRS-2358(15)
State Project No. 8.1051205
TIP Project No. B-2500
Dare County, North Carolina

Project Commitments

Highway Design Branch

1. Navigation Span Location. One navigation zone would be built to serve boats passing through Oregon Inlet. The location of the zone would be determined in coordination with the US Army Corps of Engineers (USACE).

2. Bicycle Accommodations. The Seashore management plan supports the use of bicycles along NC 12. All bridges in both replacement bridge corridors (including the Preferred Alternative) would have 8-foot (2.4-meter) wide shoulders that would be safer for bicycle and pedestrian traffic than Bonner Bridge's 2-foot (0.6-meter) wide shoulders. In addition, a bicycle-safe bridge rail on the bridges also would provide increased safety for bicyclists. New roadway would have 4-foot (1.2-meter) paved shoulders, which would be safer for use by bicycle and pedestrian traffic than existing NC 12's unpaved shoulders.

Highway Design Branch and Division 1

3. Use of Work Bridges. During construction in the Pamlico Sound Bridge Corridor, steps taken to minimize turbidity (when possible and practicable) would include the use of work bridges (rather than dredging for barges) for movement of construction equipment in shallow areas where submerged aquatic vegetation (SAV) is present. If SAV is in waters deep enough to float a barge without dredging, the use of a work bridge would not be necessary. Work bridges also would be used to carry construction equipment over intertidal marsh areas (black needlerush and smooth cordgrass). Dredging generally would only be used in depths less than 6 feet (1.8 meters) where SAV is not present. In the Parallel Bridge Corridor (including the Preferred Alternative), work bridges would be used for building proposed bridges over wetlands south of Oregon Inlet.

   The Oregon Inlet bridge would generally be built from a barge. West of Bodie Island, a temporary haul road on geotextile fabric, dredging, or a work bridge could be used. Use of a work bridge instead of a haul road for short distances at critical locations, such as SAV locations, would be considered prior to construction.

4. Sedimentation and Erosion Control. All waters in the project area are classified as SA waters (Class A salt waters) with a supplemental classification of High Quality Waters (HQW). The most stringent application of the Best Management Practices (BMPs) is expected where highway projects affect receiving waters of special designation, such as HQW. Also, impacts to adjacent areas of SAV and/or wetlands should be minimized. Therefore, sedimentation

and erosion control measures shall adhere to the Design Standards in Sensitive Watersheds [15A NCAC 04B.0124(b)-(e)]. Prior to construction, the design-build contractor will submit the proposed sediment and erosion control plans for each stage of construction to the NCDOT and permitting agencies for review.

5. Pile Placement. Bridge piles in open water would be jetted to the tip elevation (depth of the tip of the pile). Bridge piles over land would be jetted or driven.

6. Use of Bridge Demolition Debris for an Artificial Reef. The NCDOT would work with the NC Division of Marine Fisheries to accommodate this desire during demolition planning. Coordination also would be conducted with the National Marine Fisheries Service (NMFS) in association with their regulation of several protected species.

Highway Design Branch, Project Development and Environmental Analysis Branch, and Division 1

7. Design Coordination. The NCDOT would invite the National Park Service (NPS) and the US Fish and Wildlife Service (USFWS) (in the case of the Parallel Bridge Corridor alternatives including the Preferred Alternative) to participate in the development of project design and mitigation strategies as a part of the permit application process.

8. Dredging. To avoid construction impacts to protected turtles, the NCDOT's contractor would use pipeline or clamshell dredging. A hopper dredge would not be used for bridge construction or Bonner Bridge demolition.

9. Disposal of Dredged Material. Prior to construction, during the USACE permit preparation process, the FHWA and the NCDOT would work with appropriate environmental resource and regulatory agencies to identify the characteristics of dredged material from bridge construction in open water and develop a disposal plan that would minimize harm to natural resources. The appropriate location for dredged material disposal would be determined based on the character of the materials dredged, the availability of disposal sites, and coastal conditions near the time of construction. In addition, the terms and conditions outlined in the *Biological and Conference Opinion*s (USFWS, 2008) related to piping plovers specify that "all dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission."

10. Night-time Construction. Because construction activities could occur 24-hours-a-day, construction areas could be lit to daylight conditions at night. The NCDOT would work with the North Carolina Department of Environment and Natural Resources' Division of Marine Fisheries, the National Marine Fisheries Service, the NPS, and the USFWS to determine other areas near project construction where night lighting would need to be avoided or limited. Night lighting also would not be used close to areas where people sleep, including the campground at the northern end of the project area and the Rodanthe area at the southern end. Night lighting also will meet the requirements specified to protect sea turtles contained within Commitment 25a.

11. Manatee Protection. Construction contracts would require compliance with the USFWS' Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters (June 2003).

12. Sea Turtle and Smalltooth Sawfish Protection. NCDOT will comply with the NMFS's March 23, 2006, *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006) that restrict in-water construction-related activities when these protected species are observed in the project area. However, the NMFS and NCDOT agree that bridge construction or demolition activities do not need to stop when a protected species is sighted in the proximity of construction if the construction activities are not in the water. The in-water moratorium prohibits pile installation and removal and activities associated with bridge construction and demolition when listed species are present in the water, but does not restrict terrestrial activity.

13. Terminal Groin Removal. With the Parallel Bridge Corridor (including the Preferred Alternative), the NCDOT would apply for a permit to retain the groin to protect the south end of the Oregon Inlet bridge. The groin would not be needed to protect a Pamlico Sound bridge.

14. Archaeological Resources Discovered During Construction. If any historic archaeological resources (i.e., historic watercraft) are encountered in the area west of Bodie Island during construction, construction work affecting the resource will cease immediately until the resource can be identified and assessed for National Register of Historic Places eligibility.

15. Construction of Future Phases Based on Available Funding. With the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred), it is NCDOT's intent to place a high priority on the implementation of Phase II. This intent recognizes the need to build Phase II, particularly in the Rodanthe 'S' Curves, Sandbag Area, and Canal Zone hot spots, as soon as it is practicable.

16. Monitoring Program. NCDOT considers the 2060 high erosion shoreline a reasonable assumption for current planning purposes, but also recognizes that decisions related to the implementation of Phases III and IV and the specific location of Phases III and IV would likely need to evolve with actual geomorphological change relative to the NC 12 easement, whether from changes in the characteristics of expected beach erosion, the possible changes of sound-side erosion at Oregon Inlet, accelerated sea level rise, or island breaching. With this in mind, NCDOT would implement a monitoring program on Hatteras Island in the project area whose particulars would be developed in association with representatives of the Pea Island National Wildlife Refuge, including development of decision-making criteria for translating monitoring findings into a decision to move forward with Phases III and IV.

17. Breach Response-Related Data Gathering Program. Recognizing the possibility that a breach could occur at the southern part of the Refuge prior to the completion of Phase II and four other locations exist in the project area that are geologically susceptible to a breach (three are bridged in Phase II and one in Phase III), NCDOT would conduct a breach response-related data gathering program focusing on the southern end of the Refuge.

18. Reduce the Potential Impacts from NC 12 Maintenance Prior to the Completion of Each Phase. Recognizing that storm-related NC 12 maintenance will occur before the completion of Phases II, III, and IV, particularly before the implementation of Phase II in the three hot spot areas, NCDOT would continue to work with the Refuge to reduce the potential impacts to the Refuge and NC 12 resulting from NC 12 storm-related maintenance.

19. Shortnose Sturgeon. Conservation measures to protect shortnose sturgeon would include no hopper dredging and measures to minimize habitat degradation. Such measures would include BMPs involving use, storage, and disposal of construction/demolition materials to minimize short-term turbidity or water quality degradation during over water construction in Oregon Inlet and during periodic maintenance. Construction and demolition activities associated with Phase I of the project would be completed as quickly as possible in order to minimize deterring spawning sturgeon from entering Oregon Inlet. In addition, the project would incorporate BMPs to reduce habitat degradation from stormwater runoff pollution.

Highway Design Branch, Project Development and Environmental Analysis Branch, Division 1, and Right-of-Way Branch

20. Utilities. Project development and construction activities would be coordinated with utility providers in the project area in order to prevent interruption of local utility services. The following utility providers currently serve the project area: Dare County (water service); Sprint Communications (telephone service); Charter Communications (cable television service); and Cape Hatteras Electric Membership Association (electric power service).

Highway Design Branch, Project Development and Environmental Analysis Branch, Division 1, and Geotechnical Unit

21. Use of Explosives During Construction. The use of explosives during construction is not anticipated. If explosives were needed to remove Bonner Bridge's piles, the NCDOT would coordinate with the appropriate environmental resource and regulatory agencies to develop a blasting program that would minimize adverse effects to the natural environment.

Project Development and Environmental Analysis Branch

22. Memorandum of Agreement. Prior to the release of the Record of Decision (ROD), FHWA will complete a Memorandum of Agreement with the State Historic Preservation Office and the Advisory Council on Historic Preservation in consultation with other consulting parties, as per the requirements of Section 106 of the Historic Preservation Act of 1966.

23. Seabeach Amaranth. Since the favored habitat of the seabeach amaranth is highly ephemeral, a survey of the project area would be conducted for the habitat of this species at least one year prior to initiating bridge construction activities. It would occur as needed for each construction phase of the Phased Approach/Rodanthe Bridge Alternative (Preferred).

Highway Design Branch, Project Development and Environmental Analysis Branch, Division 1, and Bridge Management Unit

24. Piping Plover. The NCDOT will implement the following nondiscretionary measures that include the terms and conditions outlined in the *Biological and Conference Opinion*s (USFWS, 2008):

    a. All construction equipment and personnel must avoid all bird closure areas within the Seashore and Refuge.

       All future routine maintenance activities of bridge structures that would occur within or adjacent to current or future plover nesting areas must occur outside the nesting season (April 1 to July 15).

All future repair work on bridge structures that would occur within or adjacent to current or future plover nesting areas must occur outside the nesting season (April 1 to July 15) unless emergency or human safety considerations require otherwise. In this event, the area must be surveyed for nesting plovers and avoided to the extent possible.

b. During the construction of Phases II, III and IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred), keep all construction equipment and activity within the existing right-of-way.

   Do not moor any construction barges within 300 feet (91.4 meters) of the following islands: Green Island, Wells Island, Parnell Island, Island MN, Island C, the small unnamed island immediately east of Island C, Island D, and Island G (see Figure 1 in the *Biological and Conference Opinion*s in Appendix E).

c. All dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission. The point of contact is Sue Cameron at 910-325-3602. If the dredge material is used outside the current defined action area, the action area is assumed to be expanded to cover the beneficial placement of the material.

d. To the maximum extent practical, while ensuring the safety of the traveling public, limit or avoid the use of road signs or other potential predator perches adjacent to plover nesting or foraging areas. Where signs or other structures are necessary, determine if alternative designs would be less conducive for perching on by avian predators (gulls, crows, grackles, hawks, etc.). For example, minimize or avoid the use of large cantilever signs in favor of smaller and shorter designs.

In addition, the project will incorporate the most current BMPs to reduce habitat degradation from stormwater runoff pollution as a conservation measure. Phase I of the project will be built at least 125 feet (38.1 meters) farther west of the Bonner Bridge and currently occupied piping plover habitat. Temporary facilities such as haul roads that affect proposed piping plover critical habitat will be removed as soon as possible.

25. <u>Sea Turtles (green sea turtle, leatherback sea turtle, and loggerhead sea turtle)</u>. The NCDOT will implement the following nondiscretionary measures that include the terms and conditions outlined in the *Biological and Conference Opinion*s (USFWS, 2008):

   a. All construction equipment and personnel must avoid all marked sea turtle nests.

      Construction material and equipment staging areas must not be located seaward of the artificial dune.

      All future routine maintenance activities of bridge structures that would occur within or adjacent to current or future sea turtle nesting habitat, and which would require vehicles or equipment on the beach or the use of night lighting (excluding navigation lights required by the US Coast Guard), must occur outside the nesting season (May 1 to November 15).

All future repair work of bridge structures that would occur within or adjacent to current or future sea turtle nesting habitat, and which would require vehicles or equipment on the beach or the use of night lighting (excluding navigation lights required by the US Coast Guard) must occur outside the nesting season (May 1 to November 15) unless emergency or human safety considerations require otherwise. In this event, the area must be surveyed for sea turtle nests and avoided to the extent possible.

b. Provide an opportunity for the USFWS or an USFWS designee to educate construction contractor managers, supervisors, foremen and other key personnel and resident NCDOT personnel with oversight duties (division engineer, resident engineer, division environmental officer, etc.) as to adverse effects of artificial lighting on nesting sea turtles and hatchlings, and to the importance of minimizing those effects.

c. During turtle nesting season (May 1 to November 15), use the minimum number and the lowest wattage lights that are necessary for construction.

   During turtle nesting season, portable construction lighting must be of the low-pressure sodium-vapor type.

   During turtle nesting season, utilize directional shields on all portable construction lights, and avoid directly illuminating the turtle nesting beach at night.

   During turtle nesting season, all portable construction lights must be mounted as low to the ground as possible.

   During turtle nesting season, turn off all lights when not needed.

d. For Phases II, III and IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred)**,** on the ocean side, design the bridge structure in a manner which will shield the beach on the east side from direct light emanating from passenger vehicle headlights. For the small portion of Phase I over land on Hatteras Island, retrofit the bridge structure at the time that Phase II connects with Phase I. The specific design of the bridge will be developed in consultation with the USFWS prior to re-evaluation of the environmental document for Phase II.

e. Avoid retrofitting the bridges and approach roads with permanent light fixtures in the future (excluding navigation lights required by the US Coast Guard).

In addition, NCDOT does not anticipate the use of explosives during construction or demolition of the existing bridge. The NCDOT contractor will use pipeline or clamshell dredging, rather than a hopper dredge to minimize effects to sea turtles. No permanent light fixtures will be installed on the bridge or the approaches (with the exception of navigation lights as required by the US Coast Guard).

Photogrammetry Unit and Project Development and Environmental Analysis Branch

26. Submerged Aquatic Vegetation (SAV) Survey. The dynamic nature of the area around Oregon Inlet results in ephemeral habitats, particularly in shallow water and shoreline areas. Consequently, the NCDOT would obtain new SAV information for use by the contractor in construction access planning.

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Chapter 1

Purpose of, and Need for, Action

1.0 Purpose of, and Need for, Action

The North Carolina Department of Transportation's (NCDOT, 2008) *2009 to 2015 State Transportation Improvement Program* (TIP) includes the replacement of the Herbert C. Bonner Bridge (Bridge No. 11) over the Oregon Inlet in Dare County (TIP Project No. B-2500). Studies are underway in accordance with the requirements set forth in the National Environmental Policy Act (NEPA) of 1969, as amended. This purpose and need statement explains why the project should be implemented. The project location is illustrated in Figure 1-1.

The Bonner Bridge spans Oregon Inlet within North Carolina's Outer Banks and connects Bodie Island with Hatteras Island. The bridge provides the only highway connection of Hatteras Island and the mainland via NC 12 and US 64. The Bonner Bridge was built in 1962.

1.1 Project Need

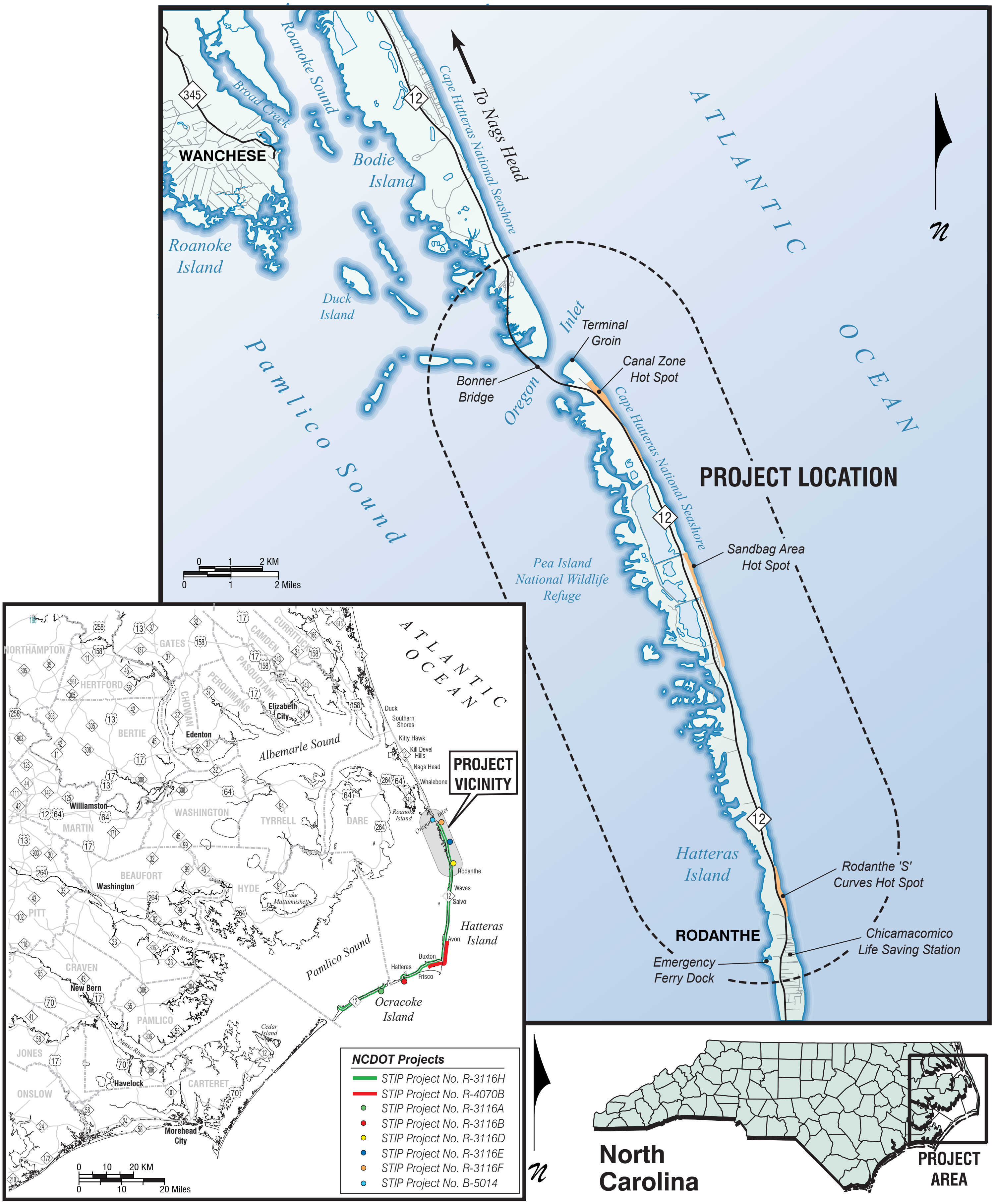
The need for an Oregon Inlet crossing will continue past the end of the service life of the Bonner Bridge. A NCDOT Bridge Inspection Report from June 2006 rates the present condition of the bridge as "poor," with a sufficiency rating of two out of 100. This report also estimates the remaining practical service life of Bonner Bridge to be five years (as of 2007), indicating a need for extensive ongoing maintenance and rehabilitation. A planned rehabilitation project (TIP Project No. B-5014) is expected to increase the estimated practical service life to 10 years. The 2006 Bridge Inspection Report indicates there are places on the bridge that show deterioration of bridge girders and substructure. Replacement of the Bonner Bridge is needed for three reasons:

1. Continued demand for convenient daily and emergency access across the Oregon Inlet is expected.

2. The natural channel or gorge through the Oregon Inlet migrates. A replacement bridge needs to provide spans of sufficient height and width for navigation through the anticipated area of future natural channel migration, helping to reduce future dredging needs, dredging impacts, and the cost of dredging.

3. The southern terminus of the Bonner Bridge is north of portions of NC 12 currently threatened by shoreline erosion and overwash. Placing the southern terminus of a replacement bridge (or incorporating a long-term NC 12 maintenance and protection project) south of these areas will reduce the frequency of maintenance of these threatened segments of NC 12.

The following paragraphs describe these needs.



PROJECT LOCATION MAP	Figure 1-1

1.1.1 Need for Access across Oregon Inlet

The existing crossing provides the only highway access to Hatteras Island. The only other way to access the island is via the ferry between Ocracoke Island and Hatteras Island. The need for continued access to Hatteras Island, with a capacity equivalent to that provided by the Bonner Bridge, is reflected in the following ways:

- **Tourist use of Hatteras Island (including the use of Cape Hatteras National Seashore), use of the Pea Island National Wildlife Refuge, and Dare County's reliance on tourism as its primary industry.**

  Tourism is the number-one industry in Dare County and on Hatteras Island. The tourist industry creates a large number of local jobs and generates substantial revenue for both Dare County and the State of North Carolina. Sixty-one percent of the employment in Dare County relates to the tourism industry. Dare County promotes both tourism during the peak (summer) season, as well as the development of "shoulder" season tourism (in the spring and fall). The labor force in Dare County increases by approximately 75 percent between off-peak season and peak season. In 1999, the seasonal economic revenues represented more than 70 percent of the annual economy in Dare County (Outer Banks Chamber of Commerce, 2003). The abundant natural resources in Dare County will continue to be a major draw for tourists.

  Cape Hatteras National Seashore is home to many species of flora and fauna and a number of biotic communities. It is a popular local, state, and national vacation destination. Recreation visit statistics posted on the National Park Service (NPS) web site show that the Cape Hatteras National Seashore (including Bodie, Hatteras, and Ocracoke islands) had 2,237,378 recreational visitors in 2007. Visitors enjoy a variety of activities, including birding, fishing, surfing, windboarding, swimming, hiking, and attending interpretive programs offered by NPS rangers. The Pea Island National Wildlife Refuge reports 2.7 million visitors annually, including birders, canoeists, beach users, fishermen, and photographers (Pea Island National Wildlife Refuge web site, August 18, 2008). Eco-tourism, a concept of combining ecological awareness and tourism, has become a new marketing tool for all of northeastern North Carolina. Dare County supports the concept of combining natural resources and tourism to promote the area's ecological values (2003 *Dare County Land Use Plan*).

- **Reliance of the permanent Hatteras Island population on mainland goods and services.**

  The southern beaches on Hatteras Island are all part of unincorporated Dare County and feature the six recreational-oriented communities of Rodanthe, Waves, Salvo, Avon, Buxton, and Frisco (see Figure 1-1). Hatteras, a seventh community, is home to the Hatteras Inlet Ferry Terminal. Development in Hatteras reflects its status as a commercial fishing village, and a dominant commercial presence exists along NC 12. Hatteras serves as both a year-round community and a seasonal resort destination. The permanent population on Hatteras Island was 4,001 in 2000.

  Products and services involved with daily life on Hatteras Island are transported across the Bonner Bridge. All types of goods can be purchased on the island, but the selection currently is limited, necessitating regular shopping trips north across Bonner Bridge to Manteo or communities on Bodie Island (Nags Head, Kill Devil Hills, etc). The island residents rely heavily on repair and other services from the mainland. Residents, as well as visitors, of

Hatteras Island rely on off-island community services. Telephone and electric service are brought to Hatteras Island via Bonner Bridge.

On Hatteras Island, the communities of Avon, Buxton, Frisco, and Hatteras are served by the Dare County Water Department. The other Hatteras Island communities of Rodanthe, Waves, and Salvo rely on private wells, as well as the County's reverse osmosis plant for potable water.

Dare County provides trash collection for the unincorporated areas of Dare County. Refuse is removed from Hatteras Island via Bonner Bridge. Dare County owns and operates transfer stations in Buxton and Manteo. On-site septic tank and drainfield systems are the predominant methods of wastewater treatment on Hatteras Island.

Hospitals are located in Nags Head, North Carolina; Elizabeth City, North Carolina; Norfolk, Virginia; and Chesapeake, Virginia. Ambulance destinations always are off the island.

- **Hatteras Island and Ocracoke Island emergency evacuation requirements.**

  In 1992, the Dare County Emergency Management Control Group was established to administer the *Dare County Emergency Operation Plan*. The plan describes evacuation procedures in the event Dare County is evacuated because of the threat of hurricanes or other storm events. An underlying objective of the plan is to minimize physical damage, injury, and loss of life in the event of a hurricane strike. In such an event, the plan provides for both Hatteras and Ocracoke islands to be evacuated to Bodie Island via Bonner Bridge and, subsequently, to the mainland via US 64 and US 158. Therefore, Bonner Bridge is considered a critical evacuation route in the plan

  The 2001 US Army Corps of Engineers (USACE) Hurricane Evacuation Model estimated that, for a Category 3-5 hurricane during a period of tourist high occupancy in 2000, 9,530 vehicles could have been expected to evacuate via NC 12 on Hatteras Island. There would be approximately 14,761 evacuating vehicles on Bonner Bridge in response to a Category 3 – 5 storm during the peak tourist season in 2025.

  A 2005 hurricane evacuation study prepared for NCDOT (PBS&J, 2005) modeled 2004 and 2030 evacuation response times (time to move all evacuees through the road network) for North Carolina coastal areas. Clearance times for evacuees using US 64 to Columbia (the closest evacuation route for Hatteras Island residents and visitors) was 17.5 hours in 2004 (assuming 75 percent tourist occupancy and a Category 3 to 5 hurricane). This time is expected to rise to 26.4 hours by 2030. An 18-hour clearance time standard was adopted by the North Carolina Legislature in 2005 (NC Gen. Stat. § 136-102.7, "Hurricane Evacuation Standard"). However, the link in the coastal road system controlling the current and future clearance time when evacuating along US 64 is between Columbia, North Carolina in Tyrrell County and Mann's Harbor in Dare County and not NC 12 in the project area.

- **Travel demand.**

  The 2002 annual average daily traffic (AADT) volume over Bonner Bridge was estimated to be 5,400 vehicles per day (vpd). Summer peak season (June through August) daily traffic flows are substantially higher than the AADT. In 2002 during the peak summer season, average weekday traffic crossing the bridge was 8,000 vpd. Average weekend traffic carried in peak season was 10,900 vpd. By 2025, these daily volumes are forecast to rise to 9,600 vpd (AADT), 14,200 vpd (summer average weekday), and 19,200 vpd (summer average weekend).

1.1.2 Migration of the Natural Channel Gorge

The Oregon Inlet channel migrates, and channel movement must be considered when determining the proper horizontal alignment of any replacement bridge. Since its opening during a storm in 1846, the midpoint of Oregon Inlet has migrated steadily southward just over two miles (3.2 kilometers) at an average rate of 70 feet (21.3 meters) per year. The history of Oregon Inlet's migration is punctuated by alternate widening and narrowing, typically in response to severe storms. Widening and narrowing of Oregon Inlet generally occurs because of erosion and accretion along the Bodie Island (north) shoulder of the inlet. Until construction of the terminal groin in 1989, the Hatteras Island shoulder moved steadily southward. Thus, most of the current variation in inlet width is the result of Bodie Island movement.

Like all active tidal inlets, Oregon Inlet requires periodic dredging to maintain a navigation channel; dredging also is required to maintain this channel such that it passes under the Bonner Bridge navigation span. The current natural inlet gorge is 30 to 40 feet (9 to 12 meters) deep.

1.1.3 Erosion of the Hatteras Island Shoreline

Shoreline erosion and ocean overwash threaten to sever segments of the NC 12 roadway for several miles south of Bonner Bridge.

In August 1991, the NCDOT sponsored a research project conducted by North Carolina State University to identify critical sections of North Carolina's coastal highways and options available for maintaining these highway corridors. The study concluded that NC 12 has six critical sections, or "hot spots," between Oregon Inlet and the southwestern tip of Ocracoke Island. Three of the hot spots are at the north end of Hatteras Island: Canal Zone, Sandbag Area, and Rodanthe 'S' Curves. The NCDOT has completed vulnerability studies (*NC 12 Shoreline Erosion Analysis, Canal and Sandbag Areas*, 2002) for the two northernmost hot spots, the Canal Zone and Sandbag Area (see Figure 1-1).

The northern Rodanthe area, including the Rodanthe 'S' Curves Hot Spot, has the highest erosion rates in the Bonner Bridge replacement project area, with a maximum rate of about 15 feet (4.6 meters) per year. Erosion rates in the Canal Zone and Sandbag Area hot spots are as high as 8 feet (2.4 meters) per year. (Overton and Fisher, June 2005).

In recognition of the need to address long-term maintenance of NC 12 on Hatteras and Ocracoke islands, a partnering agreement was formulated and adopted by the USACE, the NPS, the US Fish and Wildlife Service (USFWS), the National Marine Fisheries Service, the Federal Highway Administration (FHWA), the North Carolina Department of Environment and Natural Resources, Dare County, Hyde County, and the NCDOT. The Executive Committee and Interagency Task Force on the Transportation System on North Carolina's Outer Banks were established in October 1993 because of the partnering agreement. The Interagency Task Force's (titled the Outer Banks Task Force [OBTF]) mission has been to take an integral role in developing the long-term protection and maintenance plan for the transportation system on the Outer Banks. The Memorandum of Agreement (MOA) establishing the OBTF has expired, but the OBTF continues to meet to share information and to foster continued relationships.

In addition, the USACE is planning to conduct a feasibility study of Hatteras and Ocracoke islands to determine possible long-term solutions to the transportation problems that exist on both Hatteras and Ocracoke islands. NCDOT is the local sponsor for this Congressionally authorized feasibility study (TIP No. R-3116H). This study is currently unfunded by the US Congress.

1.2 Project Purpose

The purposes of the proposed project are to:

- **Provide a new means of access from Bodie Island to Hatteras Island for its residents, businesses, services, and tourists prior to the end of Bonner Bridge's service life.**

  Needs Addressed: Although Bonner Bridge is reaching the end of its service life, demand for convenient daily and emergency access across Oregon Inlet is expected to continue.

- **Provide a replacement crossing that takes into account natural channel migration expected through year 2050 and provides the flexibility to let the channel move.**

  Needs Addressed: The natural channel or gorge through Oregon Inlet migrates. A replacement bridge needs to provide spans of sufficient height and width for navigation through the anticipated areas of future natural channel migration, thereby helping to reduce future dredging needs. Construction of the replacement crossing west of Oregon Inlet where less sand movement occurs also could help reduce future dredging needs.

- **Provide a replacement crossing that will not be endangered by shoreline movement through year 2050.**

  Needs Addressed: The southern terminus of Bonner Bridge is north of portions of NC 12 threatened by shoreline erosion and overwash. Placing the southern terminus of a replacement bridge south of these areas, or including a long-term NC 12 maintenance and protection component, will reduce the need for frequency of maintenance of these threatened segments of NC 12. All the alternatives were ultimately developed for a service life through 2060.

1.3 Background Information

1.3.1 Project Area Setting and Land Use

The Herbert C. Bonner Bridge spans Oregon Inlet within North Carolina's Outer Banks (see Figure 1-1) and connects Bodie Island with Hatteras Island. The bridge provides the only highway connection of Hatteras Island and the mainland via NC 12 and US 64.

Oregon Inlet is within Dare County and is the northernmost inlet along the Outer Banks. The inlet was opened in 1846 by a severe storm and, after closing, reopened in 1864. The history of Oregon Inlet has been one of regular southward migration, accompanied by alternate widening and narrowing of the inlet. To maintain navigability of Oregon Inlet, maintenance dredging by the USACE has been necessary since 1960.

Prior to construction of Bonner Bridge in 1962, transport across Oregon Inlet was via ferry. The ferry was unable to keep pace as demand for transportation across the inlet increased, and the bridge was constructed to meet the increased demand. The bridge was opened to traffic in November 1963.

The project area includes three types of land use—Cape Hatteras National Seashore, Pea Island National Wildlife Refuge, and the unincorporated community of Rodanthe. Land use in the portion of Rodanthe within the project area includes vacation homes and commercial uses, a NCDOT emergency ferry dock, a community center, the Chicamacomico Life Saving Station (a National Register of Historic Places listed historic resource and museum), and the Rodanthe Historic District (eligible for inclusion in the National Register of Historic Places).

1.3.2 Population Growth

Dare County is experiencing substantial growth. Forecasts indicate that the population will continue to grow at a rapid rate over the next 20 years. The permanent population of Dare County was approximately 30,000 in 2000 and is expected to grow to approximately 44,000 by 2020, a 47 percent increase. The 2003 *Dare County Land Use Plan* indicates that the seasonal population peak for Dare County is approximately 200,000. US Census data for 2000 show that the Hatteras Island permanent population was approximately 4,000.

1.3.3 Project History

Since its construction in 1963, Bonner Bridge has required continual maintenance. Three major continuing problems requiring periodic maintenance are:

1. Deterioration of the bridge through extensive corrosion of the reinforcing steel as well as major spalling of concrete (fragments breaking off the face) on the supporting structures;

2. Scour (erosive force of moving water) of a depth great enough to affect the piles' ability to support the superstructure; and

3. Natural channel migration that results in the periodic need for boat traffic to pass beneath a span adjacent to the bridge's primary navigation span.

Maintenance projects associated with the correction of these problems began in 1965, when severe scour was discovered near the navigation span, and continue today. In 1978 and 1981, contracts to construct support bents at the Hatteras Island end of the bridge were let in response to a discovery that several bents had pile penetrations of less than 7 feet (2.1 meters). In 1989 and 1991, additional piles were installed at the Bodie Island end of the bridge. In 1989 and 1990, a terminal groin (rubble or rock mound structure), projecting 550 feet (167.7 meters) into Oregon Inlet, then turning and extending seaward perpendicular to the shoreline, was built on Hatteras Island to protect the southern bridge approach.

The bridge is also vulnerable to ship collision. This problem became apparent in October 1990. A hopper dredge used to maintain Oregon Inlet's channel struck Bonner Bridge and demolished several spans, forcing the bridge to be closed to traffic from October 1990 to February 1991. The bridge was not designed to withstand the impact of such a vessel.

A *Draft Environmental Impact Statement* (DEIS) for the replacement of Bonner Bridge was approved in November 1993. Public hearings were held on February 23 and 24, 1994. A preferred alternative was selected and a preliminary *Final Environmental Impact Statement* (FEIS) was prepared. Coordination with the USFWS related to Section 7 of the Endangered Species Act was not completed, and thus the FEIS was never finalized nor approved.

Trends in the 1990s and early 2000s in shoreline erosion, as well as overwash of NC 12 and other changes in the setting of the project resulted in the decision to prepare a *Supplemental Draft Environmental Impact Statement* (SDEIS) and assess additional alternatives for the bridge replacement. Following completion of the SDEIS in 2005, a Supplement to the SDEIS (SSDEIS) was prepared in 2007. The SSDEIS addressed the characteristics and potential direct, indirect, and cumulative impacts of two additional alternatives. The 2005 SDEIS and 2007 SSDEIS together make up the DEIS from which this FEIS was prepared.

The project area that includes both Oregon Inlet and NC 12 is shown in Figure 1-1. The project area is within the Cape Hatteras National Seashore, and the portion of the project area south of Oregon Inlet is also within the Pea Island National Wildlife Refuge. The community of Rodanthe is at the southern end of the project area.

1.4 Thoroughfare Planning

1.4.1 Overview of the Thoroughfare Planning Process

The thoroughfare planning process is a comprehensive transportation planning process that integrates urban area planning practices with local, regional, and statewide transportation planning practices. The process identifies transportation planning needs by evaluating land development and population growth trends in both rural counties and urbanized areas. The process begins through a cooperative effort between the NCDOT's Transportation Planning Branch and local planning officials. Socio-economic data, including business and residential area inventories, existing street inventories, identification of environmental constraints, and information about the history of the area, are collected. A base-year transportation model is built. Utilizing input from local planning officials, land development and population growth trends are projected and applied to the model. Through this modeling process and local knowledge of the area's socio-economic conditions, the thoroughfare planning team identifies transportation deficiencies and determines short- and long-term solutions for eliminating or diminishing those deficiencies.

1.4.2 Dare County Thoroughfare Plan

The *Dare County Thoroughfare Plan*, last updated in 1988, covers a planning period through 2010. This document is considered out-of-date and is no longer used for transportation planning purposes. (Personal communication, 2003, Donna Creef, Dare County Planning Department.) The 1988 plan, however, did list the Herbert C. Bonner Bridge among those bridges considered structurally deficient or functionally obsolete in Dare County. An update to the plan is not currently scheduled.

1.4.3 NCDOT Transportation Improvement Program

This project is included as TIP Project No. B-2500 in the NCDOT's *2009 to 2015 State* TIP covering the period from Federal Fiscal Year (FFY) 2009 (October 2008) through FFY 2015 (September 2015). The additional transportation projects that are near the proposed project are depicted in Figure 1-1 and listed below:

Project R-3116A	Planning for interim measures to protect NC 12 from sand and ocean overwash at Ocracoke Island.
Project R-3116B	Planning for interim measures to protect NC 12 from sand and ocean overwash at Hatteras Village.
Project R-3116D*	Relocation of NC 12 from north of Rodanthe to south of the Refuge Boundary (Rodanthe 'S' Curves Hot Spot) to protect roadway from sand and ocean overwash.
Project R-3116E*	Planning for interim measures to protect NC 12 from sand and ocean overwash at the Sandbag Area Hot Spot.
Project R-3116F*	Planning for interim measures to protect NC 12 from sand and ocean overwash at the Canal Zone Hot Spot. (This project is combined with Project R-3116E for planning purposes.)
Project R-3116H	Planning and environmental studies for the long-term maintenance of NC 12 from Ocracoke Island to the southern terminus of Bonner Bridge. A joint NCDOT/USACE feasibility study (Hatteras and Ocracoke islands, NC) was underway but is currently not funded by the US Congress.
Project R-4070B	Planning and environmental studies for maintaining NC 12 from Buxton to Avon. Programmed for planning and environmental studies only.
Project B-5014	Repairs to Bridge No. 11 (Bonner Bridge over Oregon Inlet) in FFY 2007 and FFY 2008.

* Project not listed in the TIP and is currently unfunded. Planning studies were underway, but they are currently (2008) on hold and are not expected to be implemented given that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is a long-term solution to protecting NC 12 from sand and ocean overwash.

1.5 Transportation Network and Operating Characteristics

1.5.1 Existing Road Network

Bridges comprise a key component of the transportation infrastructure and serve as entryways to Dare County. According to the *Dare County Land Use Plan* (2003), most travel within the County occurs on two arterial routes, NC 12 and US 158. US 158 extends north-south from Southern Shores to the Whalebone area of Nags Head. NC 12 extends north-south from

Currituck County to Hyde County on Ocracoke Island. Movements on and off the Outer Banks to the mainland are restricted to US 64 and US 158. Ferry service between Hatteras Village and Ocracoke Island also serves as a means for entering and leaving Dare County.

The Herbert C. Bonner Bridge, which links NC 12 on Hatteras and Bodie islands, provides the only roadway link for travelers driving a vehicle on and off Hatteras Island.

1.5.2 Roadway Characteristics and Posted Speed

NC 12 is designated as a major collector route by both the Dare County and the NCDOT Functional Classification Systems. NC 12 is also part of the National Highway System and is classified as an Intermodal Terminal Connector. NC 12 between the Hatteras Ferry Terminal and US 158 near Nags Head also has been designated as a Strategic Highway Corridor (SHC) by the North Carolina Board of Transportation. The purpose of the SHC initiative is to provide a network of high-speed, safe, reliable highways throughout North Carolina for the efficient movement of people and goods. These corridors are critical to statewide mobility and connectivity and promote a vision of modern transportation, supportive of economic opportunities, and environmental excellence. The initiative offers NCDOT and its stakeholders an opportunity to consider long-term vision when making land use decisions and design and operational decisions on the highway system. The creation of a long-term vision identifies the ultimate desired facility type (freeway, expressway, boulevard, or thoroughfare) for each corridor. The section of NC 12 between the Hatteras Ferry Terminal and US 158 is envisioned to remain as a thoroughfare (the functional purpose of a thoroughfare is to provide a moderate to low level of mobility, with a higher level of access). NC 12 is part of Corridor 55, which connects the Hatteras, Kitty Hawk/Kill Devil Hills/Nags Head area with the Hampton Roads, Virginia, area (a length of approximately 120 miles [193 kilometers]) using portions of NC 12, US 158, and NC 168.

The NCDOT's right-of-way for the portion of NC 12 through the Cape Hatteras National Seashore (on Bodie Island) is on a right-of-way that the State of North Carolina retained title to and control of in 1952, when the State deeded land it had acquired for creation of the Seashore to the US Department of the Interior (i.e., the NPS). The NCDOT's right-of-way for NC 12 through the Pea Island National Wildlife Refuge (on Hatteras Island) is on a permanent easement granted to the State of North Carolina in 1954 by the US Department of the Interior (i.e., the USFWS) for the purpose of "construction, operation, and maintenance of a public road across the Pea Island National Wildlife Refuge." This easement is granted to the State of North Carolina "so long as it shall continue to use the same for highway right-of-way purposes." Within the project area, NC 12 is two lanes with unpaved shoulders. The NCDOT easement or right-of-way for NC 12 in the project area is 100 feet (30.5 meters) wide, except for approximately 600 feet (182.9 meters) in Rodanthe where the right-of-way is 60 to 68 feet (18.3 to 20.7 meters) wide.

Bonner Bridge is 12,864 feet (3,921 meters) long (or 2.44 miles [3.92 kilometers]), with a navigation span providing 65 feet (19.8 meters) of vertical clearance above mean high tide and 130 feet (39.6 meters) horizontal clearance between fenders. An adjacent span with 90 feet (27.4 meters) of horizontal clearance often also is used for navigation as the result of natural channel movement. A 17-foot (5.2-meter) under-clearance at mean sea level is typical for the north and south approaches. The roadway has a 28-foot (8.5-meter) clear roadway with two 12-foot (3.7-meter) lanes and two feet (0.6 meter) of lateral clearance on each side. The total outside width of the bridge is 33.3 feet (10.1 meters), including the 2.6-foot-wide (0.8-meter-wide) bridge rails on both sides of the bridge. In addition, the Bonner Bridge has 5.3-foot-wide (1.6-meter-wide) fishing catwalks attached to the outside of the bridge on both sides near the shoreline, but the catwalks do not extend completely across Oregon Inlet.

The bridge was constructed on a curved alignment that extends across Oregon Inlet 4,000 feet (1,219 meters) inland of the Atlantic Ocean front. The alignment is shown in Figure 1-1. This curved alignment was selected in the early 1960s under the assumption that it would protect the structure from the ocean during storms, and because calmer waters facilitated construction. This alignment also allowed large vessels that could not clear the navigational span to find shelter inside Oregon Inlet during storms. The location of the navigation span was selected in anticipation of a jetty stabilization project for the Oregon Inlet, which was to follow the bridge construction by five to ten years. The jetty project was never built. As indicated in Section 1.1, Bonner Bridge is nearing the end of its service life.

The posted speed limit on NC 12, including Bonner Bridge, is 55 miles per hour (mph) (88 kilometers per hour [kph]), and passing is permitted where sight distances allow.

1.5.3 Sidewalks and Pedestrian Movements

There are no sidewalks in the project area. Visitors to the Cape Hatteras National Seashore (Seashore) and the Pea Island National Wildlife Refuge (Refuge) frequently stop on the side of the road to walk over the sand dunes east of NC 12 to reach the Atlantic Ocean. Wildlife trails used by Refuge visitors are located west of NC 12 near the Refuge Visitor Center and at the Refuge's southern border. These trails do not cross NC 12. Pedestrians cross NC 12 at Rodanthe to get from vacation homes to the beach, historic sites, and commercial recreation facilities and other commercial uses. There are no marked crosswalks in Rodanthe.

1.5.4 Bicycles

Two designated bicycle routes cross Oregon Inlet on Bonner Bridge. A national bicycle touring organization, Bikecentennial, distributes maps and leads tours on the first route, which is a multi-state route from Virginia to Florida. This route, called the North-South Atlantic Coast Bikeway, passes through North Carolina on NC 12 along the Outer Banks, including Bonner Bridge. The route extends along the East Coast from Maine to Florida and includes most portions of the Wright Brothers Bikeway, currently running from Corolla in Currituck County at its north end, through Dare County, and on to Ocracoke in Hyde County at its south end.

The NCDOT Bicycle and Pedestrian Division has designated a second route along this portion of NC 12 as part of a loop around the Pamlico Sound. Maps of this route are distributed by the Bicycle Program as part of a brochure entitled, "Around Pamlico Sound: Bicycling North Carolina's Outer Banks Region."

1.5.5 Intersections and Access Control

There is no access control on NC 12 in the project area. Project area intersections on NC 12 include:

- The driveway to the Oregon Inlet Marina and Fishing Center and an access road to a Seashore campground at the northern end of the project area on Bodie Island;

- The driveway to the Hatteras Island parking lot that serves persons who fish off the Bonner Bridge catwalks;

- Old NC 12 (SR 1257), which is the road that leads to the (former) US Coast Guard Station at the north end of Hatteras Island;
- Periodic parking lots for visitors to the Refuge and the Seashore, including the driveway to the Refuge Visitor Center; and
- Local streets within Rodanthe that serve residential developments and the NCDOT's emergency ferry dock.

There are no signalized intersections in the project area.

1.5.6 Traffic Volumes

1.5.6.1 Existing Trends (2002)

Existing traffic data for NC 12 are available from an automatic traffic counter station (# A2701) at the north end of the Bonner Bridge. Traffic volumes collected in 2002 at count station A2701 are summarized in Table 1-1.

Table 1-1. 2002 Traffic Volumes on NC 12 at Bonner Bridge

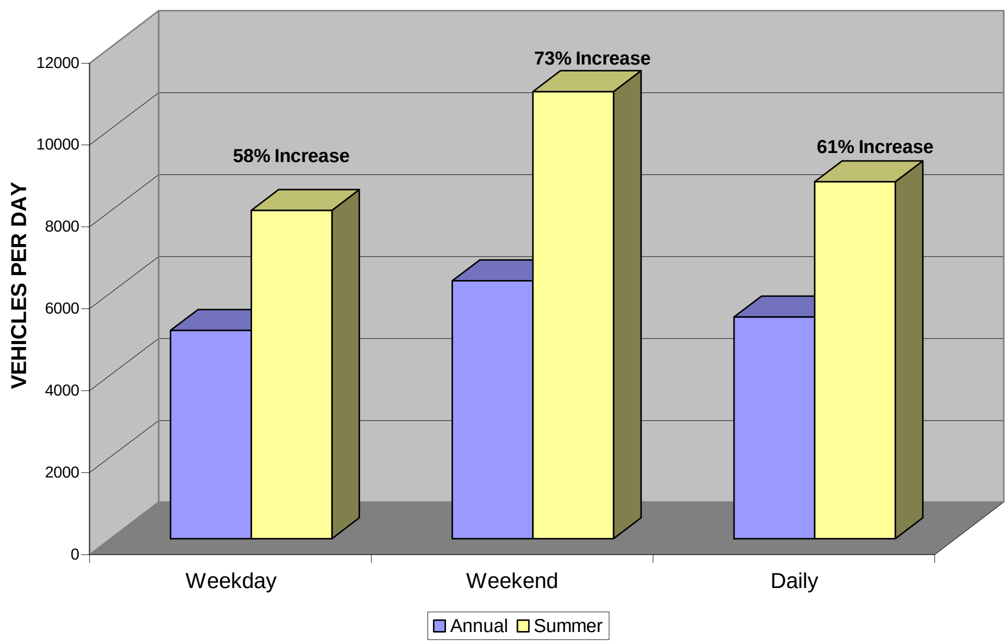
Time Period	Northbound (vpd)	Southbound (vpd)	Total (vpd)
Annual Average Daily Traffic (AADT)	2,700 (50.0% of total)	2,700 (50.0% of total)	5,400
Annual Average Weekday Traffic	2,500 (49.0%)	2,600 (51.0%)	5,100
Annual Average Weekend Traffic	3,300 (52.4%)	3,000 (47.6%)	6,300
Summer Average Daily Traffic	4,400 (50.0%)	4,400 (50.0%)	8,800
Summer Average Weekday Traffic	3,900 (48.8%)	4,100 (51.2%)	8,000
Summer Average Weekend Traffic	5,700 (52.3%)	5,200 (47.7%)	10,900
Summer Average Saturday Traffic	6,400 (50.4%)	6,300 (49.6%)	12,700
Peak Day Traffic	7,900 (55.6%)	6,300 (44.4%)	14,200

Notes:
- Summer data are based on traffic counts for the months of July and August in 2002.
- The peak day was Saturday, July 6, 2002.

NC 12 carried an AADT of 5,400 vehicles per day (vpd) in 2002. As noted in the table, there is a clear distinction between weekend and weekday traffic throughout the year. Weekend traffic is 16 percent higher than the AADT figure, with 52.4 percent traveling northbound, reflecting returning tourist traffic traveling to the north. During weekdays, the traffic volume is six percent lower than the AADT figure with a similar pattern of heavier southbound movement or inbound trips.

Table 1-1 also shows the daily traffic volume pattern along NC 12 during the summer months (July and August). As depicted in Figure 1-2, traffic volumes during the summer months are higher than average annual conditions, reflecting a strong seasonal variation in traffic patterns. In 2002, the daily weekend traffic along NC 12 was 73 percent greater than the annual traffic, with volume averaging 10,900 vehicles during summer weekend. For average daily traffic, there are 3,300 additional vehicles (61 percent) on the roadway during the summer season compared to the annual estimate.

Figure 1-2. Comparing Annual and Summer Traffic at Bonner Bridge



The highest daily traffic volume on NC 12 at Bonner Bridge was 14,270 vehicles; this was observed on Saturday, July 6, 2002.

In addition to high seasonal variation, NC 12 experiences daily traffic variation. This daily variation is depicted in Figure 1-3 for AADT and in Figure 1-4 for the summer peak season. The maximum daily volume spread is 2,340 vehicles, or 49 percent. During the summer peak season, the maximum daily volume spread is 5,500 vehicles, or 77 percent.

Figure 1-3. Annual Average Daily Traffic by Day of the Week at Bonner Bridge

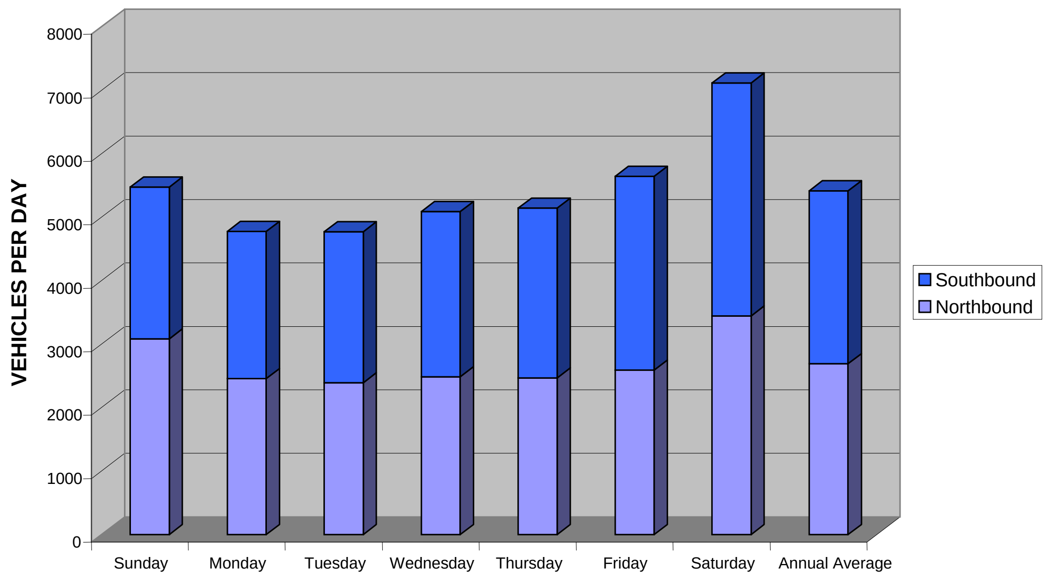
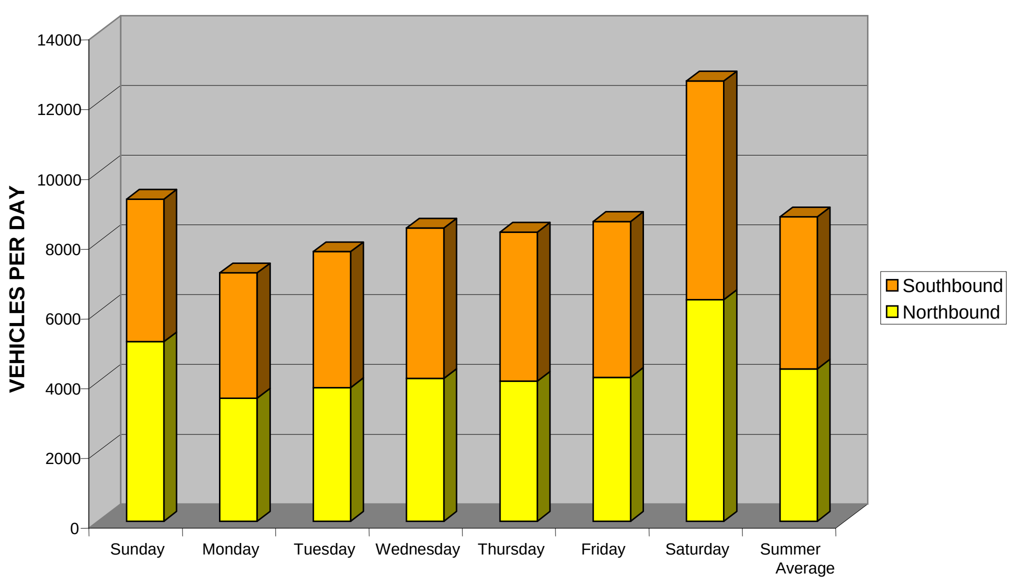


Figure 1-4. Peak Summer Daily Traffic by Day of the Week at Bonner Bridge



1.5.6.2 Future Volumes (2025)

Projected 2025 traffic volumes are presented in Table 1-2. Future traffic projections were estimated for year 2025 using the uniform growth rate approach. The traffic growth rate was estimated to be 2.5 percent per year. This is consistent with the traffic forecast performed for the 1993 DEIS, as well as NCDOT forecasts for other nearby projects, area population projections, historic traffic growth, area visitor forecasts, and the development potential of available parcels on Hatteras Island.

Table 1-2. 2025 Traffic Volumes on NC 12 at Bonner Bridge

Time Period	Northbound (vpd)	Southbound (vpd)	Total (vpd)
Annual Average Daily Traffic (AADT)	4,800	4,800	9,600
Annual Average Weekday Traffic	4,400	4,600	9,000
Annual Average Weekend Traffic	5,800	5,400	11,200
Summer Average Daily Traffic	7,700	7,700	15,400
Summer Average Weekday Traffic	6,900	7,300	14,200
Summer Average Weekend Traffic	10,100	9,100	19,200
Summer Average Saturday Traffic	11,200	11,100	22,000
Peak Day Traffic	14,000	11,200	25,200

1.5.7 Levels of Service

Existing and future levels of service (LOS) along NC 12 were estimated based on the two-way, two-lane methodology described in the *Highway Capacity Manual* (HCM) (Transportation Research Board, 2000).

LOS is a qualitative measure that characterizes the operational conditions within a traffic stream and represents the perception of traffic service by motorists and passengers. The different levels of service characterize these conditions in terms of such factors as vehicle speed, travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. Six levels, represented by the letters A through F, are used to measure level of service. For roadways, LOS A indicates no congestion and LOS F represents more traffic demand than available road capacity and extreme delays.

Table 1-3 provides a general description of various levels of service for roadways as given in the HCM, as well as descriptions for unsignalized two-way stop intersections. Specific level of service definitions vary for two-lane highways, multi-lane highways, and intersections. In addition, the level of service for signalized and unsignalized intersections cannot be compared directly. In general, a poor level of service rating still can be considered acceptable for an unsignalized intersection. This is because the unsignalized intersection analysis is based upon the delay for minor street drivers as they await sufficient gaps in major street traffic. The signalized intersection analysis provides an overall average delay and level of service for the entire intersection.

Traffic operations on two-lane, two-way roadways are subjected to lane changing and passing in the opposing lane. As a result, the HCM approach uses a passing capacity that is dependent on the peak-hour traffic volume in both directions of travel. Consequently, LOS for a two-lane roadway is defined based on two primary measures. These are:

- Average travel speed; and
- Average percentage of travel time that vehicles must travel in platoons (groups of vehicles) behind slower vehicles because of the inability to pass those slow vehicles (percent time-spent-following).

Table 1-3. Level of Service Criteria

Level of Service	Traffic Flow on Roadways	Delay at Two-Way Stop Intersection
A	Free flowing traffic with little or no delays.	<=5 sec
B	A stable flow with few congestion-related restrictions on operating speed.	5-10 sec
C	Stable flow but with more restrictions on speed and changing lanes.	10-20 sec
D	Approaches unstable conditions and passing becomes extremely difficult. Motorists are delayed an average of 75 percent of the time.	20-30 sec
E	The capacity of a roadway. Passing is virtually impossible, speeds drop when slow vehicles or other interruptions are encountered.	30-45 sec
F	Heavily congested flow with traffic demand exceeding the capacity of the highway.	>45 sec

A traffic capacity analysis was performed for two roadway types and locations encountered within the project area. One location was within the Pea Island National Wildlife Refuge south of the bridge, and the other was on the Bonner Bridge structure. Although the traffic volumes are nearly identical for the two locations, it is necessary to analyze both cases separately because of their unique operational characteristics and geometric differences. These differences include shoulder widths, percent no passing zones, and access points per mile, which affect average travel speed and percent time-spent-following. Table 1-4 details these differences, as well as other key inputs assumed for the capacity analysis.

Table 1-4. Highway Capacity Analysis Variable Comparison

Analysis Variable	Mainland	Bonner Bridge
Shoulder Width	8 feet (2.4-meters)	2 feet (0.6-meters)
Lane Width	12 feet (3.7-meters)	12 feet (3.7-meters)
Highway Class	II	II
Directional Split	60%	60%
Peak Hour Factor	0.88	0.88
Truck Percentage	6%	6%
% No Passing Zone	20%	50%
Access Points Per Mile	2	0

Table 1-5 shows a summary of existing and future LOS for Bonner Bridge during five time periods:

1. Average Weekday;

2. Average Weekend;

3. Peak Season Weekday;

4. Peak Season Weekend; and

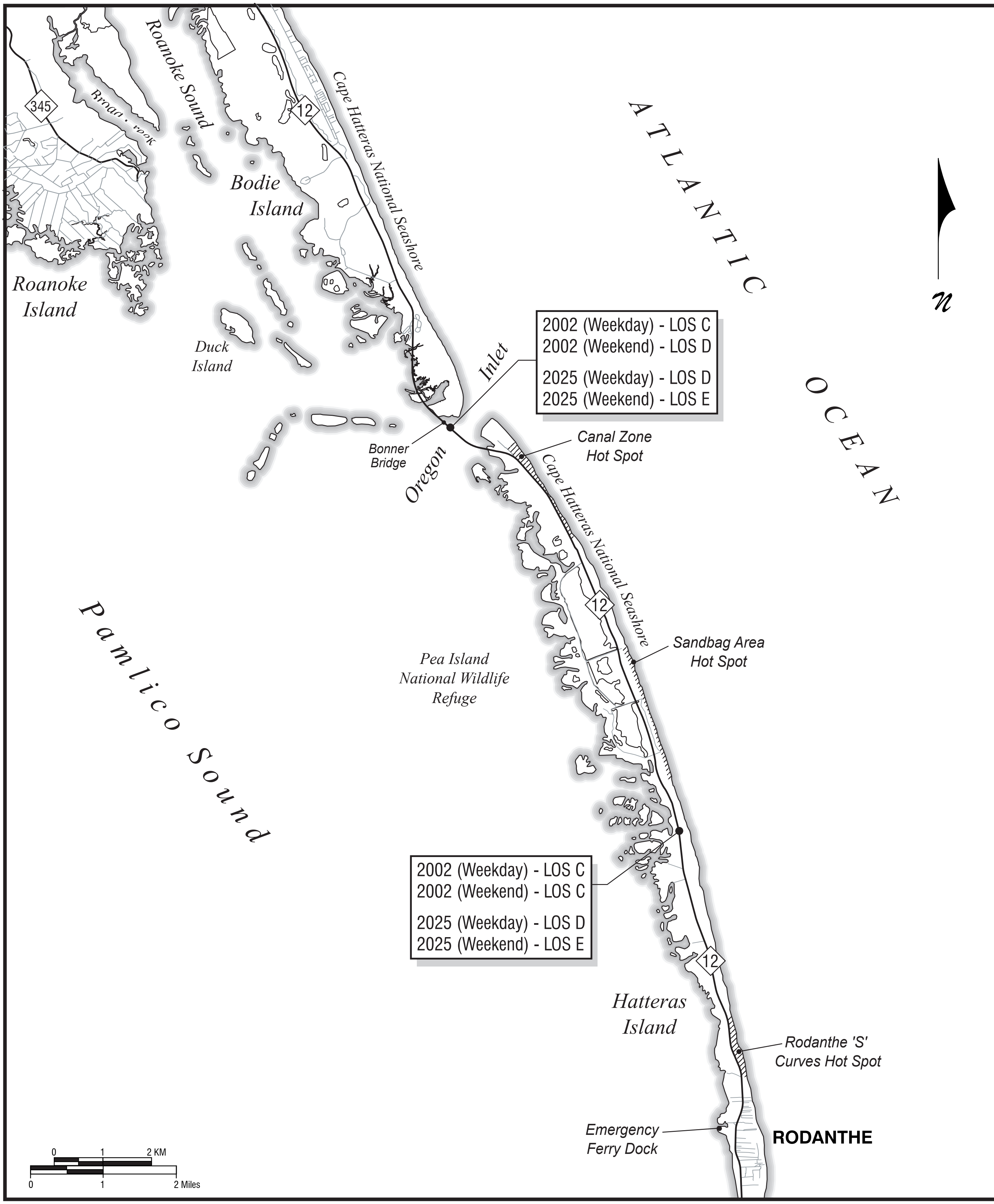
5. Peak Season Saturday.

Table 1-5. Level of Service (LOS) on Bonner Bridge

Time Period	Peak Hour Traffic Volume (vehicles per hour [vph])	Average Travel Speed (mph)	Percent Time-Spent-Following	LOS
EXISTING (2002)				
Average Weekday	450	50.3	54.9%	B
Average Weekend	600	49.6	60.0%	C
Peak Season Weekday	690	49.1	61.9%	C
Peak Season Weekend	1,030	46.8	72.6%	D
Peak Season Saturday	1,180	45.8	76.0%	D
FUTURE (2025)				
Average Weekday	790	48.4	65.4%	C
Average Weekend	1,060	46.6	73.4%	D
Peak Season Weekday	1,210	45.6	76.7%	D
Peak Season Weekend	1,810	40.6	86.9%	E
Peak Season Saturday	2,080	38.2	89.9%	E

Similarly, Figure 1-5 and Table 1-6 show the existing and future LOS for the NC 12 roadway segment immediately south of Bonner Bridge.

Table 1-5 shows that Bonner Bridge operates at an unstable flow condition (LOS D) during peak summer weekend because motorists are delayed in platoons for nearly 73 percent of their travel time, as passing becomes extremely difficult. This peak summer weekend condition is projected to worsen to LOS E by 2025, when passing would be virtually impossible and platooning would increase. By 2025, the Bonner Bridge is also projected to operate at LOS D, with an extremely difficult passing environment during a peak summer weekday or an average weekend.



PEAK SEASON LEVEL OF SERVICE

Figure 1-5

Table 1-6. Level of Service (LOS) on NC 12 South of Bonner Bridge

Time Period	Peak Hour Traffic Volume (vph)	Average Travel Speed (mph)	Percent Time-Spent-Following	LOS
EXISTING (2002)				
Average Weekday	450	53.6	49.0%	B
Average Weekend	600	52.6	55.1%	C
Peak Season Weekday	690	52.0	57.8%	C
Peak Season Weekend	1030	49.5	69.5%	C
Peak Season Saturday	1180	48.4	73.3%	D
FUTURE (2025)				
Average Weekday	790	51.2	61.6%	C
Average Weekend	1060	49.3	70.3%	D
Peak Season Weekday	1210	48.1	74.1%	D
Peak Season Weekend	1810	42.9	85.8%	E
Peak Season Saturday	2080	40.5	89.0%	E

Table 1-6 shows that NC 12 south of the Bonner Bridge is projected to operate at similar LOS conditions by 2025, but with slightly less platooning and a higher travel speed than on Bonner Bridge.

1.5.8 Hurricane Evacuation

The residents and visitors of Hatteras Island and Ocracoke Island, two hurricane-prone coastal communities in North Carolina, travel on NC 12 and across Bonner Bridge when evacuating the area during a storm warning. Consequently, the Bonner Bridge serves an important function in emergency evacuation and helps maintain the clearance time (i.e., time to evacuate all participating population during a hurricane storm).

The evacuation clearance time depends on the following key emergency planning variables:

- Type of hurricane storm (Categories 1 – 5, see Table 1-7);
- Tourist Season (peak season with high occupancy vs. off-peak season with low occupancy);
- Location and number of people living in permanent occupied units, mobile home units and seasonal tourist units;
- Rates of participation in the evacuation;

Table 1-7. Hurricane Categories[1]

Storm Type	Wind Speed	Damage Potential
Category 1 (Weak)	74 – 95 mph (118 – 153 kph)	Minimal damage to vegetation
Category 2 (Moderate)	96 – 110 mph (154 – 177 kph)	Moderate damage to houses
Category 3 (Strong)	111 – 130 mph (178 – 209 kph)	Extensive damage to small buildings
Category 4 (Very strong)	131 – 155 mph (210 – 247 kph)	Extreme structural damage
Category 5 (Devastating)	> 155 mph (> 248 kph)	Catastrophic building failures possible

[1] Hurricanes are rated in intensity on the Saffir-Simpson Hurricane Scale based on wind speed, pressure, storm surge, and damage potential. This list from the Federal Emergency Management Agency provides a basic description.

- Origin and destination of the evacuation trip;
- Use of vehicles; and
- Service capacity of the critical roadway links along major evacuation routes.

The above emergency planning variables were used to develop a Hurricane Evacuation Model for the USACE's Wilmington District in 2001. The model automated the steps involved in calculating clearance times for different storm types during the peak and off-peak tourist seasons. The Hurricane Evacuation Model uses demographic data from the 2000 Census, which can be updated to a future year. The 2001 evacuation model estimated that for a Category 3-5 hurricane during a period of tourist high occupancy in 2000, 9,530 vehicles could be expected to evacuate via NC 12 on Hatteras Island.

Year 2025 modeling results for the Hatteras and Ocracoke islands are presented in Table 1-8 for Categories 1 – 2 and Categories 3 – 5 hurricanes. The table shows that there would be approximately 14,761 evacuating vehicles on the Bonner Bridge in response to a Category 3 – 5 storm during the peak tourist season in 2025, an indicator of the continued importance of Bonner Bridge to hurricane evacuation.

A 2005 hurricane evacuation study prepared for NCDOT (PBS&J, 2005) modeled 2004 and 2030 evacuation response times (time to move all evacuees through the road network) for North Carolina coastal areas. Data are not presented in the report for Hatteras Island alone but instead by major route off the Outer Banks. The number of evacuating vehicles, and the clearance time in hours, for 2004 and 2030 on the two routes off the Outer Banks are presented in Table 1-9. Both the number of vehicles evacuating and clearance times are expected to rise from 2004 to 2030.

Table 1-8. Year 2025 Hurricane Evacuation Analysis by Zones

Evacuation Zone	Evacuating People		Evacuating Vehicles	
	Off-Peak Tourist Season	Peak Tourist Season	Off-Peak Tourist Season	Peak Tourist Season
CATEGORY 1–2 HURRICANE				
Hatteras Island	17,152	38,165	5,679	12,246
Ocracoke Island	1,979	4,832	724	1,723
Total	**19,131**	**42,997**	**6,403**	**13,969**
CATEGORY 3–5 HURRICANE				
Hatteras Island	19,249	40,262	6,471	13,038
Ocracoke Island	1,979	4,832	724	1,723
Total	**21,228**	**45,094**	**7,195**	**14,761**

Source: USACE.

Table 1-9. 2004 and 2030 Evacuating Vehicles and Clearance Time

Route Off Outer Banks	Evacuating Vehicles in 2004 by Tourist Occupancy Level		Evacuating Vehicles in 2030 by Tourist Occupancy Level		Clearance Time in 2004 by Tourist Occupancy Level		Clearance Time in 2030 by Tourist Occupancy Level	
	Low	High	Low	High	35%	75%	35%	75%
US 158 from Wright Memorial Bridge								
Category 1--2 Hurricane	15,042	33,912	23,724	53,527	14.2	23.5	20.6	35.2
Category 3-5 Hurricane	18,002	36,875	28,378	58,183	16.5	25.8	24.4	39.0
US 64 from Mann's Harbor								
Category 1-2 Hurricane	8,515	17,085	13,457	29,286	9.7	15.7	14.1	23.6
Category 3--5 Hurricane	13,581-18,042	22,546-27,007	16,560	32,389	11.5	17.5	16.9	26.4

Source: PBS&J, 2005.

1.6 Modal Interrelationships

1.6.1 Railroads

Railroad service is not available in Dare County.

1.6.2 Airports

Dare County Regional Airport is a publicly owned, general aviation airport in Manteo on Roanoke Island, outside the project area. The airport is capable of serving most regional jets.

There are three publicly owned airstrips for private aircraft on the Outer Banks, but not within the project area. One is further north in Kill Devil Hills. The other two are further south on Hatteras and Ocracoke islands. Each airstrip is owned and managed by the NPS and operates during daylight hours only.

No commercial passenger or freight air service is available in the project area.

1.6.3 Transit

There is no local or regional bus service provided in the project area. Taxi service is available. Para-transit services are provided by Dare County to serve elderly and handicapped persons.

1.6.4 Water Travel (Ferry)

Six vessels operate at no charge to users between the southern end of Hatteras Island and Ocracoke Island across Hatteras Inlet. In 2000, more than 25,800 ferry trips carrying 989,435 travelers were made between the two islands. On Ocracoke Island, a tolled ferry service is provided south to Cedar Island and north to Swan Quarter on the Hyde County mainland. Ferry schedules are designed to accommodate expected vehicular demand, which is highest in the summer months. Emergency ferry landings are located at Rodanthe on Hatteras Island and at Stumpy Point on the mainland. These would be used by ferries if access to Hatteras Island via the Bonner Bridge were to be disrupted.

1.7 Summary

The North Carolina Department of Transportation’s *2009 to 2015 TIP* includes the replacement of the Herbert C. Bonner Bridge (Bridge No. 11) over the Oregon Inlet in Dare County (TIP Project No. B-2500). The need for a crossing of the Oregon Inlet will continue past the end of the service life of the Bonner Bridge. Continued demand for convenient daily and emergency access across Oregon Inlet is expected. The natural channel, or gorge, through the Oregon Inlet migrates, and any replacement bridge needs to provide spans of sufficient height and width for navigation through the anticipated area of future natural channel migration, helping to reduce future dredging needs, dredging impacts, and the cost of dredging. The southern terminus of the Bonner Bridge is located north of parts of NC 12 that are frequently threatened by shoreline erosion and overwash. Placing the southern terminus of a replacement bridge at Rodanthe or implementing a long-term NC 12 maintenance project between Rodanthe and Oregon Inlet will eliminate regular maintenance of NC 12 in this part of Hatteras Island.

Chapter 2

Alternatives Considered

2.0 Alternatives Considered

Chapter 2 describes the No-Action Alternative, as well as the two Bonner Bridge replacement corridors evaluated in detail in Chapter 4 of this document. It also describes other alternatives considered, but not retained, for detailed evaluation. It explains why these other alternatives were dropped from consideration as reasonable bridge replacement options. This chapter has the following discussions, beginning in chronological order with the detailed study alternatives development process:

- The No-Action Alternative is discussed beginning on page 2-4.

- 1993 Draft Environmental Impact Statement (DEIS) Alternatives

  The alternatives examined in the November 1993 Draft for the replacement of Bonner Bridge, including the preferred replacement bridge corridor selected for implementation after public hearings in February 1994, are discussed beginning on page 2-5 and shown in that section in Figure 2-1. Alternatives assessed were:

  – Transportation Systems Management (TSM);

  – Rehabilitate Existing Bridge;

  – Ferry;

  – Tunnel;

  – East Bridge Corridor;

  – West Bridge Corridor; and

  – Original Parallel Bridge Corridor (preferred alternative in the 1993 DEIS).

- 2002 Pamlico Sound Bridge Corridor Alternatives

  Additional replacement bridge corridor alternatives studied in 2002 because of changed conditions in the project area and changed regulatory requirements are discussed beginning on page 2-34 and shown in that section in Figure 2-3. Alternatives assessed were:

  – Alternative 1a;

  – Alternative 1b (wide);

  – Alternative 1b (close);

  – Alternative 1c;

  – Alternative 2 (wide);

  – Alternative 2 (close);

– Alternative 3 (wide);

– Alternative 3 (close); and

– Alternative 4 (selected for alignment alternatives study in 2003).

- 2003 Pamlico Sound Bridge Corridor Alternatives

  Bridge alignment alternatives studied in 2003 following the identification of the Pamlico Sound Bridge Corridor as a corridor to evaluate in detail in this Final Environmental Impact Statement (FEIS) are discussed beginning on page 2-42 and shown in that section in Figure 2-4 . Two of the alternatives selected for detailed assessment in Chapter 4 were identified as a part of this study. Alternatives assessed were:

  – Alignment A **(selected for detailed study as the Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus Alternative)**;

  – Alignment B;

  – Alignment C **(selected for detailed study as the Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus Alternative)**;

  – Alignment D;

  – Alignment E; and

  – Alignment F.

- 2004 Additional Replacement Bridge Scenarios

  At the request of the Dare County Commissioners, additional replacement bridge (including long-span bridges) scenarios were evaluated in 2004 and are discussed beginning on page 2-54 and their location is shown in that section in Figure 2-7. Alternatives assessed were:

  – Multiple Cable-Stayed;

  – Single Span Cable-Stayed;

  – Suspension; and

  – Multiple Arch Bridges.

- 2005 Parallel Bridge Corridor with NC 12 Maintenance Alternatives

  Parallel Bridge Corridor with NC 12 Maintenance Alternatives studied in 2005 following the decision to add this corridor to the alternatives evaluated in detail in this FEIS are discussed beginning on page 2-58 and shown in that section in Figure 2-9a and Figure 2-9b. Three of the alternatives selected for detailed assessment in Chapter 4 were identified as a part of this study. Alternatives assessed were:

  – Nourishment **(selected as the Parallel Bridge Corridor with Nourishment Alternative for detailed study)**;

- Nourishment North/Bridge South;
- Relocate Road North (West of 2060 Shoreline)/Bridge South **(selected for detailed study as the Parallel Bridge Corridor with Road North/Bridge South Alternative)**;
- Relocate Road North (West of Ponds)/Bridge South;
- Relocate Road North (West of 2060 Shoreline)/Interim Road then Bridge South; and
- All Bridge **(selected for detailed study as the Parallel Bridge Corridor with All Bridge Alternative)**.

- 2006 Additional Parallel Bridge Corridor with NC 12 Maintenance Alternatives

  Additional Parallel Bridge Corridor with NC 12 Maintenance Alternatives studied in 2006, which added two more NC 12 Maintenance alternatives to the three selected in 2005 for detailed evaluation in Chapter 4 of this FEIS are discussed beginning on page 2-77 and are shown in Figure 2-21.

  - Phased Approach/Rodanthe Bridge **(selected for detailed study)**; and
  - Phased Approach/Rodanthe Nourishment **(selected for detailed study)**.

- 2006 Long Bridge Operations and Safety Study

  A Long Bridge Operations and Safety Study was conducted in 2006 to address questions about the safe operation of long bridges, which were raised at the November 2005 public hearing and during the review of the Supplemental Draft Environmental Impact Statement (SDEIS). These concerns dealt specifically with the proposed Pamlico Sound Bridge Corridor Alternative that includes a 17.5-mile bridge crossing of the Sound, beginning on page 2-78.

Following the descriptions of the detailed study alternatives development process, Chapter 2 concludes with descriptions of the detailed study alternatives presented in the following discussions:

- Pamlico Sound Bridge Corridor Detailed Study Alternatives

  Descriptions of the Pamlico Sound Bridge Corridor alternatives, as evaluated in detail in Chapter 4 of this FEIS are discussed beginning on page 2-81.

- Parallel Bridge Corridor with NC 12 Maintenance Detailed Study Alternatives

  A description of the Parallel Bridge Corridor with NC 12 Maintenance alternatives, as evaluated in detail in Chapter 4 of this FEIS, are discussed beginning on page 2-93.

- Demolition and Removal of Bonner Bridge

  The process for the demolition and removal of the existing Bonner Bridge is discussed beginning on page 2-130.

- Costs and Funding

  Cost estimates and funding sources for both the Pamlico Sound Bridge Corridor and Parallel Bridge Corridor alternatives (including the Preferred Alternative) are discussed beginning on page 2-132.

- Environmental Protection During Construction and Demolition

  General environmental protection strategies that would be used during both project construction and Bonner Bridge demolition are discussed beginning on page 2-144.

- Permits and Approvals

  The permits and approvals needed for the replacement bridge from various regulatory agencies are described beginning on page 2-146.

Finally, the identification and rationale for selection of the Preferred Alternative is discussed beginning on page 2-148.

2.1 No-Action Alternative

The No-Action Alternative assumes that Bonner Bridge would be demolished at the end of its practical service life and not replaced. A small-scale ferry service adequate to meet the fundamental travel needs of Hatteras Island residents would be provided across Oregon Inlet. Access to the mainland also would remain via existing ferry routes from the mainland (i.e., Cedar Island and Swan Quarter) to Ocracoke Island and then the existing ferry route from Ocracoke Island to Hatteras Island. The inclusion of a small-scale ferry service in the No-Action Alternative acknowledges that Bonner Bridge cannot remain in place indefinitely because it is at the end of its practical service life. North Carolina Department of Transportation (NCDOT) is obligated to provide transportation access of some sort to all properties in the state.

The current ferry service between Hatteras Island and the mainland via Ocracoke Island offers space for approximately 400 to 450 automobile crossings per day during the summer. The ferry across the Hatteras Inlet from Hatteras Island to Ocracoke Island carries as many as 3,500 vehicles per day in the summer. The sailing time for these services is three hours and five minutes from Hatteras Island to the mainland via either ferry route, not including time to change ferries on Ocracoke Island. (Personal communication, October 10, 2003, Jesse Vinson, NCDOT Ferry Division.)

Specifics related to a new small-scale ferry service from Bodie Island to Hatteras Island would have been developed if following public review of the SDEIS and the Supplement to the Supplemental Draft Environmental Impact Statement (SSDEIS), this alternative had been selected as the Preferred Alternative. The environmental impact assessment process requires that the No-Action Alternative be presented for review.

The level of service of the small-scale ferry service implemented under a No-Action Alternative likely would be similar to the service between Hatteras Island and the mainland via Ocracoke Island described above. The emergency ferry service across Oregon Inlet—provided from November 1990 to February 1991 after Bonner Bridge was damaged by a dredge and temporarily closed—had a maximum transport capacity of approximately 6,000 vehicles per week or 900 vehicles per day. The sailing time for that service was 80 minutes, including loading and unloading.

Nine hundred vehicles per day is far less than both the existing demand and the expected 2025 demand presented in Table 1-2, which shows an average annual daily traffic of 9,600 vehicles per day and peak traffic of 25,200 vehicles per day in 2025. The No-Action Alternative would not meet the project's purpose and need as presented in Chapter 1.

2.2 1993 Draft Environmental Impact Statement Alternatives

The alternatives considered in the November 1993 DEIS, as well as the Preferred Alternative selected after the February 23 and 24, 1994 public hearings were developed based on a feasibility study that was completed in 1991 to examine possible Bonner Bridge replacement alternatives. The study's findings are documented in *Feasibility Study for the Replacement of the Herbert C. Bonner Bridge on NC 12 over Oregon Inlet* (NCDOT, April 1991). The range of alternatives examined in the study was based upon agency input in response to:

- A May 1990 feasibility study scoping letter;
- Public input from a July 19, 1990, Citizens Informational Workshop; and
- Engineering, environmental, and coastal studies documented in the 1991 feasibility study report.

The alternatives and preliminary feasibility study findings were presented for public review at Citizens Informational Workshops on February 19 and 20, 1991. Selection of the Preferred Alternative presented in the 1993 DEIS was based on:

- Workshop comments;
- Feasibility study findings;
- Agency responses to the May 1991 distribution of a scoping letter and copies of the feasibility study report; and
- Input from a May 29, 1991, scoping meeting held for local, state, and federal environmental resource and regulatory agencies.

Refinements were made to the 1993 DEIS Preferred Alternative based on agency responses to the November 1993 distribution of the DEIS, public hearings held in February 1994, and a bridge type study completed in 1995. Because beach erosion increased problems with ocean overwash along NC 12 south of Bonner Bridge, the Preferred Alternative evaluated in the 1993 DEIS (i.e., the Parallel Bridge Corridor without a NC 12 maintenance component) is no longer considered a viable replacement alternative for Bonner Bridge. The description of 1991 to 1993 findings contained in this section is presented to inform the reader of past study results. Study results are updated, as appropriate, to account for current alternative selection criteria.

2.2.1 Basic Assumptions Used in 1991 and 1993

The alternatives considered in the 1991 feasibility study report and the 1993 DEIS were developed based on several basic assumptions regarding:

- The implementation of the then-proposed US Army Corps of Engineers' (USACE) jetty project;
- The future disposition of the terminal groin at the northern end of Hatteras Island;
- Future coastal conditions; and
- Connection of a new crossing to NC 12.

These assumptions are described below.

2.2.1.1 US Army Corps of Engineers' Proposed Jetty Project

The construction of jetties, both to stabilize Oregon Inlet and to partially stabilize the adjacent barrier island shoreline, was being considered when the feasibility study report and DEIS were prepared. Originally, these jetties were to be built shortly after the completion of Bonner Bridge in the 1960s. The jetty project, however, was delayed many times, and it is no longer under consideration.

In light of the uncertainty of the jetty project in 1991 and 1993, all of the alternatives considered at that time assumed that the USACE's proposed jetties would not be built. The alternatives would not have interfered with jetty construction or would not have been incompatible with the changes that jetties would have caused in Oregon Inlet.

2.2.1.2 Future Disposition of the Terminal Groin

It was assumed that the terminal groin at the northern tip of Hatteras Island, which was built by the NCDOT in 1989 and 1990, would remain in place.

2.2.1.3 Coastal Conditions

Hatteras Island and Bodie Island continually change because of natural and manmade events. All of the alternatives examined in 1991 and 1993 assumed that:

- The USACE did not maintain the navigation channel through Oregon Inlet via hopper dredging with offshore dredged sand disposal, but instead either disposed of sand on Hatteras Island beaches via a hydraulic pipeline dredge or maintained natural sand bypassing of Oregon Inlet.
- The terminal groin was not flanked by beach erosion south of the groin, and it would continue to secure the northern tip of Hatteras Island.
- Hatteras Island beaches would continue to erode. This erosion would result in approximately 1.4 miles (2.2 kilometers) of NC 12, at its existing location south of Bonner Bridge, being lost by year 2050. Either NC 12 would be relocated further west as needed to connect to any new bridge terminus on Hatteras Island, or the new bridge terminus would be modified before 2050 to connect to a longer bridge west of Hatteras Island.

2.2.1.4 NC 12 Connection

During the 1991 feasibility study (in which the relocation of NC 12 on or west of Hatteras Island was not a part of the bridge replacement alternatives), it was decided that a replacement crossing of the Oregon Inlet should transition back to the existing NC 12 alignment as quickly as possible at each end of the crossing. This decision was made for the following reasons:

- The decision was compatible with the coastal conditions assumptions described in Section 2.2.1.3.

- A new crossing, connecting to existing NC 12 on Hatteras Island, could be designed such that later it could be connected to a range of potential future NC 12 locations.

- Better decisions related to the disposition of NC 12 near the Bonner Bridge could be made if it were studied as a part of a comprehensive study of NC 12 rather than as a part of the Bonner Bridge replacement study. Such a study was underway in consultation with the USACE, but is currently (2008) unfunded by the US Congress. The Parallel Bridge Corridor with NC 12 Maintenance Alternatives assessed in this FEIS address long-term (through 2060) NC 12 maintenance as far south as the community of Rodanthe.

- Placement of a connection between a new crossing and NC 12 at any other location would result in greater natural resource impacts.

- The need to replace Bonner Bridge was urgent and is even more urgent presently. In 1991, it seemed unreasonable to tie the long-term need of NC 12 with the short-term need of replacing Bonner Bridge.

- The purpose of the project—as included in the NCDOT's *State Transportation Improvement Program* (TIP) at the time—was to replace a structurally deficient bridge.

2.2.2 Summary of Alternatives Analysis Findings

Sections 0 through 2.2.9 describe the alternatives that were developed in 1991 and discussed in the 1993 DEIS, including the then-Preferred Alternative (1993 Parallel Bridge Corridor) as refined after the 1994 public hearings and 1995 bridge type study. The alternatives to the then-Preferred Alternative evaluated during the 1991 feasibility study found to not warrant detailed study in the 1993 DEIS were the: TSM Alternative, Rehabilitate the Existing Bridge Alternative, Ferry Alternative, Tunnel Alternative, East Bridge Corridor, and West Bridge Corridor. Given shoreline erosion trends since 1994, with the exception of the Ferry Alternative, none of these alternatives would eliminate the need to maintain portions of NC 12 that are threatened by shoreline erosion and overwash. In addition, these alternatives were found not to warrant detailed study for the following reasons:

- <u>TSM Alternative</u>. This alternative was not studied in detail in 1993 since the purpose of the proposed project is not to augment an existing system because of over-utilization but to replace a structure nearing the end of its service life.

- <u>Rehabilitate the Existing Bridge Alternative</u>. The problems with Bonner Bridge have proven to be difficult, expensive to resolve, and increasing in degree of severity. The bridge suffers extensive corrosion of reinforcing steel, major spalling of concrete (pieces of concrete breaking away from the surface of a steel reinforced concrete structure), extensive pile scour, insufficient ship impact strength, and has a narrow navigation span zone. It would leave the amount of dredging required to maintain the Oregon Inlet navigation channel unchanged.

- Ferry Alternative. This alternative would decrease the present level of traffic service across Oregon Inlet and increase emergency evacuation time. Lost accessibility would have a substantial impact on the economies of Hatteras Island and Dare County. This alternative also would be one of the most damaging to the natural environment because of the dredging required for navigation. Approximately 59 acres (23.6 hectares) of wetlands would be permanently used by ferry operating facilities on Bodie and Hatteras islands.

- Tunnel Alternative. This alternative would be substantially more expensive than building a new bridge and one of the most damaging to the natural environment. Excavation of Oregon Inlet's bottom would be required during the construction phase, which would remove benthos in a total area of approximately 150 acres (60 hectares). In addition, approximately 33.3 acres (13.3 hectares) of wetlands would be filled.

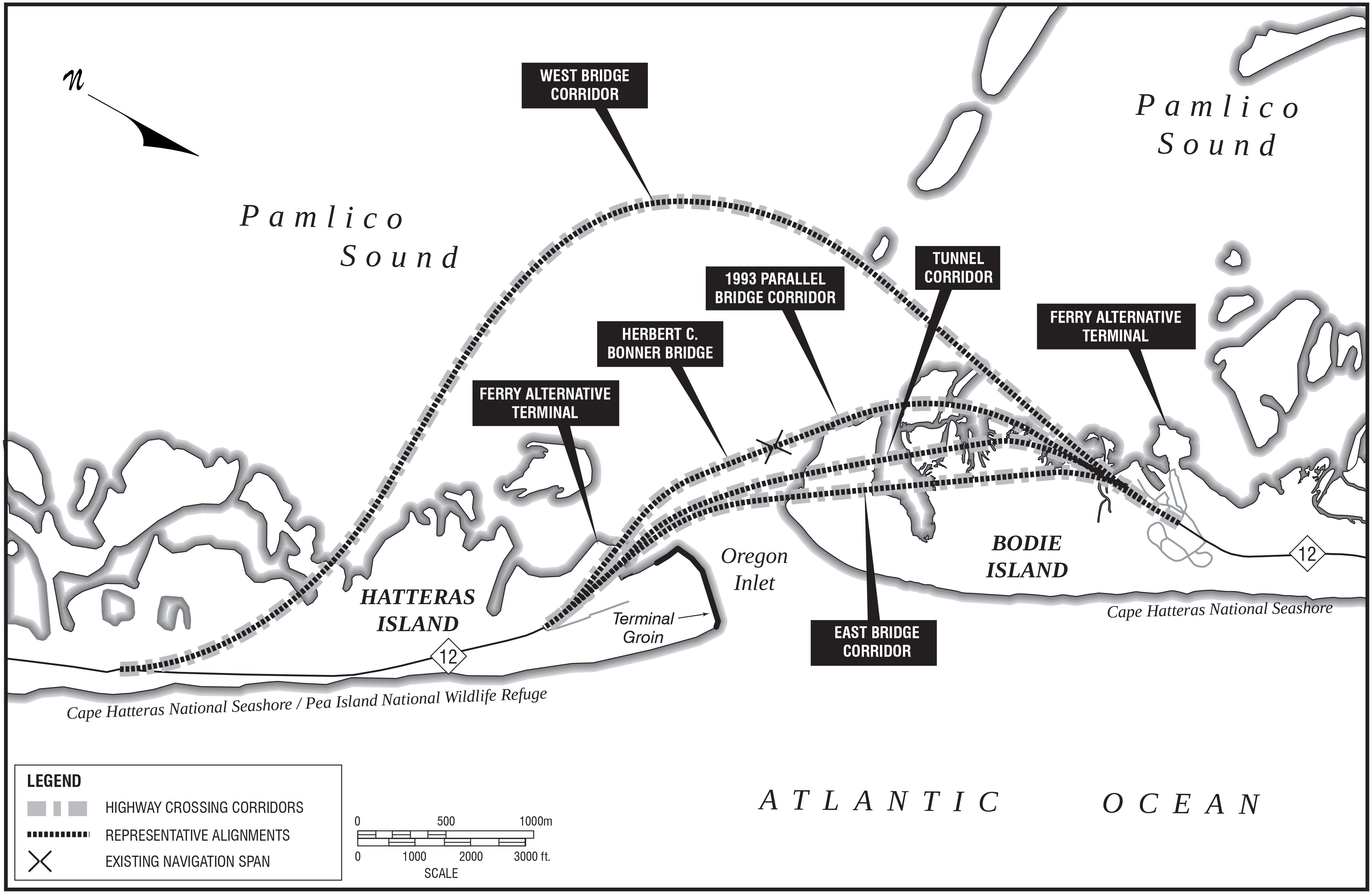
- East Bridge Corridor. This corridor would be shorter than the other bridge corridors. However, it would result in greater impacts to biotic communities and wildlife habitat on Bodie Island. In addition, cost savings resulting from a shorter structure would be offset by costs related to the risks introduced by construction in an area of greater wave activity, faster currents during storm surges, and less protected from storms.

- West Bridge Corridor. Compared to the then-preferred 1993 Parallel Bridge Corridor, this corridor would be a substantially longer and more expensive structure. It also would result in connections to existing NC 12 that would cross valuable habitat within the Pea Island National Wildlife Refuge (Refuge). This corridor is similar to Corridor Alternative 1, which was examined and dropped from consideration in the 2002 corridor alternatives studies described in Section 2.3.

The 1993 Parallel Bridge Corridor was assessed in the 1993 DEIS as the preferred corridor and was selected by the NCDOT as the Preferred Alternative for implementation after public hearings in February 1994. It was further refined after a 1995 bridge type study. Because beach erosion has increased problems with ocean overwash along NC 12 south of Bonner Bridge, the Preferred Alternative identified in 1993 is now being considered in conjunction with a long-term plan or strategy for NC 12 maintenance through the Refuge (see Sections 2.6 and 2.7).

Sections 2.2.3 to 2.2.9 review the alternatives identified above and describe more specifically the reasons they were dropped from further consideration. The TSM and West Bridge Corridor, dropped from further study early in the feasibility study process, are discussed only in general terms. During the feasibility study, the Ferry Alternative, the Tunnel Alternative, the East Bridge Corridor, and the 1993 Parallel Bridge Corridor (the then-Preferred Alternative) were examined closely. The paragraphs describing the 1993 Parallel Bridge Corridor reflect the project as refined after the 1994 public hearing and the 1995 bridge type study.

The locations of the 1993 Parallel Bridge, Ferry, Tunnel, East Bridge, and West Bridge Alternatives are shown in Figure 2-1. Table 2-1, Table 2-2, and Table 2-3 compare the 1993 Parallel Bridge, Ferry, Tunnel, and East Bridge Alternatives from the perspectives of transportation, coastal engineering, and environmental tradeoffs, respectively. In addition, the expense and impact of the on-going maintenance of NC 12, including beach nourishment, dune maintenance, and repairs required because of highway overwash during storms would continue south of the Hatteras Island terminus of these alternatives until a long-term solution to NC 12 maintenance (between the northern end of Hatteras Island and Rodanthe) could be implemented.



1993 CROSSING ALTERNATIVES

Figure 2-1

Table 2-1. Transportation Tradeoffs for 1993 Crossing Alternatives

Evaluation Factors	1993 Parallel Bridge Corridor (1993 Preferred Alternative)	Ferry	Tunnel	East Bridge Corridor
Inlet Navigation	Navigation spans with a minimum 200-ft. (61 m) horizontal and a 75-ft. (22.9 m) vertical clearance would meet inlet navigation needs. Navigation spans across Oregon Inlet would mean the channel could be allowed to drift with the inlet's gorge, making it easier to keep clear.	Ferry service would increase inlet traffic and operate across and conflict with existing inlet traffic.	The tunnel should have no effect on, or be affected, by inlet navigation since it would be under the Oregon Inlet floor.	Navigation spans with a minimum 200-ft. (61 m) horizontal and 75-ft. (22.9 m) vertical clearances would meet inlet navigation needs. Navigation spans across Oregon Inlet would mean the channel could be allowed to drift with the inlet's gorge, making it easier to keep clear.
Traffic Service	An acceptable peak hour level of service would be provided on NC 12 through 2025 except on summer weekends when a four-lane NC 12 would be needed. Roadway width of 36 ft. (11 m) would allow a wider recovery area during accidents and around obstructions.	Ferry service could not meet existing or future traffic demand.	An acceptable peak hour level of service would be provided on NC 12 through 2025 except on summer weekends when a four-lane NC 12 would be needed.	An acceptable peak hour level of service would be provided on NC 12 through 2025 except on summer weekends when a four-lane NC 12 would be needed. Roadway width of 36 ft. (11 m) would allow a wider recovery area during accidents and around obstructions.
Emergency Evacuation	The 36-ft. (11 m) cross-section would permit operation of three lanes (two leaving the island) in emergencies; this could facilitate evacuation clearance.	Limited transport capacity would dramatically increase the evacuation clearance time from Hatteras and Ocracoke islands.	The existing capacity for emergency evacuation would remain.	The 36-ft. (11 m) cross-section would permit operation of three lanes (two leaving the island) in emergencies, which could facilitate evacuation clearance.
Bicycles & Pedestrians	The 6-ft. (1.8-m) bridge shoulders would be safer for bicycle and pedestrian traffic than the existing 2-ft. (0.6-m) shoulders.	Bicyclists and pedestrians could use the ferry service.	The tunnel environment would not be suitable for bicyclists and pedestrians.	The 6-ft. (1.8-m) bridge shoulders would be safer for bicycle and pedestrian traffic than the existing 2-ft. (0.6-m) shoulders.

Table 2-2. Coastal Engineering Tradeoffs for 1993 Crossing Alternatives

Evaluation Factors	1993 Parallel Bridge Corridor (1993 Preferred Alternative)	Ferry	Tunnel	East Bridge Corridor
Inlet Migration	Provided that hopper dredging does not occur or is mitigated and the terminal groin is maintained, Oregon Inlet's migration at Hatteras Island should cease, and abutments would not be threatened during bridge life expectancy.	Ferry service would not be affected by inlet migration; ferry landings could be located so that they would not be endangered by erosion.	The portals of the Tunnel Alternative would not be threatened by erosion, provided that hopper dredging does not occur (or is mitigated) and the groin is maintained.	Provided that hopper dredging does not occur or is mitigated and the terminal groin is maintained, Oregon Inlet migration at Hatteras Island should cease and abutments would not be threatened during bridge life expectancy.
Inlet Gorge	If the gorge moves south, vessels would be forced to make a sharp, cross-current turn to complete the transition from the island-parallel channel between Wanchese and the Oregon Inlet channel. Also, Oregon Inlet's channel is more variable along this alignment, and the proper navigation span to use might change frequently.	The Ferry Alternative would not be affected by channel changes. It would be difficult, however, to maintain the required ferry channel in a cross-current direction across Oregon Inlet. Continuous maintenance dredging of the ferry channel probably would be needed.	Channel changes would not affect the Tunnel Alternative.	This alignment would provide a less severe angle in the channel at the bridge if the gorge moves south. Also, Oregon Inlet's gorge is not as variable in this location; thus, the navigation span would not change as often as with the west alternative.
Flexibility to Meet Future Navigation Demand	Navigation spans would be provided throughout the range of possible inlet gorge locations. This design feature would allow flexibility in the number and sizes of vessels using Oregon Inlet.	Other than frequent ferry crossings of the navigation channels, future navigation demand should not be influenced by the ferry service.	The Tunnel Alternative would not affect future navigation demands.	Navigation spans would be provided throughout the range of possible inlet gorge locations. This design feature would allow flexibility in the number and sizes of vessels using Oregon Inlet.
Dredging Requirements	The bridge would provide the opportunity to scale back dredging operations in Oregon Inlet. The placement of the navigation spans across the entire inlet would permit greater acceptable movement of the navigation channel.	Dredging would be necessary to maintain the depth and horizontal clearances for the vessel passages to and from the ferry terminals. This activity would be in addition to that for the maintenance of Oregon Inlet's channel. The USACE believes the ferry channel in the Oregon Inlet area would have stability problems.	Construction of the tunnel would require extensive excavation during construction. Beyond that, however, the movement of Oregon Inlet's gorge would place no restrictions on maintaining a navigation channel through Oregon Inlet, provided the inlet remains between the portals.	The alternative could provide the opportunity to scale back dredging operations in Oregon Inlet. The placement of the navigation spans across the entire inlet would permit greater acceptable movement of the navigation channel.
Shoreline Erosion	Anticipated natural shoreline erosion would threaten up to 1.4 miles (2.2 km) of NC 12 at the north end of Hatteras Island by 2050. NC 12 would need to be relocated.	Anticipated natural shoreline erosion on Hatteras Island would make it difficult to locate a southern ferry terminal north of Rodanthe; this would necessitate a ferry channel approximately 18 miles (29.0 kilometers) long.	Anticipated natural shoreline erosion would threaten up to 1.4 miles (2.2 km) of NC 12 at the north end of Hatteras Island by 2050. NC 12 would need to be relocated.	Anticipated natural shoreline erosion would threaten up to 1.4 miles (2.2 km) of NC 12 at the north end of Hatteras Island by 2050. NC 12 would need to be relocated.

Table 2-3. Environmental Tradeoffs for 1993 Crossing Alternatives

Evaluation Factors	1993 Parallel Bridge Corridor (1993 Preferred Alternative)	Ferry	Tunnel	East Bridge Corridor
Community	This alternative would have no impact on land use and socioeconomic factors since the same level of traffic service would be maintained and community services would not be disrupted.	This alternative would severely limit the movement of goods and services from the mainland to Hatteras Island. Residents and visitors to Hatteras Island rely on off-island community services, such as hospitals, solid waste disposal, and electrical power.	This alternative would have no impacts on land use and socioeconomic factors since the same level of traffic service would be maintained and community services would not be disrupted.	This alternative would have no impacts on land use and socioeconomic factors since the same level of traffic service would be maintained and community services would not be disrupted.
Visual	Views from the (former) US Coast Guard Station on Hatteras Island, at the marina, and on the Bodie Island spit would be virtually unchanged.	Bonner Bridge would be removed from view and ferry terminals introduced at the Oregon Inlet Marina and in the Rodanthe area.	Bonner Bridge would be removed from view. A trestle approach structure would be built on Bodie Island. The wall and ventilation building around the portals would be an intrusive feature not in keeping with the island's character.	The new bridge would be closer to the historic (former) US Coast Guard Station. It would dominate views to the west on the Bodie Island spit. Views from the marina would be virtually unchanged. Longer spans would present a less cluttered profile than Bonner Bridge.
Air	Since this alternative would not result in increased traffic levels over the existing situation, no impact would occur.	Since this option would reduce the vehicular traffic across Oregon Inlet, it would have no impact on air quality.	Since this alternative would not result in increased traffic levels over the existing situation, no impact would occur.	Since this alternative would not result in increased traffic levels over the existing situation, no impact would occur.
Noise	Because of its location, this bridge corridor should have minimal impact on noise in the Oregon Inlet area.	Since traffic is the dominant source of noise in this area, the ferry service, with a reduction in traffic level, would have a minimal negative impact on the noise level.	Because of its location, the tunnel should have a minimal impact on noise in the Oregon Inlet area.	Noise levels would increase at the Bodie Island spit.
Cultural Resources				
Historic Architectural Resources	No land within the (former) US Coast Guard Station National Register site would be used. See Visual comparison above.			
Human Habitation Related Archaeological Resources	The Outer Banks' dynamic environment is not conducive to good archaeological preservation. No impacts are expected.			
Shipwreck Archaeological Resources	There are no known shipwreck sites in the corridor; however, there is a history of shipwrecks at Oregon Inlet.			

Table 2-3 (continued). Environmental Tradeoffs for 1993 Crossing Alternatives

Evaluation Factors	1993 Parallel Bridge Corridor (1993 Preferred Alternative)	Ferry	Tunnel	East Bridge Corridor
Parks	The north and south ends of this alternative would be within the Cape Hatteras National Seashore. The south end also would be in the Pea Island National Wildlife Refuge.	This alternative could alter access opportunities to the Seashore and the Refuge. One terminal and the landing areas would be constructed in the Cape Hatteras National Seashore.	The north and south ends of this alternative would be within the Cape Hatteras National Seashore. The south end also would be in the Pea Island National Wildlife Refuge.	The north and south ends of this alternative would be within the Cape Hatteras National Seashore. The south end also would be in the Pea Island National Wildlife Refuge.
Natural Systems				
Biotic Communities	There would be slight impacts on biotic communities since the corridor crosses substantial acreage of needlerush pockets, smooth cordgrass stands, and open waters. Slight impacts would occur in maritime shrub thickets and to fisheries. Minimal impacts would accrue to birds, small mammals, and amphibians from loss of habitats. Moderate impacts to benthos.	Dredging in open waters would affect benthos and fisheries. Permanent use of biotic communities for the operating facilities associated with the landings on Hatteras and Bodie islands would be substantial.	The tunnel would cause substantial impacts on biotic communities on Bodie Island as it would necessitate the removal of large stands of needlerush pockets and smooth cordgrass stands, which in turn would cause slight to moderate impacts on birds, small mammals, reptiles, and amphibians resulting from loss of habitat. Substantial impacts on benthos and moderate impacts on fisheries would result from a loss of critical habitat because of construction dredging.	This alignment would cause moderate impacts on biotic communities as it crosses substantial acreage of high marsh, maritime shrub thickets, needlerush pockets, smooth cordgrass stands, and open water areas. Slight impacts on birds, small mammals, reptiles, amphibians, benthos, and fisheries as a result of loss of habitats.
Oregon Inlet Birds	Slight impacts on wintering waterfowl and migrating shorebirds could occur because of habitat loss associated with temporary dredge canals and placement of piers.	Moderate impacts would be expected on wintering waterfowl and migrating shorebirds because of loss of habitat caused by dredging basins and navigational channels and permanent habitat loss.	Slight to moderate impacts would be expected on wintering waterfowl and migrating shorebirds because of permanent habitat loss.	Moderate impacts on wintering waterfowl and migrating shorebirds could occur because habitat loss associated with temporary dredge canals and placement of piers.

Table 2-3 (continued). Environmental Tradeoffs for 1993 Crossing Alternatives

Evaluation Factors	1993 Parallel Bridge Corridor (1993 Preferred Alternative)	Ferry	Tunnel	East Bridge Corridor
Surface Water Quality	Slight temporary impact could result from increased turbidity during construction of temporary dredge canals and the placement of piers.	Moderate impacts would result from increased turbidity during initial dredging and maintenance of basins and navigation channels.	Moderate impacts could result from increased turbidity during excavation, construction, and maintenance. Elevated levels of metals also could occur during tunnel construction and maintenance.	Slight temporary impact could result from increased turbidity during construction of temporary dredge canals and the placement of piers.
Protected Species	By disturbing resting and feeding activities, construction activities could cause temporary minimal impacts on several federally protected birds that occasionally utilize the area. No impacts are anticipated for federally protected sea turtles. Some piping plover habitat would be used during construction but it is not likely to affect the piping plover adversely.	Slight impacts on several federally protected birds that occasionally use the area could result from dredge disposal on potential nesting and resting sites.	Slight impacts on several federally protected birds that occasionally use the area could result from construction activities and permanent loss of habitat. No impacts would be expected on federally protected sea turtles. Some permanent loss of habitat potentially used by nesting and feeding piping plovers.	Construction activities could cause temporary minimal impacts on several federally protected birds that occasionally use the area: piping plover, Arctic peregrine falcon, bald eagle, and roseate tern. No impacts would be anticipated for federally protected sea turtles. Substantial piping plover habitat would be used during construction.

Table 2-3 (concluded). Environmental Tradeoffs for 1993 Crossing Alternatives

Evaluation Factors	1993 Parallel Bridge Corridor (1993 Preferred Alternative)		Ferry		Tunnel		East Bridge Corridor	
Wetlands Filled by Community in acres (hectares)	Total Filled	Temporary Construction Impact	Total Filled	Temporary Construction Impact	Total Filled	Temporary Construction Impact	Total Filled	Temporary Construction Impact
• Herbaceous Swales	0.0 (0.0)	0.0 (0.0)	4.6 (1.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
• Low Shrub/Grass-lands	0.2 (0.1)	0.1 (0.0)	4.2 (1.7)	0.0 (0.0)	1.2 (0.5)	0.7 (0.3)	1.2 (0.5)	0.1 (0.0)
• Maritime Shrub Thicket	2.4 (1.0)	1.3 (0.5)	20.5 (8.2)	0.0 (0.0)	8.9 (3.6)	3.2 (1.3)	4.5 (1.8)	3.2 (1.3)
• Salt-meadow Flats	0.2 (0.1)	1.2 (0.5)	8.6 (3.4)	0.0 (0.0)	0.9 (0.4)	0.7 (0.3)	0.0 (0.0)	0.0 (0.0)
• High Marsh	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.1 (0.4)	0.0 (0.0)	0.0 (0.0)	3.2 (1.3)
• Needlerush Pockets	0.1 (0.0)	1.3 (0.5)	16.1 (6.4)	0.0 (0.0)	6.3 (2.5)	2.9 (1.2)	0.0 (0.0)	2.5 (1.0)
• Smooth Cordgrass Stands	0.3 (0.1)	3.4 (1.4)	1.4 (0.6)	0.0 (0.0)	2.9 (1.2)	0.5 (0.2)	0.0 (0.0)	0.2 (0.1)
• Mudflat	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
• Reed Stands	0.1 (0.0)	0.9 (0.4)	2.4 (1.0)	0.0 (0.0)	1.4 (0.6)	0.4 (0.2)	1.1 (0.4)	0.1 (0.0)
• Submerged Aquatic Vegetation (SAV) Beds	0.1 (0.0)	0.7 (0.3)	1.2 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
• Flooded Pools	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Total Area	3.5 (1.4)	8.9 (3.6)	59.0 (23.6) (Assuming a southern terminal near the end of Bonner Bridge; impact similar to that of a terminal in Rodanthe.)	0.0 (0.0)	22.7 (9.1)	8.5 (3.4)	6.8 (2.7)	9.4 (3.8)

NOTE: Following are relative quantifications of the impact level descriptors used in Table 2-3:

No impact (not measurable)

Minimal impact (barely measurable)

Slight impact (measurable)

Moderate impact (localized loss)

Substantial impact (complete localized loss)

2.2.3 Transportation Systems Management (TSM) Alternative

A Transportation Systems Management Alternative is one that seeks to maximize the efficiency of the present system so that it can carry greater traffic volumes at an acceptable level of service. Typical TSM alternatives include fringe parking, ride-sharing, high-occupancy vehicle lanes on existing roadways, and traffic signal timing optimization. This alternative generally is found to be relevant only for major projects proposed in urbanized areas with populations greater than 200,000.

A TSM alternative was not assessed in detail since the purpose of the proposed project is not to augment an existing system because of over-utilization but to replace a structure nearing the end of its service life.

2.2.4 Rehabilitation of Existing Bridge

This alternative was not assessed in detail because of Bonner Bridge's poor condition, its insufficient ship impact strength, and its narrow navigation span zone.

As described in Chapter 1, Bonner Bridge has required continual maintenance since its construction. There are three major chronic problems:

1. Deterioration of the bridge through extensive corrosion of the reinforcing steel and major spalling of concrete on the supporting structures;

2. Scour to a depth equal to, or greater than, the critical depth for the piles supporting the bridge; and

3. The periodic need for vessels to use spans other than the primary span for navigation because of encroachment on the primary span by the Bodie Island spit.

These problems were, and continue to be, mitigated temporarily, but large maintenance and repair expenditures are expected to continue on a regular basis unless the bridge is replaced. The narrow navigation span zone of Bonner Bridge would remain with this alternative and no benefits from decreased dredging would occur. Finally, the Bonner Bridge was not designed to withstand the impact of a dredge, a vessel that regularly operates near the bridge. A hopper dredge vessel demolished several spans of Bonner Bridge in late 1990.

2.2.5 1993 Parallel Bridge Corridor (1993 DEIS Preferred Alternative)

Construction of a new bridge in a corridor parallel to Bonner Bridge was the preferred alternative in the 1993 DEIS, and that alternative was formally selected as the preferred alternative after public hearings in 1994. For evaluating the impact of a new bridge in the 1993 Parallel Bridge Corridor, a representative project was used in the DEIS. The use of the term "representative" reflects that the project as defined for environmental studies could be refined or slightly altered during final design, although the impacts would not be substantially changed. A refined representative project was in fact developed as a part of a bridge type study completed in 1995. The type study is described in *Bonner Bridge Type Study* (Parsons Brinckerhoff Quade & Douglas, Inc., March 1995). This refined project is described in this section. This description reflects the characteristics of the Parallel Bridge Corridor that when compared with other Oregon

Inlet crossing alternatives in 1993 and 1994, yielded the decision that a replacement bridge immediately west of Bonner Bridge is the preferred approach.

Sections 2.2.5.1 through 2.2.5.5 describe the 1993 Parallel Bridge Corridor's representative horizontal alignment, design characteristics, environmental impact potential, costs, and construction procedures.

The 1993 Parallel Bridge Corridor is incorporated, with variations in the location of its south terminus, into the several Parallel Bridge Corridor detailed study alternative described in Section 2.10 and evaluated in detail in Chapter 4.

2.2.5.1 Representative Horizontal Alignment

The representative alignment used in the 1993 Parallel Bridge Corridor would range from 60 feet (18.3 meters) to 500 feet (152.4 meters) west of Bonner Bridge; the alignment is illustrated in Figure 2-1. The representative alignment would have the following bridge lengths:

Southern Approach	800 feet (243.8 meters)
Main Bridge	9,987 feet (3,043.9 meters)
Northern Approach	3,730 feet (1,136.8 meters)
TOTAL LENGTH	14,517 feet (4,424.6 meters)

Approach roadway on fill at each end of the bridge structure would be approximately 1,450 feet (441.9 meters) long on Hatteras Island and 2,850 feet (868.6 meters) long on Bodie Island, resulting in a total project length of approximately 18,817 feet (5,735 meters).

2.2.5.2 Design Characteristics

The design criteria developed for the replacement structure in the 1993 Parallel Bridge Corridor assumed a bridge with two 12-foot (3.6-meter) lanes and 6-foot (1.8-meter) shoulders on each side, a 36-foot (11-meter) clear roadway width. The total outside width of the bridge was assumed to be 38.6 feet (11.8 meters); the additional 2.6 feet (0.8 meter) would accommodate the bridge rails. The approach roadway (on fill) was assumed to have 8-foot (2.4-meter) shoulders (4-foot [1.2-meter] paved) and provide 8 feet (2.4 meters) of clearance from the edge of the travel lane to the face of the guard rail.

The shoulders would accommodate bicyclists and pedestrians more safely than the existing 2 feet (0.6 meters) of clearance and allow room for movement around stranded vehicles and accidents. A bicycle-safe bridge rail would be utilized. The 36-foot (11-meter) clear roadway width on the bridge could allow for the temporary emergency designation of three lanes during evacuations, with two lanes of traffic moving off the island.

Scour is a characteristic result of the dynamic nature of the Oregon Inlet that has the potential to threaten crossing structures. The new bridge would include adequate 500-year hurricane scour protection depths. Multiple navigational spans over about 5,000 feet (1,524 meters) of the bridge length with a vertical clearance of 75 feet (22.9 meters) were assumed. A minimum horizontal clearance of 200 feet (61 meters) was assumed for each navigation span. A hopper dredge, the heaviest vessel to operate in Oregon Inlet, was selected during the 1995 bridge type study as the design vessel for ship impact. In other words, the foundations of the new bridge would need to withstand the impact of this vessel.

The geometric features for a bridge in this corridor could be designed such that extension of the bridge in association with a future relocation of NC 12 could be accommodated.

For the main bridge superstructure, long-span precast concrete segmental box girders built using the balanced cantilever construction method were planned. A box girder is a concrete girder whose cross-section is shaped like a box. Based on the scour and ship impact criteria, the foundations required in this corridor would need to be both deep and substantial in construction. Multiple large piles would be required. A footing would be cast just above the waterline on the cylinder piles. A precast segmental box column would be placed on the footing to support the superstructure.

2.2.5.3 Environmental Impact Potential

The environmental impact potential of the 1993 Parallel Bridge Corridor is summarized in Table 2-3. Key environmental considerations are described below.

<u>*Community*</u>

A bridge in this corridor would be compatible with the *Dare County Land Use Plan* and zoning, the *Coastal Zone Management Plan*, and National Park Service (NPS) plans. No unanticipated growth would be generated with the bridge replacement in this corridor, either in terms of an increased rate of development or an increased intensity of development. The Dare County plan supports new transportation projects, and the project is compatible with the "conservation" area objectives applied by that plan to the project area. Through its compliance with the local land use plan, the project would be consistent with the *Coastal Zone Management Plan*. The project is compatible with the NPS's desire of managing the Cape Hatteras National Seashore (Seashore) in ways "that support the natural processes of barrier island dynamics..." (NPS, 1991).

The social characteristics of the project area would not change with this corridor. Accessibility of Hatteras Island, the Seashore, and the Refuge would not change for area residents, tourists, workers, and off-island goods and services. The 1993 Parallel Bridge Corridor would not adversely affect community services.

The visual character of the Oregon Inlet area would not be affected by a bridge in this corridor. The scale and dominance of the replacement structure in relation to other Oregon Inlet visual elements would not differ substantially from those of Bonner Bridge.

<u>*Cultural Resources and Parks*</u>

A bridge in this corridor would not affect historic resources or change the accessibility to area resources. No shipwrecks or other archaeological sites are in the area of potential effect for this alternative.

The project would be within the Seashore on both sides of Oregon Inlet. On Hatteras Island, the project also would be within the Refuge. A bridge in this corridor would maintain roadway access to the Hatteras Island portions of the Seashore and to the Refuge. The catwalks on Bonner Bridge used for fishing likely would not be replaced for the reasons presented in Section 2.10.1.2, under "Access to Recreation Opportunities." The primary impact on the Seashore and Refuge would be on natural systems, as described later in this section.

Coastal Conditions

The project would have a negligible effect on natural inlet migration, profile, and gorge alignment. The bridge design proposed in this corridor would make navigation channel dredging operations easier to undertake and could reduce the frequency and size of dredging operations compared to what is required today.

Erosion of the Hatteras Island shoreline has continued since the 1993 studies for this alternative. Shoreline erosion and ocean overwash regularly threaten to sever segments of the NC 12 roadway for several miles south of the southern terminus of this corridor. As such, there would remain an ongoing risk of NC 12 closure and periodic temporary loss of access unless a long-term plan or strategy for minimizing this risk was implemented.

The terminal groin would need to be retained with this alternative.

Natural Systems

The area of biotic communities and wetlands affected by a bridge in this corridor would be approximately 41.8 acres (16.7 hectares):

- Permanent (fill or foundation placement)

Section 404 wetlands including 0.8 acre (0.32 hectare) of Coastal Area Management Act (CAMA) wetlands	3.5 acres	(1.4 hectares)
Aquatic bottom (pile placement only, no fill)	2.8 acres	(1.1 hectares)
Uplands (excluding man-dominated areas)	0.2 acre	(0.08 hectare)
TOTAL	6.5 acres	(2.6 hectares)

- Temporary (construction staging, haul road, or dredging)

Section 404 wetlands including 6.0 acres (2.4 hectares) of CAMA wetlands	8.9 acres	(3.6 hectares)
Aquatic bottom	25.6 acres	(10.2 hectares)
Uplands (excluding man-dominated areas)	0.8 acre	(0.3 hectare)
TOTAL	35.3 acres	(14.1 hectares)

The above impacts include 0.1 acre (0.04 hectare) of permanent submerged aquatic vegetation (SAV) loss and 0.7 acre (0.3 hectare) of temporary SAV loss.

A bridge in the 1993 Parallel Bridge Corridor would minimally affect birds using the project area. The 1993 Parallel Bridge Corridor would affect 0.5 acre (0.2 hectare) of potential nesting habitat and 1 acre (0.4 hectare) of foraging and resting habitat for the piping plover (federally-listed threatened species). The impact to the feeding patterns of the piping plover caused by construction activities generally would be reduced because of the abundance of unaffected feeding sites in the project area. Since 1993, piping plover breeding pairs have been observed during several years at the south end of Bodie Island (North Carolina Wildlife Resources Commission [NCWRC], unpublished data, 2003). Over the same period, piping plover breeding pairs also were recorded at the north end of Hatteras Island near Oregon Inlet (NCWRC, unpublished data, 2003). Thus, a potential exists for affecting piping plover nesting with this corridor. Dredging and beach nourishment operations associated with dredge material disposal would be subject to protective measures implemented by the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS) to protect sea turtles. Beaches would not be nourished in locations where the seabeach amaranth is present.

Air Quality and Noise
Since this alternative would not result in increased traffic levels over the existing situation, no air quality impact would occur. Because of its location, this corridor should have a minimal impact on noise levels other than temporary noise associated with construction activities.

2.2.5.4 Costs
In 1995, the capital cost of a bridge in the 1993 Parallel Bridge Corridor was estimated to be \$88.7 million. This cost is higher than that presented in the DEIS (\$54.8 million in 1993 dollars) for this corridor because:

- The overall bridge was lengthened during the 1995 bridge type study, reducing the amount of approach fills; and

- The vessel impact loads applied to the 5,000-foot (1,524-meter) multiple span navigation zone in the 1993 DEIS representative design were applied to most of the 9,987-foot (3,044-meter) main bridge. This was done to meet then-new requirements associated with scour and ship collision.

These considerations added approximately \$22 million to the cost of the bridge. Additional funds for contingencies also added approximately \$11 million to the total cost.

A 40-year bridge service life was assumed. Operation and maintenance costs, including the cost of rehabilitation in the middle of its service life, were estimated to be \$20.1 million. Operation and maintenance costs for fixed-span, concrete bridges are relatively low for the first half of a structure's estimated service life. During this period, regular maintenance is required, including cleaning of scuppers or drains and joints and replacement of lights for navigation. Minor repairs to handrails, steel bearing plates, and concrete surfaces also might be required. In addition to maintenance, concrete bridges typically require rehabilitation after 20 to 30 years. Rehabilitation work may include repairing concrete spalls and cracks, replacement of bearings, joints, scuppers, and other miscellaneous items. The total cost of the new bridge over 40 years was estimated to be \$108.8 million (\$88.7 million in capital costs plus \$20.1 million for operation and maintenance) in 1995 dollars.

2.2.5.5 Construction
Construction of a bridge in the 1993 Parallel Bridge Corridor would involve primarily the assembly of large precast concrete units. The footings would be cast-in-place concrete. The least expensive method for shipping all parts probably would be by barge.

The bridge superstructure in this corridor would be built using the balanced cantilever construction method from barges and a haul road. Top-down construction and construction from a work bridge would be impractical. For the main bridge, the method of construction would be from barges. When building over a water body, the easiest way to move an erection crane from place to place is by attaching it to a barge and moving the barge. For the northern approach, construction was assumed to involve temporary construction of a haul road on geotextile fabric. Here, foundations would be lighter than on the main bridge or southern approach, and crawler cranes operating on a haul road could be used to erect the precast piles. Except for the top surface, temporary haul road and permanent approach road fills were assumed to consist of fill dredged from Oregon Inlet or Pamlico Sound.

Land for construction staging would be required near the project. A staging area near the construction project would make it easier to manage the construction process, make it easier to respond to emergencies, be less costly, and reduce construction-related traffic on NC 12. The staging area would require both water and road access. A single 4.8-acre (1.9-hectare) staging site on Hatteras Island was proposed for this corridor. It was the same site used during terminal groin construction and for temporary ferry boarding and unboarding in late 1990 and early 1991.

The staging area would be used for:

- Receipt of construction materials by truck and barge;
- Loading various components onto construction barges;
- Construction management and worker trailers;
- Equipment storage; and
- Minor equipment maintenance.

Construction in this corridor was assumed to take approximately 3.5 years.

2.2.6 Ferry Alternative

A Ferry Alternative was examined during the 1991 feasibility study. The Ferry Alternative was not studied in detail in the "Environmental Consequences" chapter of the 1993 DEIS nor this FEIS for these reasons:

- It would result in a decrease in the present level of traffic service across Oregon Inlet, even though traffic predictions indicate a continuing increase in demand. This decrease in service would reduce access between Hatteras Island and the mainland for permanent residents and visitors (including visitors to the Seashore and the Refuge) and increase the evacuation time for Hatteras Island and Ocracoke Island in the event of an emergency. The decrease in access would substantially affect the economies of the islands and Dare County, which are heavily dependent upon travel and tourism industries.

- It would require extensive dredging to maintain a navigation channel 200 feet (61 meters) wide and approximately 3 miles (4.8 kilometers) long across Oregon Inlet (assuming a direct route from the Bodie Island terminal and around Bodie Island to a Hatteras Island terminal near the southern terminus of Bonner Bridge). This length would increase to as much as 18 miles (29.0 kilometers) if the Hatteras Island terminal for this alternative were placed at the emergency ferry dock that now exists in Rodanthe. Given the current problems maintaining NC 12 north of Rodanthe that have arisen since the 1991 feasibility study, the 18-mile (29.0-kilometer) route likely would be required. Thus, with 3 miles (4.8 kilometers) or 18 miles (29.0 kilometers) of dredging, this alternative would be one of the most damaging to the natural environment because of the massive amount of excavation of Oregon Inlet's bottom that would be required during the creation and maintenance of a ferry channel. Facilities on Bodie and Hatteras islands would permanently use approximately 59 acres (23.6 hectares) of wetlands, assuming a southern ferry terminal near the end of Bonner Bridge. Extensive wetlands also exist near the emergency ferry dock in Rodanthe.

- The 1991 study found that this alternative would be substantially more expensive than a bridge alternative. The Ferry Alternative's cost (construction and maintenance) would be $418.5 million (in 1991 dollars) over 40 years compared to $108.8 million (in 1995 dollars) for the construction and maintenance of a bridge in the 1993 Parallel Bridge Corridor.

Table 2-1, Table 2-2, and Table 2-3 document the transportation, coastal engineering, and environmental study findings for the Ferry Alternative. This alternative was developed based upon information and communication with the NCDOT Ferry Division in 1991. The following paragraphs describe design characteristics, operating characteristics, environmental impact potential, and costs of the Ferry Alternative.

2.2.6.1 Design Characteristics

<u>Vessel</u>

A Hatteras Class ferryboat was assumed for this alternative. This type of vessel has a 30-passenger car capacity. This is the same type of ferry vessel used for the Ferry Division's Hatteras Island to Ocracoke Island service. The Oregon Inlet environment is conducive to the utilization of the same type of ferry vessels.

Consideration was also given to the potential of air-cushion vehicle (Hovercraft) ferries. An air-cushion vehicle can provide for a faster travel time between terminals, and channel dredging would not be required. Large stable pads, rather than an enlarged boat basin, would be used for loading and unloading. An air-cushion vehicle, however, would not be a sound alternative to a ferry boat for the following reasons:

- Air-cushion ferries with more than a two- or three-car capacity are no longer manufactured.

- Air-cushion vehicles could be custom-manufactured for use between Bodie and Hatteras islands. However, although no cost estimates are available, a representative of British Hovercraft Corporation indicated that it was doubtful such an approach would be cost-effective even taking into account the dredging required for operation of ferry boats. (Personal communication, 1993, Curt Chatelain, British Hovercraft Corporation.)

- Even if air-cushion vehicles were readily available, the time saved by using a faster vehicle would be small in comparison to the total trip time, which includes the time it takes to load and unload either type of ferry.

- Some economies of scale (i.e., use of existing off-site maintenance facilities) would be lost because of the use of a completely different vessel.

Consideration also was given to a catamaran (Hoverspeed), designed specifically to compete with the English Channel tunnel. This vessel can carry 80 automobiles and can travel at speeds up to 50 miles per hour (80 kilometers per hour)—much faster than Hatteras Class ferry vessels. It would not be a sound alternative to a ferryboat for the same time and economies of scale reasons described above for the air-cushion vehicle.

<u>Facilities</u>

Although ferry service across the Oregon Inlet was provided prior to the opening of Bonner Bridge in 1963, permanent primary support facilities for the ferry service, including terminal buildings, slips, ramps, and fuel storage facilities, are no longer available with the exception of a single slip and ramp at the emergency ferry dock in Rodanthe.

The original Bodie Island terminal is now used as part of the Oregon Inlet Marina complex. Navigation channels are maintained to the landing area. Transition of this area to a permanent ferry terminal would require expansion of the existing basin and navigational channel and construction of bulkhead, slips, ramps, and a main terminal building complete with necessary support facilities. These facilities would require approximately 52 acres (20.8 hectares) of land in the area of the marina and the adjacent (former) US Coast Guard Station.

Severe erosion of the north end of Hatteras Island has destroyed the old southern terminal on Hatteras Island. New facilities would be required for the southern landing area. The 1991 study assumed the southern terminal would be in the area of the bulkhead (removed in 1994) that was used in the construction of the terminal groin project in 1989 and 1990 (see Figure 2-1). The most logical location for a terminal on Hatteras Island would be at the emergency ferry dock in Rodanthe, given the current NC 12 overwash problems north of Rodanthe. The facilities associated with this landing would require approximately 23 acres (9.2 hectares) of land.

2.2.6.2 Operating Characteristics

<u>Capacity</u>

Maximum safe operating capacity, rather than travel demand, tends to set the upper limit for ferry service capacity. Safe operating is defined as no less than 10-minute headways between departures and arrivals of ferry vessels within a single travel corridor. This criterion is based on the standards of the NCDOT Ferry Division.

The Ferry Alternative assumes the use of 12 Hatteras Class ferries on a schedule typical of the NCDOT Ferry Division. Such a schedule would include approximately 150 one-way trips per day across Oregon Inlet with a total capacity of 4,500 vehicles per day (vpd). Trips would be concentrated in the daytime hours with a limited number of late evening trips.

With a maximum safe operating headway of ten minutes between departures and arrivals of ferry vessels, a 30-vehicle capacity ferry, and six ferries in each direction, up to 360 vehicles per hour could be transported across the Oregon Inlet. This capacity is insufficient to meet the peak hour two-way volumes of 690, 1,030, and 1,180 vehicles estimated for the 2002 peak season weekday, weekend, and Saturday, respectively.

If the maximum hourly service (360 vehicles) could be provided 24 hours a day, the 8,640 vehicles that could be carried per day would just meet 2002 peak season weekday traffic demand (8,000 vpd). It would not meet 2002 weekend peak-hour demand (as high as 14,200 vpd). It is unreasonable, however, to assume that this maximum amount of service would be used, since it assumes full use of the ferries at all hours of the day and night and demand spread evenly over a 24-hour period.

It would be possible to create an additional ferry route between Roanoke Island and another portion of Hatteras Island that could operate safely in tandem with an Oregon Inlet ferry (but in a different channel) and provide additional capacity. This would necessitate even more ferries and more dredging, thereby raising the project cost. The idea of using a second route to increase capacity was not pursued, because even the single Oregon Inlet route proved to be a very costly alternative when compared to other crossing alternatives.

<u>Dredging</u>

Ferry service could not be provided without extensive dredging operations. A dredged channel 200 feet (61 meters) wide to allow the passing of two Hatteras Class ferries, a channel alignment of approximately 3 miles (4.8 kilometers), a channel depth of approximately 14 feet (4.3 meters) below mean low water, and the removal and disposal of approximately 1.8 million cubic yards (1.4 million cubic meters) of dredging material to create the channel was assumed for the Ferry Alternative in 1991. Increasing the length of the ferry route from 3 to 18 miles (4.8 to 29.0 kilometers) would increase the amount of dredged material from 1.8 million cubic yards to 10.8 million cubic yards (1.4 million cubic meters to 8.2 million cubic meters).

2.2.6.3 Environmental Impact Potential

The environmental impact potential of the Ferry Alternative is summarized in Table 2-3. Key environmental impact concerns are as follows:

- Emergency Evacuation. A critical roadway segment in the Dare County plan for the evacuation of Hatteras and Ocracoke islands would be lost. The time required to evacuate Hatteras Island would rise. In addition, weather conditions during evacuations would threaten the safety of the ferry voyages.

- Community Services. Loss of road access to Bodie Island across Oregon Inlet would isolate the communities on Hatteras Island from the larger community of Dare County. The ground time required to transport critically ill or injured persons, and others requiring immediate medical aid, across Oregon Inlet would be increased. The ability of the fire and police service on Hatteras Island to obtain timely assistance from other departments during large-scale emergencies would be reduced. Although the school-aged population of Hatteras Island is served by school facilities on the island, extracurricular activities—including sporting events—that involve off-island travel could be curtailed or the travel time to those activities increased. Transport by ferry would double the daily operation time for removal of solid waste to a mainland landfill. An alternative system for providing telephone and electric services to Hatteras Island would have to be developed.

- Local Economy. The variety of goods and services available to island residents and visitors would become more limited than what is available at present, and the prices of available items would become more costly because of reduced accessibility. Commerce between Hatteras Island and the rest of Dare County, and even the region, would be reduced. Employment opportunities for Hatteras Island residents elsewhere in the county and region would be diminished, as would employment opportunities on Hatteras Island for nonresidents. Commercial and residential construction on the island would be curtailed.

- Regional Economy. The ease of travel for Dare County visitors to Hatteras Island and the Hatteras Island portion of the Cape Hatteras National Seashore would be reduced. Visitor levels would be affected both by the lack of capacity and by the additional time it would take to cross Oregon Inlet.

- Natural Resources. Dredging for ferry navigation would cause a loss of benthos. The area of inlet bottom disturbed would be about 200 feet (61 meters) wide and approximately 3 miles (4.8 kilometers) long or approximately 70 acres (28 hectares). This length would increase to as much as 18 miles (29.0 kilometers) if the Hatteras Island terminal were at the emergency ferry dock that now exists in Rodanthe. Given the current problems maintaining NC 12 north of Rodanthe that have arisen since the 1991 feasibility study, the 18-mile (29.0-kilometer) route likely would be required. The area disturbed in this case would be 420 acres (168 hectares).

Disposal of dredged material could affect wintering waterfowl, migrating shorebirds, and estuarine subtidal wetlands. Because of the abundance of wetlands in the project area, it can be estimated that approximately 59 acres (23.6 hectares) of wetlands would be permanently affected by ferry operating facilities on Bodie and Hatteras islands, assuming a southern ferry terminal near the end of Bonner Bridge. However, extensive areas of wetlands also exist near the emergency ferry dock in Rodanthe.

2.2.6.4 Cost

The 1991 cost estimates for the Ferry Alternative were based on the design and operating characteristics described above, as well as capital acquisition and operating and maintenance expenditures incurred by the NCDOT Ferry Division. They assumed a southern ferry terminal near the end of Bonner Bridge. Given that the 1991 ferry costs were high compared to a comparable bridge, and that the primary reason for dropping the ferry from further consideration in the 1993 DEIS was its inability to meet even existing travel demand, the costs were not revisited in this FEIS for an assumed 18-mile (29.0-kilometer) ferry route to Rodanthe.

The existing ferry service between Hatteras and Ocracoke islands was examined and cost projections were developed based on Fiscal Year 1989 expenditures for provision of service. The Hatteras to Ocracoke service was used as a basis for the financial analysis because of similarities in conditions to Oregon Inlet, such as distances and the physical constraints of limited and constantly changing navigable waterways.

The initial capital cost for Ferry Alternative equipment, facilities, and initial channel dredging would be approximately $41.5 million (1991 dollars). The annual operating and maintenance costs for the Ferry Alternative would be $8.7 million (1991 dollars). Over the 40-year life of a bridge these annual costs would total $347 million. At 20 years, the 12 ferries would have to be replaced at an additional cost of $30 million.

The total cost for the Ferry Alternative over 40 years would be $418.5 million (1991 dollars). Like the bridge alternatives, the NCDOT would incur the cost of removing Bonner Bridge when the Ferry Alternative is completed.

The capital cost estimate includes all costs associated with procurement of ferry vessels, mechanized ramp equipment, construction of retaining walls (bulkhead), and ferry terminal buildings at both the Bodie Island and Hatteras Island terminals. The cost estimate includes 12 Hatteras Class ferry vessels. Eight ramps, four per terminal, were assumed to service the fleet. Some additional storage area in the form of bulkheads also was assumed for out-of-service vessels. One main terminal building with support facilities (including offices, storage areas, maintenance area, and restrooms) would be required on Bodie Island. A secondary terminal building with only basic support facilities would be required at the Hatteras Island landing area. The initial cost of dredging a 3-mile (4.8-kilometer)-long ferry channel was assumed.

The provision of ferry service is labor-intensive and produces substantial operating and maintenance (O&M) costs. The O&M cost for the Ferry Alternative was estimated by defining expected fixed dredging, vessel and terminal labor, and maintenance costs; these costs do not vary by the number of vessels operating. Oregon Inlet service with 12 vessels would increase the Ferry Division fleet size by about 50 percent. Some economies of scale, however, would exist in the provision of the additional ferry service. Existing off-site maintenance facilities and administrative personnel could be used. These savings, however, would be offset by the added dredging cost, which would be required to keep navigation channels open. According to the

Ferry Division, the useful life expectancy of a Hatteras Class ferry vessel is 20 years. Thus, additional capital funds would need to be spent for replacement vessels every 20 years.

2.2.7 Tunnel Alternative

The Tunnel Alternative was examined during the 1991 feasibility study. The Tunnel Alternative was not studied in detail in the "Environmental Consequences" chapter of the 1993 DEIS nor this FEIS, for the following reasons:

- It would be substantially more expensive than a bridge alternative. The Tunnel Alternative's cost would be $258 million (1991 dollars) for construction and maintenance over 40 years, compared to $108.8 million (1995 dollars) for a bridge in the 1993 Parallel Bridge Corridor. The Tunnel Alternative's costs would be even higher if the bridge and scour requirements applied to the 1993 Parallel Bridge Corridor during the 1995 bridge type study were applied to the Bodie Island approach bridge that is a part of the Tunnel Alternative.

- Excavation of Oregon Inlet's bottom would be required during the construction phase. An area approximately 600 feet (182.9 meters) wide and 11,300 feet (3,444 meters) long would be affected. Approximately 150 acres (60 hectares) of inlet bottom would be disturbed. In addition, approximately 23 acres (9.2 hectares) of wetlands would be lost to tunnel approaches. Thus, the tunnel also would be one of the most damaging alternatives to the natural environment.

- The southern terminus of the Tunnel Alternative was assumed to end near the south end of Bonner Bridge. Given the cost and environmental impact of even this short tunnel, neither a longer (18-mile [29.0-kilometer]) tunnel that would end at Rodanthe nor connecting the shorter tunnel to a bridge that continues south to Rodanthe would be practical.

Table 2-1, Table 2-2, and Table 2-3 document the transportation, coastal engineering, and environmental study findings for the Tunnel Alternative.

The immersed tube Tunnel Alternative would be along a corridor approximately 800 to 1,000 feet (243.8 to 304.8 meters) east of the Bonner Bridge alignment and have a horizontal curve to intersect the approach roadways on shore. A representative alignment is illustrated in Figure 2-1. The corridor and alignment were selected to minimize the overall tunnel length. The minimum length generally is determined by the width of the water channel above the tunnel and the allowable slope of the tunnel roadway. In keeping with the scour protection design criteria of 50 feet (15.2 meters) below mean sea level used during the 1991 feasibility study, the approximate length of the main channel of the tunnel would be 5,000 feet (1,524 meters). At both ends of the main channel section, the tunnel would rise at a maximum grade of 4 percent to 5 feet (1.5 meters) above mean sea level. The overall tunnel length from portal to portal would be approximately 11,300 feet (3,444 meters). A 2,500-foot (762-meter) approach bridge would be built on Bodie Island. Approach roads on fill would be built on Hatteras Island and lead to the bridge on Bodie Island.

Sections 2.2.7.1 through 2.2.7.4 describe design characteristics, environmental impact potential, costs, and construction procedures of the Tunnel Alternative.

2.2.7.1 Design Characteristics

Design Criteria and Traffic Service

With the immersed tube tunnel, a roadway with two 13-foot (4-meter) lanes would be used (see Figure 2-2). A narrow width was assumed because of the high cost of tunnels. Unlike the bridge alternatives, the tunnel would not be wide enough to accommodate two lanes of traffic moving off Hatteras Island during an emergency. There would be no provision for pedestrians or bicyclists. Adequate ventilation could not be provided for pedestrians and bicycles.

Scour

General scour at Oregon Inlet's gorge would be 50 feet (15.2 meters) below mean sea level. Thus, the scour depth criteria used for the Tunnel Alternative was 50 feet (15.2 meters) below mean sea level across the inlet. To provide a minimum of 5 feet (1.5 meters) of cover backfill over the tunnel element, the top of the tube would be at 55 feet (16.8 meters) below mean sea level.

Tunnel Components

The components of the tunnel structure would include the approach ramps, ventilation buildings, and immersed tubes in dredged trenches. The approach ramps and ventilation buildings on each side of the immersed tunnel would be constructed on shore, outside the limits of the scour areas. The top elevation of the approach would be established to protect the tunnel from the hazards of flooding in extreme weather conditions.

The tunnel would be flanked by two approach ramps descending to the portals from a low-level bridge on Bodie Island and from fill on Hatteras Island. The approach ramps would consist of a sloped embankment and a depressed roadway of two 13-foot (4-meter) lanes within a cast-in-place, reinforced concrete U-type structure. The U-type structures could be built either in an open excavation with sloping sides or within a sheeted and braced open excavation. Tunnel vertical clearance would be greater than 18 feet (5.5 meters) and would not restrict large vehicles.

To remove exhaust air and furnish fresh air through the air ducts, two ventilation buildings, one at each portal, would be required. A portal sump with pump room would be required at each building to intercept any runoff from the approach ramp leading to the portal.

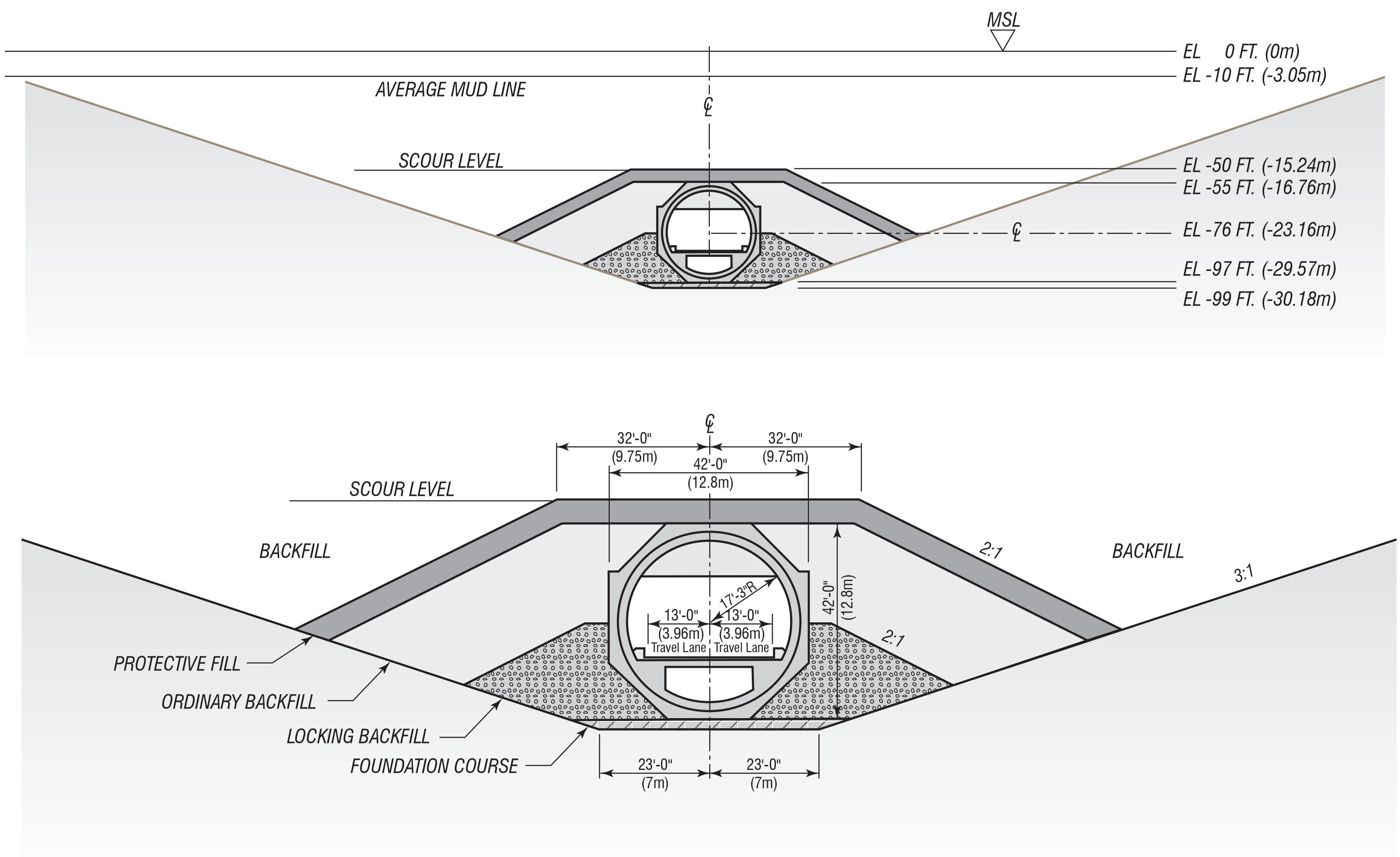
The immersed portion of the tunnel between ventilation buildings would be constructed by linking prefabricated tube segments, each approximately 300 feet (91.4 meters) long. The steel shell tube segments would be constructed off-site, launched, outfitted with concrete, floated to the site, and sunk into dredged trenches onto a screeded (smoothed) foundation course.

To construct the tunnel, a large amount of material would be dredged from the channel bottom. This amount would be extremely large based on the criteria of placing the tunnel below the scour elevation of 50 feet (15.2 meters) below mean sea level.

2.2.7.2 Environmental Impact Potential

The environmental impact potential of the Tunnel Alternative is summarized in Table 2-3. Key environmental impact concerns are:

- Substantial impacts on biotic communities would occur. The portals and tunnel approaches on Hatteras Island and Bodie Island, as well as the bridge approach on Bodie Island would permanently use approximately 23 acres (9.2 hectares) of wetlands. A total of 33.3 acres



TUNNEL TYPICAL SECTION

Figure
2-2

(13.3 hectares) of wetlands would be filled. These wetlands include both estuarine intertidal emergent wetlands and estuarine subtidal wetlands. Habitat for wintering waterfowl and migrating shorebirds would be lost permanently. In addition, dredging and/or a haul road would be required on Bodie Island during construction of the approach trestle.

- Excavation of Oregon Inlet's bottom during construction would remove benthos in an area approximately 600 feet (182.9 meters) wide and 11,300 feet (3,444 meters) long (approximately 150 acres [60 hectares]).

2.2.7.3 Cost

The total cost for the Tunnel Alternative over 40 years would be approximately $258 million (1991 dollars). Including excavation, backfill, the sunken tube, portal and vents, fans, and approaches, the order of magnitude construction cost for the Tunnel Alternative would be $236 million (1991 dollars). Operation and maintenance costs could average $500,000 to $600,000 per year or between $20 million and $24 million over the 40-year life (1991 dollars). Operation and maintenance costs would include regular maintenance to ventilation fans and sump pumps, lighting, washing of tunnel walls, as well as replacement of worn equipment.

2.2.7.4 Construction

In the construction of an immersed tube tunnel, prefabricated tunnel segments would be laid in a pre-excavated trench across Oregon Inlet's bottom, linked to previously installed segments, and then covered with backfill to secure them in place (see Figure 2-2). The excavation limits for the trench would be governed by subsoil conditions, as well as the dimensions of the tube. The trench excavation would need to be deep enough to provide a minimum 2-foot (0.6-meter) thick foundation course beneath the tube, and a minimum 5-foot (1.5-meter) cover of backfill over the tube. Side slopes of the trench excavation would depend on the properties of the subsoils. In the soft channel bottom deposits, the excavation could require a 1:3 slope, or flatter. In the stiffer underlying soils, excavation slopes could be approximately 1:2. Figure 2-2 indicates a trench that is 600 feet (182.9 meters) wide. Because of the strong currents in the channel, it could be difficult to maintain the trench side slopes because of constant infilling. Spoil would be disposed in the sound or ocean.

Trench backfill would include a foundation course, locking fill, and ordinary backfill:

- The foundation course would consist of a 2- to 3-foot (0.6- to 0.9-meter) thick layer of sand and gravel.

- The locking fill would consist of graded granular material ranging in size from sand to about 3-inch size (7.6 centimeters) stone to lock the tunnel elements in place during backfill placement and provide lateral support for the tubes.

- Ordinary backfill generally is composed of clean granular material to minimize silting and turbidity during placement in the channel.

On top of the ordinary backfill, a riprap layer would be placed to provide protection from ships' anchors and, if required, from erosion because of action by the current. Because of the extreme scour problems in Oregon Inlet, special riprap design could be required to protect the tubes.

2.2.8 East Bridge Corridor

A bridge corridor east of Bonner Bridge also was examined during the 1991 feasibility study. The East Bridge Corridor was not studied in detail in the "Environmental Consequences" chapter of the 1993 DEIS, nor this FEIS for the following reasons:

- Although shorter than the 1993 Parallel Bridge Corridor, it would result in greater impacts to biotic communities and wildlife habitat on Bodie Island. This would include impacts to birds that forage, rest, and sporadically nest on the southern tip of Bodie Island.

- Cost savings resulting from a shorter structure would be offset by costs related to the risks introduced by construction in an area of greater wave activity and faster currents during storm surges and less protection from storms. Conversations with several contractors working in the Oregon Inlet area indicated that working conditions in this corridor would increase equipment, insurance, and down time costs. Thus, the cost of a bridge in this corridor would be virtually identical to the cost of a bridge in the 1993 Parallel Bridge Corridor.

Table 2-1, Table 2-2, and Table 2-3 document the transportation, coastal engineering, and environmental study findings for the East Bridge Corridor. The cost and engineering characteristics associated with the East Bridge Corridor cannot be compared to the 1993 Parallel Bridge Corridor as presented in this chapter in Section 2.12. Unlike the 1993 Parallel Bridge Corridor, the representative bridge assumed in the East Bridge Corridor was not revisited in the 1995 bridge type study because the alternative was no longer under consideration. Thus, the discussion below compares the East Bridge Corridor's cost and engineering characteristics with the 1993 Parallel Bridge Corridor as represented in the feasibility study and the DEIS. If the alignment, south abutment location, and foundations of the East Bridge Corridor's representative bridge design were altered to achieve the same objectives as the representative design in the 1993 Parallel Bridge Corridor, costs in the East Bridge Corridor would rise to an amount similar to the 1993 Parallel Bridge Corridor costs.

The representative alignment examined for the East Bridge Corridor is illustrated in Figure 2-1. It would have the following bridge length:

Southern Approach Length	1,900 feet (579 meters)
Navigation or Main Spans Length	4,500 feet (1,372 meters)
Northern Approach Length	6,500 feet (1,981 meters)
TOTAL LENGTH	12,900 feet (3,932 meters)

Fill approaches at each end of the structure would be 2,000 feet (610 meters) long on Hatteras Island and 1,000 feet (305 meters) long on Bodie Island, for a total project length of about 15,900 feet (4,846 meters). Fill would be between the natural ground and the 20-foot (6.1-meter) minimum profile grade elevation for the bridge.

The comparable representative bridge project in the 1993 Parallel Bridge Corridor (as used for comparison in the feasibility study and DEIS) would have the following bridge length:

Southern Approach Length	1,700 feet (518 meters)
Navigation or Main Spans Length	5,000 feet (1,524 meters)
Northern Approach Length	6,800 feet (2,073 meters)
TOTAL LENGTH	13,500 feet (4,115 meters)

Fill approaches at each end of the structure would be approximately 2,000 feet (610 meters) long on Hatteras Island and 1,300 feet (396 meters) long on Bodie Island, resulting in a total project length in the East Bridge Corridor of approximately 16,800 feet (5,120 meters).

The following paragraphs describe design characteristics, environmental impact potential, costs, and construction procedures of the East Bridge Corridor in contrast to the 1993 Parallel Bridge Corridor.

2.2.8.1 Design Characteristics

Design Criteria

The design criteria used for a representative bridge in the East Bridge Corridor were the same as those presented for the 1993 Parallel Bridge Corridor, as defined in the 1993 DEIS and after the 1995 bridge type study. The only exceptions were the scour criteria. Scour depths used for the East Bridge Corridor representative project were not as deep as those defined for the 1993 Parallel Bridge Corridor during the 1995 bridge type study. Scour depths assumed for the East Bridge Corridor ranged from 20 feet (6.1 meters) below mean sea level to 75 feet (22.9 meters) below mean sea level. The comparable 1993 Parallel Bridge Corridor in the 1993 DEIS used the same design criteria as the East Bridge Corridor representative project except a 70-foot (21.3-meter) preliminary depth of scour was used in the location where a depth of 75 feet (22.9 meters) was specified for the East Bridge Corridor.

Bridge Type Options

During the feasibility study and preparation of the 1993 DEIS, several superstructure (structural components spanning the distance between piers) options were evaluated for both the East and 1993 Parallel Bridge Corridors. Two basic types were considered: precast girders and segmental box girders.

For the navigation zone, precast girders with a span length of 225 to 240 feet (68.6 to 73.1 meters) and box girders with a span length of 220 to 400 feet (67.1 to 121.9 meters), were evaluated. Outside the navigation zones, precast girders with spans 90 feet (27.4 meters) long and 135 to 145 feet (41.1 to 44.2 meters) long were considered, as well as box girders with spans of 140 to 150 feet (42.7 to 45.7 meters).

For foundations, 54-inch (135-centimeter) precast concrete cylinder piles were assumed. Based upon the geotechnical information available at the time for the existing structure site and a 70-foot (21.3-meter) scour depth, pile tip elevations between 100 and 150 feet (30.5 and 45.7 meters) below mean sea level, depending upon structure type and load, were assumed. At locations requiring a 50-foot (15.2-meter) scour depth, pile tip elevations were assumed to range between 75 and 95 feet (22.9 and 29.0 meters) below mean sea level.

Other

At each end of the East and 1993 Parallel Bridge corridors, fill at a 3:1 slope was assumed instead of structure between the natural ground and the 20-foot (6.1-meter) minimum profile grade elevation for the bridge. Characteristics of recreational access opportunities and utility relocation were the same as for the 1993 Parallel Bridge Corridor.

2.2.8.2 Environmental Impact Potential

The environmental impact potential of the East and 1993 Parallel Bridge corridors is summarized in Table 2-3. Most environmental impacts of the East Bridge Corridor are expected to be similar to those of the 1993 Parallel Bridge Corridor. The natural resource impact of this alternative in contrast to the 1993 Parallel Bridge Corridor is the key environmental concern. The East Bridge Corridor is shorter than the 1993 Parallel Bridge Corridor. Rather than minimizing harm, however, construction of a bridge in the East Bridge Corridor would cross the Bodie Island spit far from its end in a good shorebird nesting habitat. Suitable habitat for federally protected birds also is more likely to occur in the East Bridge Corridor than in the 1993 Parallel Bridge Corridor. The East Bridge Corridor would dissect larger and more diverse habitats than the 1993 Parallel Bridge Corridor, potentially causing a greater adverse impact to wildlife. The permanent and temporary use of wetlands also would be greater than with the 1993 Parallel Bridge Corridor.

2.2.8.3 Costs

The total cost for a bridge in the East Bridge Corridor would be virtually identical to a comparable bridge in the 1993 Parallel Bridge Corridor. Construction costs (in 1991 dollars) in the East Bridge Corridor would be as much as $55.5 million compared to $54.8 million for a comparable bridge in the 1993 Parallel Bridge Corridor. (The East Bridge cost of $55.5 million cannot be compared directly to the 1993 parallel corridor bridge capital cost of $88.7 million presented in Section 2.15 because it has not undergone the same post-public hearing and bridge type study refinements. If the alignment, south abutment location, and foundations of the East Bridge Corridor's representative project were altered to achieve the same objectives as the post-type study 1993 Parallel Bridge Corridor project, its costs would rise to a level similar to $88.7 million.)

Although the East Bridge Corridor is shorter than the 1993 Parallel Bridge Corridor and presumably cheaper because there would be less bridge to build, the additional construction risk of working closer to Oregon Inlet would add $4.6 million (1991 dollars) to the East Bridge cost. This addition would make the total cost virtually identical to the cost of a bridge in the 1993 Parallel Bridge Corridor. This additional cost was identified through discussions with contractors who have experience constructing bridges in an environment like that of Oregon Inlet. The cost reflects the use of sea-going barges, higher insurance costs, and increased down time during inclement weather (see Section 2.2.8.4).

Operation and maintenance costs for a bridge in the East Bridge Corridor would be the same as those for the 1993 Parallel Bridge Corridor.

2.2.8.4 Construction

Construction in the East Bridge Corridor would involve greater risks than construction in the 1993 Parallel Bridge Corridor. The East Bridge Corridor is an area of greater wave activity. Faster currents during storm surges and less protection from storms would necessitate the use of more stable jack-up barges, additional insurance, and increased down time because of inclement weather.

During calm periods, the difference in currents and waves between the East Bridge Corridor and the 1993 Parallel Bridge Corridor is small. The difference increases markedly, however, as weather conditions grow severe. Oregon Inlet is narrower at the East Bridge Corridor. Currents at the East Bridge Corridor have been estimated to increase to almost double those at the 1993 Parallel Bridge Corridor under extreme ocean storm surges. There is less wave activity parallel to Bonner Bridge since it is sheltered from ocean waves by Bodie and Hatteras islands to a greater extent than the East Bridge Corridor. Also, the shoals between the two corridors cause many waves to break before they can reach a corridor immediately adjacent and parallel to Bonner Bridge; this would affect construction barges in the East Bridge Corridor.

2.2.9 West Bridge Corridor

A bridge corridor to the west of Bonner Bridge and farther into Pamlico Sound than the 1993 Parallel Bridge Corridor also was considered during the 1991 feasibility study (see Figure 2-1). It was examined solely because it would have the advantage of placing a replacement bridge in an area where the navigational channel is defined more clearly. This corridor is similar to Corridor Alternative 1 that was examined and then dropped from consideration in the 2002 corridor alternatives studies described in Section 2.3.

In 1991, it was concluded that this corridor would result in a crossing substantially longer than the other crossing alternatives considered at that time (approximately 6 miles [9.6 kilometers] long compared to 2.7 miles [4.3 kilometers] for the 1993 Parallel Bridge Corridor), would involve greater cost, and would result in more difficult and less desirable connections to NC 12 on either end of the bridge.

In 1991, it was concluded that use of the West Bridge Corridor would not minimize harm to the Refuge, although at the time the long-term maintenance of NC 12 from Oregon Inlet to Rodanthe was not component of the alternatives studies. The West Bridge Corridor would pass through additional environmentally sensitive areas on the Refuge in contrast to the 1993 Parallel Bridge Corridor. It would pass through the waters of Pamlico Sound just off Hatteras Island, which are used by thousands of wintering waterfowl for feeding and resting. It also would be a location close to numerous dredge material islands used extensively by colonial waterbirds for nesting. The West Bridge Corridor's use of wetlands would be as follows:

Community	*Permanent Fill acres (hectares)*	*Temporary Construction Impact acres (hectares)*
Low Shrub/Grassland	6.5 (2.6)	3.7 (1.5)
Maritime Shrub Thicket	0.3 (0.1)	1.5 (0.6)
Saltmeadow Flats	0.0 (0.0)	1.3 (0.5)
Needlerush Pockets	0.0 (0.0)	1.0 (0.4)
Smooth Cordgrass Stands	1.0 (0.4)	1.3 (0.5)
Mudflats	0.0 (0.0)	1.0 (0.4)
Submerged Aquatic Vegetation (SAV) Beds	0.0 (0.0)	0.5 (0.2)
TOTAL	**7.8 (3.1)**	**10.3 (4.1)**

The permanent and temporary use of wetlands would be greater than those associated with the 1993 Parallel Bridge Corridor (see Table 2-3).

Finally, the West Bridge Corridor would provide for the relocation of a portion of NC 12 that is threatened by beach erosion. This, however, was not considered a positive attribute during the 1991 to 1994 studies for reasons discussed in Section 2.2.1.4. For these reasons, a corridor to the west of Bonner Bridge was eliminated from consideration early in the feasibility study process.

2.3 2002 Pamlico Sound Bridge Corridor Alternatives Study

Since the 1994 public hearings and the selection of the 1993 Parallel Bridge Corridor as the Preferred Alternative, changes in the setting of the project resulted in the decision to assess additional alternatives. NC 12 is regularly threatened by shoreline erosion and overwash. Three areas on NC 12, or "hot spots," between Oregon Inlet and Rodanthe are especially vulnerable. One hot spot, known as the Canal Zone Hot Spot (shown on Figure 1-1), is immediately south of the southern terminus of Bonner Bridge and is already overwashed during minor storm events.

The issue of shoreline erosion and overwash was recognized in the previous studies as noted in the assumptions presented in Section 2.2.1.4. It was assumed, however, in the 1993 DEIS that in the short term NC 12 could be moved farther west as needed. Since the 1993 DEIS, the Outer Banks Task Force (OBTF) was established to develop a long-term protection and maintenance plan for the transportation system on Hatteras and Ocracoke islands. This partnership includes representatives from the NCDOT, the Federal Highway Administration (FHWA), the USACE, the NPS, the USFWS, the NMFS, the North Carolina Department of Environment and Natural Resources (NCDENR), and other state and federal environmental resource and regulatory agencies. The Memorandum of Agreement (MOA) establishing the OBTF has expired, but the OBTF continues to meet to share information and to foster continued relationships.

The OBTF's goals under its MOA included:

- Preserving the natural barrier island system;
- Minimizing impacts to Hatteras and Ocracoke islands; and
- Maintaining access to and on the islands so that the transportation system is safe, efficient, and has minimal impact on the environment.

A part of the work of the OBTF under its MOA was to develop both short-term and long-term plans for maintaining NC 12 in light of recent trends of shoreline erosion and highway overwash. Bonner Bridge replacement decisions now consider the placement of a replacement bridge within the context of these larger OBTF goals. Thus, this section and Sections 2.4 to 2.7 examine several new bridge corridor alternatives with respect to natural resource impacts, costs, natural resource agency input, and other evaluation criteria. This material from the studies described in this section was presented in the report, *Evaluation of Corridor Alternatives* (Parsons Brinckerhoff Quade & Douglas, Inc., January 2003).

The National Environmental Policy Act (NEPA)/Section 404 Merger Team meetings are a formal means for early involvement in the project development process for state and federal environmental resource and regulatory agencies that have an interest in the issuance of USACE dredge and fill permits for wetland and stream impacts under the terms of Section 404 of the Clean Water Act. The findings of the alternatives studies described in this section and in Section 2.4 were discussed with the NEPA/Section 404 Merger Team. More information regarding the NEPA/Section 404 Merger Team is in Section 8.3.1. The first meeting of the Merger Team for this project was held on July 31, 2002.

2.3.1 Screening Criteria

During the 2002 studies, potential new corridors were developed and screened for suitability based on several criteria, including:

- The corridor and the southern NC 12 termini locations should be potentially compatible with the April 1938 Executive Order 7864 creating the Pea Island National Wildlife Refuge, the National Wildlife Refuge System Improvement Act of 1997, and Refuge's Management Plan;

- The corridor and NC 12 termini locations should be potentially eligible to receive a non-impairment determination from the NPS;

- Selected corridors should minimize impacts to multiple resources, including SAV, wetlands, and federally protected species; and

- Corridor locations should be compatible with a possible connection to a longer bridge extending further south (potential long-term solution for maintenance of NC 12) or other long-term solutions to NC 12 maintenance.

2.3.2 Corridor Alternatives

Corridors were identified to meet the screening criteria and to avoid sensitive resources to the extent possible. The corridors were placed to provide a bridge that is constructible, crosses navigation channels at a reasonable angle, and avoids the rising sand island west of the south shoulder of Oregon Inlet. The three areas where the corridor rejoins NC 12 on Hatteras Island are:

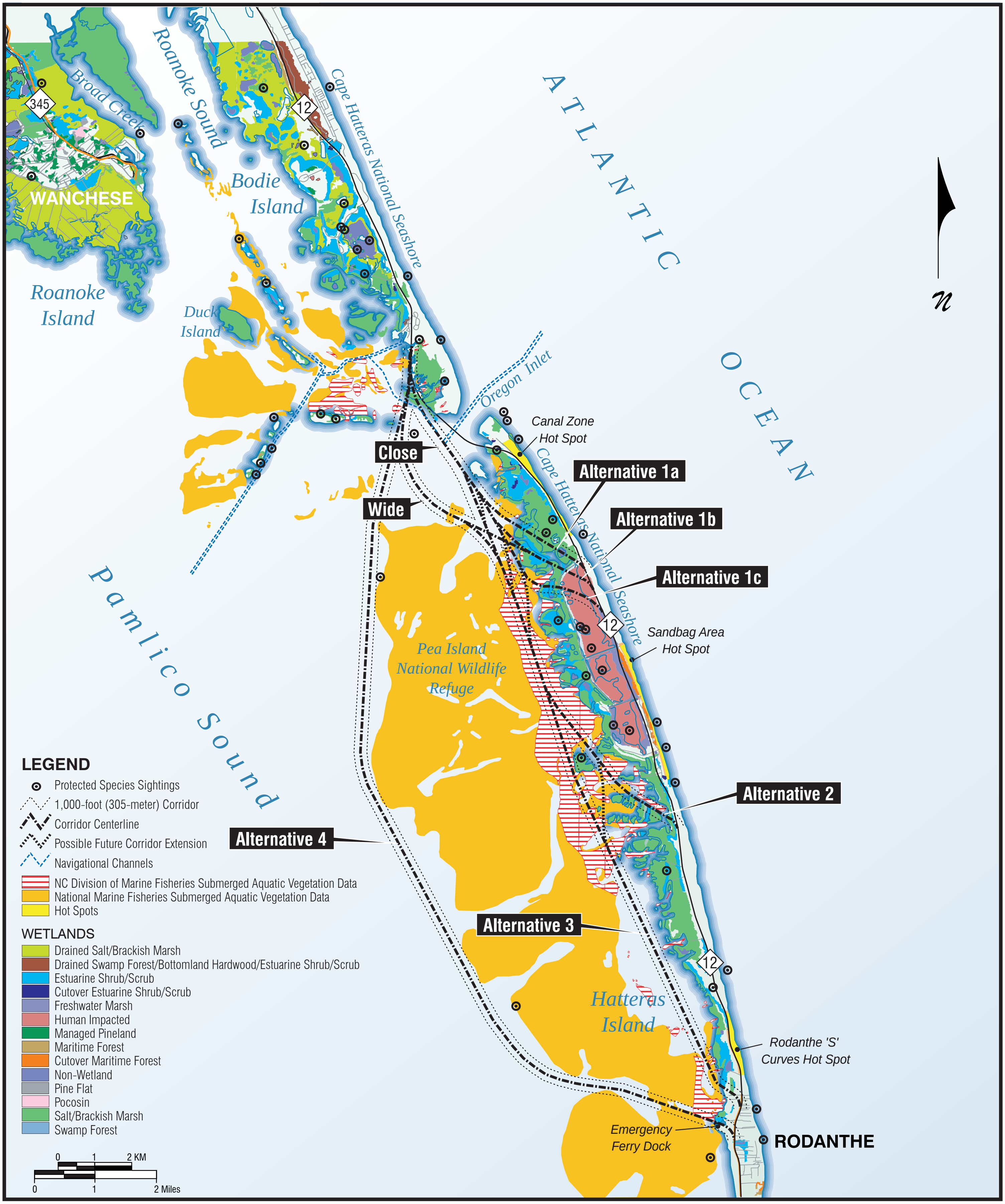
- Between the Canal Zone and Sandbag Area hot spots (Corridor Alternative 1);

- Between the Sandbag Area and Rodanthe 'S' Curves hot spots (Corridor Alternative 2); and

- South of the Rodanthe 'S' Curves Hot Spot (Corridor Alternatives 3 and 4).

All of the corridor alternatives begin on Bodie Island at the existing northern endpoint of Bonner Bridge near the (former) US Coast Guard Station and the Oregon Inlet Marina. The corridor alternatives are shown in Figure 2-3.

Corridor Alternatives 1 through 3 each have a *close* and a *wide* option. The *wide* option is placed farther to the west, increasing the distance between the most dynamic portion of Oregon Inlet and the bridge. The centerlines shown in each corridor on Figure 2-3 are representative of a broad range of potential alignments. The corridors are:



2002 CORRIDOR ALTERNATIVES AND RESOURCES	Figure 2-3

1. Corridor Alternative 1

   Three representative terminus options, or sub-alternatives, were examined for Corridor Alternative 1. Each of the sub-alternatives makes landfall in the Refuge south of the Canal Zone Hot Spot: Corridor Alternative 1a makes landfall on Hatteras Island, just north of the Refuge's wildlife management ponds; Corridor Alternative 1b crosses the Refuge just inside the Refuge's north pond; and Corridor Alternative 1c divides the north pond to a greater extent.

   The *wide* option adds approximately one-half mile (0.8 kilometers) to the length of the bridge. The *close* Corridor Alternative 1 is approximately 5.7 miles (9.1 kilometers) long, and the *wide* Corridor Alternative 1 is approximately 6.2 miles (9.9 kilometers) long.

2. Corridor Alternative 2

   Corridor Alternative 2 ends just south of the second, or Sandbag Area, hot spot. The *close* option is approximately 9.7 miles (15.6 kilometers) long, and the *wide* option is approximately 9.9 miles (15.8 kilometers) long.

3. Corridor Alternative 3

   Corridor Alternative 3 ends just south of the Rodanthe 'S' Curves Hot Spot. The *close* option is approximately 14.6 miles (23.5 kilometers) long, and the *wide* option is approximately 14.8 miles (23.8 kilometers) long.

4. Corridor Alternative 4

   Corridor Alternative 4 also ends just south of the Rodanthe 'S' Curves Hot Spot, but is further west in the Pamlico Sound than the first three corridor alternatives. It has a southern terminus that is near the emergency ferry dock in Rodanthe. It is approximately 17.1 miles (27.4 kilometers) long.

Options for extending the bridge further south (i.e., potential long-term solution) are also shown for each corridor centerline drawn in Figure 2-3. It was assumed that NC 12 would be maintained on Hatteras Island at Rodanthe and the adjoining communities of Waves and Salvo.

2.3.3 Evaluation Factors

To aid in the identification and evaluation of corridors, the following sensitive environmental features were mapped using a Geographic Information System (GIS); the features are shown in Figure 2-3:

- Hot spots;
- Known sites for federally protected species;
- Marsh and sand islands;
- USACE navigation channels;
- NCDENR's Division of Coastal Management (DCM) wetland mapping;

- SAV locations mapped by the NMFS; and
- SAV locations mapped by the NCDENR's Division of Marine Fisheries (DMF).

Other data evaluated but not shown in Figure 2-3 include Refuge land cover classifications, water depth, NPS vegetation types, and Refuge management areas, trails, and other facilities. Public perception and affordability also were evaluation factors.

2.3.3.1 Wetlands

Much of Bonner Bridge currently crosses salt marsh communities. The predominant wetland types crossed by the corridor options include salt/brackish marsh, estuarine shrub-scrub, maritime forest, and pond. Locating a replacement bridge to the west generally would be moving into areas occupied by less wetland and more open water-mudflat habitat. Wetland data in Figure 2-3 is from the DCM.

2.3.3.2 Protected Species

There are several federally-listed threatened and endangered species in Dare County. They are listed in Section 3.7.7 in Table 3-24.

The North Carolina Natural Heritage Program has provided data to the North Carolina Center for Geographic Information and Analysis (CGIA) that show occurrences of Natural Heritage elements in the project area (see Figure 2-3). Natural Heritage elements include state and federally-listed threatened and endangered species as well as other important species. The CGIA does not release information regarding what species is associated with Natural Heritage elements other than threatened and endangered species. The Refuge is considered a Significant Natural Heritage Area.

2.3.3.3 Submerged Aquatic Vegetation

The dynamic nature of the area around Oregon Inlet results in ephemeral habitats, particularly in shallow water and shoreline areas. The NMFS and the Division of Marine Fisheries SAV data used in the 2002 corridor study are shown in Figure 2-3. The NMFS data is based on aerial photography from the early 1990s. The DMF data were generated from boat surveys conducted in the late 1990s. Information on the importance of SAV is presented in Section 3.7.3.1.

2.3.3.4 Biotic Communities

Plant communities consist of primarily wetland communities and some upland maritime shrub-scrub and dune communities. Additional information on biotic communities is in Section 3.7.3.

2.3.3.5 Water, Shellfish, and Fisheries Resources

The estuarine waters of the Pamlico Sound are classified by the NCDENR Division of Water Quality (DWQ) as market shellfish – salt waters (SA) and high-quality waters (HQW) (Pasquotank Basin, Stream Index 30-22). Shallow waters and extensive mudflats within the project area are considered valuable for fisheries resources and important foraging habitat for birds. Additional information on water resources can be found in Section 3.7.2. Additional information on fish and shellfish resources can also be found in Section 3.7.6.2.

2.3.3.6 Public Perception

The area around the Refuge's wildlife management ponds is considered to be of global importance for shorebirds and migratory waterfowl. It is also an area that receives considerable recreational use by bird watchers. The Refuge staff anticipates that impacts to the ponds, other than perhaps those that would occur in association with natural shoreline erosion, would generate public concern, as would impacts to the walking areas around the northernmost freshwater pond.

2.3.3.7 Project Affordability

Because the current bridge is reaching the end of its service life, (at the time of this analysis - 2002) construction of a replacement bridge was scheduled to begin by 2008 so that it would be open by 2012. For this FEIS, these dates are now 2009 and 2013, respectively.

The affordability of the alternatives was based on the NCDOT's 2006 to 2012 TIP that included total funding of $184,000,000 for Bonner Bridge (TIP Project No. B-2500). Of that total, $180,000,000 was for construction and $4,000,000 was for right-of-way acquisition. The Bonner Bridge replacement project at the time of the alternatives analysis represented 34 percent of available statewide bridge replacement funds programmed for 6 years.

The estimated cost for each corridor alternative is in Table 2-4. All cost estimates are for a 4-year construction period and are in year 2000 dollars. The *close* options are more expensive than the *wide* options for each corridor alternative because the required navigation zone (spans with navigation height and width) would be longer with the *close* options. The natural channel or gorge is less stable in Oregon Inlet than in Pamlico Sound.

2.3.4 Alternatives Analysis

A comparison of the corridor alternatives illustrated in Figure 2-3 is shown in Table 2-4.

2.3.4.1 Corridor Alternative 1

Corridor Alternative 1 would have the greatest impact potential to wetlands of the four corridors, although extending the bridge structure to a point near NC 12 would minimize those impacts. The type of wetland impacts would vary depending on the project location; for example, 1a would affect primarily salt/brackish marsh, 1b would affect primarily estuarine shrub-scrub, and 1c would affect primarily the wildlife management ponds. There would be no difference in wetland impacts between the *close* and *wide* options for any of the corridor alternatives. Corridor Alternative 1a would cross 1.2 miles (1.9 kilometers) of Refuge land, 1b would cross 1.3 miles (2.1 kilometers), and 1c would cross 0.9 miles (1.4 kilometers) of Refuge land.

Based on conversations with Refuge representatives, Corridor Alternative 1 was expected to generate a substantial amount of public comment because of its proximity to waterfowl feeding and nesting areas. Splitting the pond under Corridor Alternative 1c would disrupt the ability to walk around the pond and would create a divide that would be much wider than what would be needed if the pond were divided for a resource management purpose. If the pond were split, a second set of pumps would be needed to regulate the water levels.

This alternative would have the greatest amount of bridge structure on the Refuge land, but would affect the least amount of SAV. The *wide* and *close* options would have a similar impact on SAV for all of the alternatives.

Table 2-4. 2002 Corridor Alternatives Impact Comparison

Impact	Corridor Alternatives			
	1 – Canal Zone Endpoint	2 – Sandbag Area Endpoint	3 – Rodanthe Area Endpoint 1	4 – Rodanthe Area Endpoint 2
Relation to Hot Spots	Ties in south of the Canal Zone Hot Spot	Ties in south of the Sandbag Area Hot Spot	Ties in south of the Rodanthe 'S' Curves Hot Spot	Ties in near the emergency ferry dock at Rodanthe (south of the Rodanthe 'S' Curves Hot Spot)
Estimated Impact to SAV in Miles (km) Crossed	a-0.86 (1.38), b-0.84 (1.34), c-1.33 (2.13) *wide* alternative adds 0.22 (0.35) to each sub-alternative	5.07 (8.11) (*close*) 5.29 (8.46) (*wide*)	6.46 (10.34) (*close*) 6.68 (10.69) (*wide*)	1.48 (2.37)
Estimated Impact to Wetlands[1] in Miles (km) Crossed	a-1.2 (1.9), b-1.1 (1.8), c-1.1 (1.8)	0.18 (0.29)	0.33 (0.53)	0.30 (0.48)
• Salt/Brackish Marsh in Miles (km)	a-1.1 (1.8), b-0.24 (0.38), c-0.29 (0.46)	0.17 (0.27)	0.22 (0.35)	0.13 (0.21)
• Estuarine Shrub-Scrub in Miles (km)	a-0.1 (0.16), b-0.53 (0.85), c-0.02 (0.03)	0.01 (0.02)	0.11 (0.18)	0.17 (0.27)
• Maritime Forest in Miles (km)	a-0.0, b-0.0, c-0.20 (0.32)	0.00	0.00	0.00
• Human-Impacted (wildlife management ponds) in Miles (km)	a-0.0, b-0.33 (0.53), c-0.60 (0.96)	0.00	0.00	0.00
Threatened or Endangered Species	Might impact protected species and habitats	Might impact protected species and habitats	Might impact protected species and habitats	Might impact protected species and habitats
Affect on Bird-Watching at Refuge	Corridor in close proximity to wildlife management ponds	Avoids impacts to bird watching since public access points are only at the northern-most pond	Avoids impacts to bird watching	Avoids impacts to bird watching
Estimated Total Length of Bridge in Miles (km)	5.7 (9.1) (*close*) 6.2 (9.9) (*wide*)	9.7 (15.6) (*close*) 9.9 (15.8) (*wide*)	14.6 (23.5) (*close*) 14.8 (23.8) (*wide*)	17.1 (27.4)
Estimated Total Length of Bridge on Refuge Land in Miles (km)[2]	a-1.2 (1.9), b-1.3 (2.1), c-0.9 (1.4)	0.17 (0.27)	0.00	0.00
Estimated Cost of Bridge (Four-Year Construction) in year 2000 dollars	$142,000,000 (*close*) $138,000,000 (*wide*)	$240,000,000 (*close*) $230,000,000 (*wide*)	$357,000,000 (*close*) $347,000,000 (*wide*)	$260,000,000
Cost per Year	$35,500,000 (*close*) $34,500,000 (*wide*)	$60,000,000 (*close*) $57,500,000 (*wide*)	$89,250,000 (*close*) $86,750,000 (*wide*)	$65,000,000
Percent of Annual Available Bridge Replacement Funds ($90,000,000)	39.4 (*close*) 38.3 (*wide*)	66.7 (*close*) 63.8 (*wide*)	99.2 (*close*) 96.4 (*wide*)	72.2
Possible Construction Techniques	Combination of barge access and work bridge	Combination of barge access and work bridge	Combination of barge access and work bridge	Mostly floating access

[1] The sum of the different wetland types might not equal the total because of rounding.
[2] The bridge section through the Refuge would be temporary. This section would be removed upon construction of the long-term solution.

Corridor Alternative 1 would be the least expensive alternative and would be less expensive than the TIP funds for the Bonner Bridge replacement project in 2002. However, the expense and impact of the on-going maintenance of NC 12, including beach nourishment, dune maintenance, and repairs required because of highway overwash during storms, would continue south of the terminus of Corridor Alternative 1 until a long-term solution to NC 12 maintenance, at an additional cost, could be implemented for NC 12 to Rodanthe.

A Refuge representative indicated that the Canal Zone Hot Spot may have extended south to a point across from the northern edge of the first pond. Therefore, the available “window” between the Canal Zone Hot Spot and the North Pond might be smaller than what is depicted in Figure 2-3. Alternatives studies in 2005 and discussed in Section 2.6, found that over time, the Canal Zone Hot Spot and the Sandbag Area Hot Spot will expand and meet.

2.3.4.2 Corridor Alternative 2

Corridor Alternative 2 would extend south of the second hot spot. It would cross approximately 0.17 mile (0.27 kilometer) of Refuge land.

Corridor Alternative 2 would have the least linear impact on Refuge wetlands; however, it would enter into an area of SAV. A work bridge is assumed (and included in the cost estimates) to reduce the severity of the impact. Corridor Alternative 2 would have the greatest impact on SAV when one combines the impact of the initial bridge (5.1 to 5.3 miles [8.2 to 8.5 kilometers]) with the impact of building a possible future bridge extension (1.5 miles [2.4 kilometers]) plus the impact of removing the no-longer-needed portion of the initial bridge (1.4 miles [2.3 kilometers]). The impact would be 8.0 to 8.2 miles [12.9 to 13.2 kilometers].

Corridor Alternative 2 *wide* would be approximately 25 percent more expensive than the TIP funds allocated for Bonner Bridge in 2002. Corridor Alternative 2 *close* would be 30.4 percent more expensive than the 2002 allocated TIP funds. In addition, the expense and impact of the on-going maintenance of NC 12, including beach nourishment, dune maintenance, and repairs required because of highway overwash during storms would continue south of the terminus of Corridor Alternative 2 until a long-term solution to NC 12 maintenance could be implemented for NC 12 to Rodanthe.

2.3.4.3 Corridor Alternative 3

Corridor Alternative 3 would be the most expensive of the four alternatives. Corridor Alternative 3 *wide* is 88.6 percent more expensive than the TIP funds allocated in 2002, and Corridor Alternative 3 *close* is 94.0 percent more expensive.

Corridor Alternative 3 would affect 6.5 to 6.7 miles (10.4 to 10.7 kilometers) of SAV. It would completely avoid use of Refuge land, which is a protected resource under Section 4(f) of the US Department of Transportation Act of 1966. (See the introduction to Chapter 5 for a description of the requirements of Section 4(f)).

2.3.4.4 Corridor Alternative 4

Corridor Alternative 4 would include some construction cost savings. There would be barge access for most of the bridge construction, since it would be in deeper water and away from SAV areas. The use of a work bridge, which the other three alternatives would require, is more expensive. Using the year 2000 dollars presented in Table 2-4 that were used in this comparison of alternatives, a bridge in this corridor would be approximately 41.3 percent more expensive than the then (2002) currently allocated Bonner Bridge replacement TIP funds. Its costs are comparable to those associated with Corridor Alternative 2.

Corridor Alternative 4 is the second most preferable alternative from a wetlands and SAV impacts perspective. It also would not cross Refuge land.

2.3.5 Corridor Selected for Detailed Evaluation

At its February 12, 2003, meeting, the NEPA/Section 404 Merger Team (Section 8.3.1.2) selected Corridor Alternative 1 *wide* and Corridor Alternative 4 to be studied in detail in the FEIS. Corridor Alternatives 2 and 3 were removed from consideration because of higher cost and natural resource impacts.

Subsequent to the February NEPA/Section 404 Merger Team Meeting, the USFWS concluded that it would be unlikely that a bridge in Corridor Alternative 1 could be found compatible with the April 1938 Executive Order 7864, which reserved the Refuge to advance the purposes of the Migratory Bird Conservation Act, or with the National Wildlife Refuge System Improvement Act of 1997. Without such a compatibility determination, the USFWS could not issue a permit for the construction of a bridge on new alignment within the Refuge. As a result, on September 10, 2003, the NEPA/Section 404 Merger Team revised their previous decision to study in more detail Corridor Alternatives 1 *wide* and 4 to have additional studies conducted only for Corridor Alternative 4. Recognizing that the cost of a bridge in this corridor would be greater than the funds allocated to the project in the current TIP and that the cost of all alternatives has continued to rise since this analysis of alternatives, the NCDOT was committed to exploring and identifying other additional sources of funds to build this alternative should it be selected as the Preferred Alternative.

Prior to the decision to narrow the scope of the assessment to Corridor Alternative 4, the NCDOT met with Dare County officials and held three Citizen Informational Workshops (two on June 26, 2003, one on July 22, 2003). At the meeting and the workshops, concerns were raised about the continued provision of access to and within Refuge if a replacement bridge were built in Corridor Alternative 4 bypassing the Refuge. Refuge representatives indicated that some type of access within the Refuge would be maintained if a replacement bridge were placed within Corridor Alternative 4. A joint study between the NCDOT, the USFWS, and the NPS would address how best to provide future access within the Refuge.

Henceforth in the FEIS, Corridor Alternative 4 is referred to as the Pamlico Sound Bridge Corridor.

2.4 2003 Pamlico Sound Bridge Corridor Alignment Alternatives Study

On September 10, 2003, following a July 23, 2003 meeting, the NEPA/Section 404 Merger Team selected the Pamlico Sound Bridge Corridor (Corridor Alternative 4) to be studied in detail in the FEIS. Additional data were gathered and evaluated in order to develop alignment alternatives within the Pamlico Sound Bridge Corridor. Section 2.4.3 identifies the resources that were studied in more detail. Results of the study are presented in *Evaluation of Alignment Alternatives* (Parsons Brinckerhoff Quade & Douglas, Inc., July 2003). Using this information, alignments were drawn to meet the screening criteria described in Section 2.4.1 to the extent possible.

Centerlines were placed to insure constructability, to cross navigation channels at a reasonable angle, to avoid the rising sand island west of the south shoulder of Oregon Inlet, and to end between the Rodanthe 'S' Curves Hot Spot (and the southern Refuge boundary) and the emergency ferry dock in Rodanthe.

2.4.1 Screening Criteria

Potential alignments were screened for suitability based on several criteria, including:

- The alignment connections to NC 12 must be potentially eligible to receive a non-impairment determination from the NPS;
- Selected alignments would minimize impacts to multiple natural resources, including SAV, wetlands, and federally protected species; and
- Selected alignments would minimize impacts to cultural resources and community features including historic properties, home and business displacements, scenic views, recreational opportunities, and public services to the maximum extent practicable.

2.4.2 Alignment Alternatives within the Pamlico Sound Bridge Corridor

All of the alignment alternatives within the Pamlico Sound Bridge Corridor terminate on Bodie Island near the US Coast Guard Station and Oregon Inlet Marina, approximately in the same location as the previous 1993 Parallel Bridge Corridor Alternative described in Section 2.2.5. There are two alignment alternatives for the portion of a replacement bridge in the open water of the Pamlico Sound and three Rodanthe terminus options. The alignment alternatives, labeled by segment, are shown in Figure 2-4. Termini locations are shown in more detail in Figure 2-5 and Figure 2-6.

2.4.2.1 Rodanthe Termini – Segments A, B, and C

Segments A, B, and C begin in Rodanthe. All three segments begin north of the emergency ferry dock.

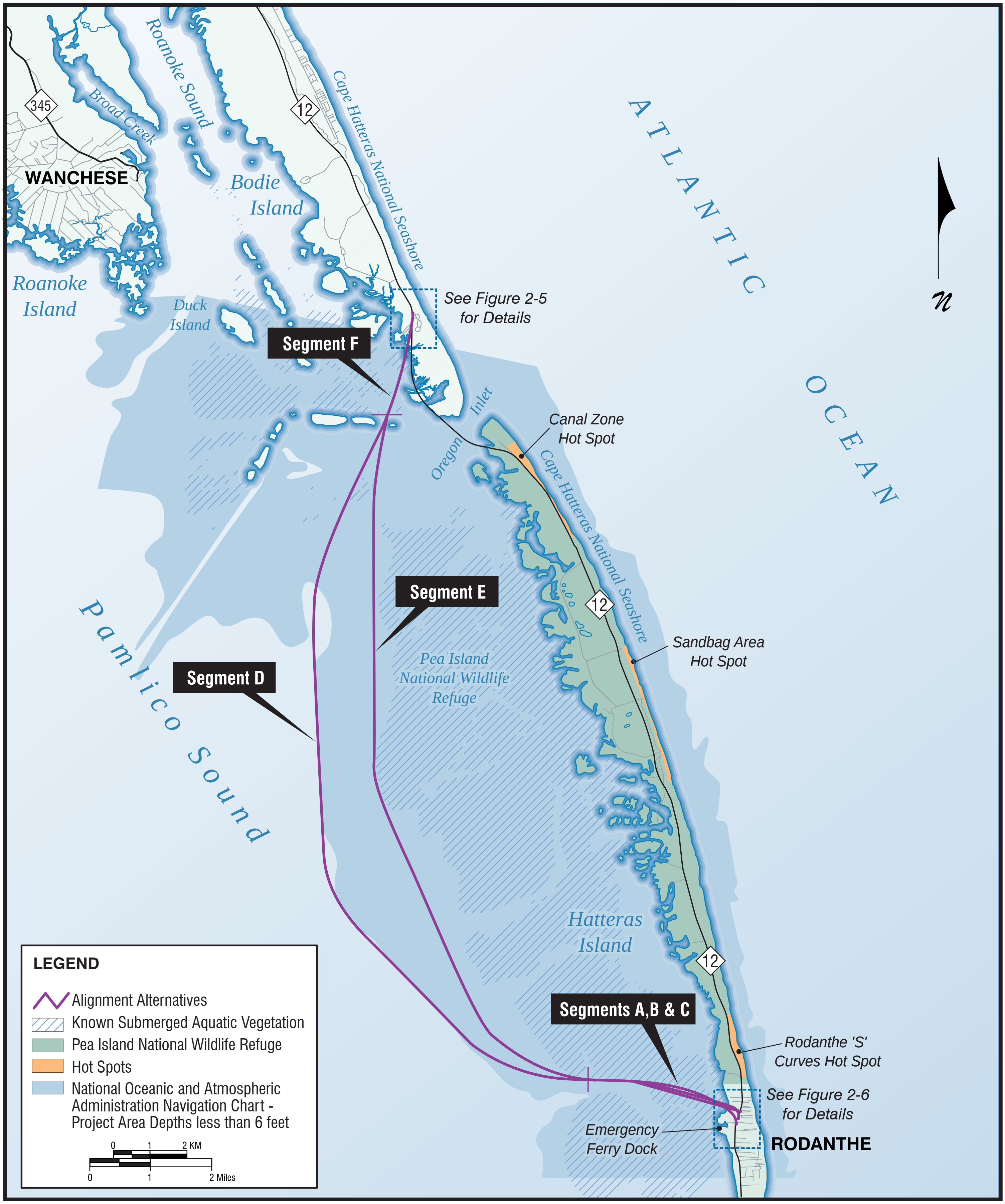
Segment A is 1.9 miles (3.0 kilometers) long. It curves from the land and begins on existing NC 12 approximately 200 feet (61 meters) south of the Liberty service station.

Segment B also curves from the land and is 2.0 miles (3.2 kilometers) long. Segment B begins at existing NC 12 approximately 600 feet (183 meters) south of the Chicamacomico Life Saving Station.

Segment C is 1.8 miles (2.8 kilometers) long and is the northernmost Rodanthe alignment alternative. Segment C begins at existing NC 12 approximately 600 feet (183 meters) north of the Liberty service station. It has a straight approach, and it meets with existing NC 12 at a signalized intersection.

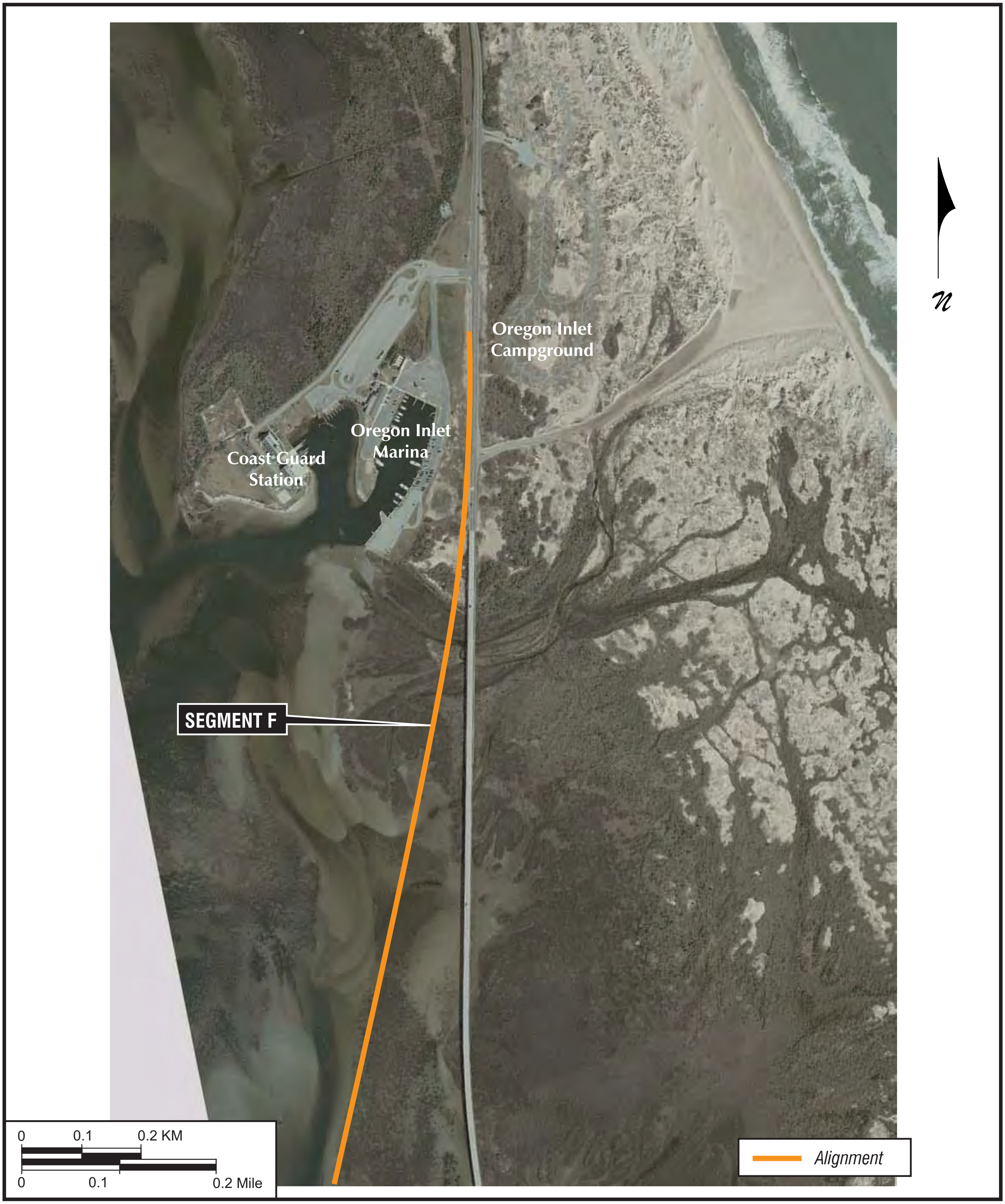
2.4.2.2 Pamlico Sound Open Water – Segments D and E

Segments D and E begin where Segments A, B, and C end. Both extend north through Pamlico Sound, bypassing the Pea Island National Wildlife Refuge. Segment D is 14.8 miles (23.8 kilometers) long and Segment E is 13.8 miles (22.1 kilometers) long. Segment E is within



2003 ALIGNMENT ALTERNATIVES

Figure 2-4



2003 BODIE ISLAND TERMINUS

Figure 2-5

2003 RODANTHE TERMINUS OPTIONS

Figure
2-6

Corridor Alternative 4, just outside of known SAV areas mapped by the NMFS and the DMF. Segment D is further west in areas mapped by the National Oceanic and Atmospheric Administration (NOAA) as having depths greater than 6 feet (1.8 meters). Segments D and E converge as they begin their approach to Bodie Island.

2.4.2.3 Bodie Island Termini – Segment F

Segment F begins where Segments D and E merge and ends just south of the entrance to the US Coast Guard Station and Oregon Inlet Marina. It is 1.3 miles (2.1 kilometers) long.

2.4.3 Evaluation Factors

The following resources were considered in the development of alignment alternatives:

- Community
  - Displacements
  - Views
  - Accessibility
  - Public services
  - Recreational use of Pamlico Sound
  - Traffic service at Rodanthe
- Natural Resources
  - Wetlands
  - SAV locations mapped by the NMFS and the DMF
- Cultural Resources
  - Historic properties
  - Underwater archaeology
- Coastal Conditions

Other factors considered included utility impacts, possible construction techniques, adequacy of traffic service provided, and the potential effect on known hazardous material or underground storage tank sites.

2.4.3.1 Community

Tourism is the principal industry in Dare County and on Hatteras Island. The tourist industry creates a large number of local jobs and generates substantial revenue for both Dare County and the State of North Carolina. Dare County promotes tourism during the peak season and the development of “shoulder” season tourism (in the spring and fall) (Outer Banks Chamber of Commerce, 2001). Abundant natural resources will continue to be a major draw for tourists.

At the time of the study, the NPS web site showed total recreation visits to the Seashore in 2002 at more than 3.6 million. The Seashore is a popular local, state and national vacation destination. Visitors enjoy a variety of activities, including birding, fishing, surfing or wind boarding, swimming, hiking, and attending interpretive programs offered by NPS Rangers. Boating, fishing, wind boarding, and kite boarding are popular recreational activities within the project area.

The USFWS web site for the Refuge shows that it receives 2.7 million visitors annually, including people passing through the Refuge on NC 12, birders, canoeists, beach users, fishermen, and photographers (Pea Island National Wildlife Refuge web site, August 18, 2008).

The southern beaches on Hatteras Island are part of unincorporated Dare County and feature the six recreational-oriented communities of Rodanthe, Waves, Salvo, Avon, Buxton, and Frisco. Hatteras Village, a seventh community, is home to the Hatteras Inlet Ferry Terminal. Rodanthe, like the other communities on Hatteras Island, is experiencing growth. New home construction continues to supply an increasing demand for personal and rental recreational properties. New commercial properties to support the increasing use of the island are also emerging.

Products and services involved with daily life on Hatteras Island come across Bonner Bridge. The island relies heavily on repair and other services from the mainland. Residents (as well as visitors) of Hatteras Island rely on off-island community services. Telephone and electric service are brought to Hatteras Island via Bonner Bridge. See Section 3.1 for additional community information.

2.4.3.2 Natural Resources

The natural resource evaluation factors listed under Section 2.3.3 were assessed when evaluating the Pamlico Sound Bridge Corridor alignment alternatives. In addition, detailed data on wetlands, biotic communities, fisheries and wildlife resources, and protected species were collected and utilized in the alignment alternative evaluation process. (See Section 3.7)

The predominant wetland types crossed by the alignment alternatives are man-dominated, maritime shrub thicket, salt shrub/grassland, black needlerush, and smooth cordgrass (see Figure E-2a through Figure E-2h in Appendix E, which illustrate wetland locations and plant communities in the project area). Plant communities consist of primarily wetland communities and some upland maritime shrub-scrub and dune communities.

The USFWS lists 18 species for Dare County (as of February 11, 2003, the latest available at the time of this comparison of alternatives) that are federally threatened, endangered, or Federal species of concern. However, according to the USFWS, the Shortnose sturgeon should have been included on the USFWS list for Dare County as a federally endangered species. (It was added during the next update.) (Personal communication, April 2, 2004, Dale Suiter, USFWS Raleigh Field Office.) In addition, one species found in Dare County (the red wolf) was listed as experimental by the USFWS. Critical wintering habitat for the piping plover is designated on the shores of Oregon Inlet, both on the southern tip of Bodie Island and the northern tip of Hatteras Island. The Endangered Species Act of 1973 (16 USC 1531-1543) defines critical habitat as specific geographic areas that contain habitat features essential for the conservation of a threatened or endangered species. These areas may require special management considerations or protection. A critical habitat designation affects activities with federal involvement such as federal funding or a federal permit. Federal agencies are required to consult with the USFWS on activities they carry out, authorize, fund, or permit that may affect critical habitat.

North Carolina Natural Heritage Program data show occurrences of Natural Heritage Elements—which include state and federally-listed threatened and endangered species as well as other important species—in the project area.

2.4.3.3 Cultural Resources

Archaeological studies indicate that the environment of the Outer Banks provides little of the stability necessary for good archaeological preservation. Based on historical background research, no sites related to human habitation or evidence of shipwrecks are known in the project area (Krivor, 2003). An underwater archaeological survey identified no potentially significant submerged cultural resources within the project area (Krivor, 2004). Letters from the State Historic Preservation Officer (SHPO) concurring with this finding are included in Appendix A.

The (former) Oregon Inlet US Coast Guard Station at the northern end of Hatteras Island is listed in the National Register of Historic Places (NRHP). It is owned by the State of North Carolina. The Pamlico Sound Bridge Corridor alternatives would be further away from the (former) Oregon Inlet US Coast Guard Station than Bonner Bridge and would not directly affect the Station. However, although the USFWS and the NPS have indicated that they intend to maintain some type of access within the Refuge with these alternatives, the method of access to the Station could be something different than a paved road.

The Chicamacomico Life Saving Station, on the east side of NC 12 at Owens Road in Rodanthe, also is on the NRHP. Constructed in 1910, the Chicamacomico Life Saving Station is representative of the style of station erected for the US Life Saving Service during the late nineteenth and early twentieth centuries. It is owned by the private Chicamacomico Historical Association.

A Phase II Historic Architectural Survey recommends an area that includes four contributing houses, associated out-buildings, and the Chicamacomico Life Saving Station in Rodanthe in the Pamlico Sound Bridge Corridor be considered a National Register-eligible historic district (see Chapter 3, Section 3.4.1). This recommendation was affirmed by the SHPO in a letter dated September 17, 2003 (see Appendix A).

2.4.3.4 Coastal Conditions

From 1849 to 1989, Oregon Inlet has migrated southward approximately 2.2 miles (3.5 kilometers) and 2,070 feet (631 meters) landward (Joyner et al., 1998). Annual erosion rates from 1946 to 1989 are approximately 75 feet (22.9 meters) per year southward and 16 feet (4.9 meters) per year landward (Inman et al., 1989). In addition to Oregon Inlet migration, the inlet has alternated widening and narrowing in response to severe storms since its opening. Because of the continued inlet migration threatening the southern terminus of Bonner Bridge, a terminal groin was constructed in 1989 at the northern end of Hatteras Island. As a result, Hatteras Island migration has halted. However, Bodie Island has continued to exhibit both along-shore and cross-shore migration. The continued migration has resulted in changes in both inlet width and orientation (Moffatt and Nichol, 2003).

Like all active tidal inlets, Oregon Inlet requires periodic dredging to maintain a navigation channel. The current natural inlet gorge is 30 to 40 feet (9 to 12 meters) deep but is south of the primary navigation span on Bonner Bridge.

The rate of erosion of the Hatteras Island ocean shoreline accelerated in 1993 and has continued since then. Shoreline erosion and ocean overwash threaten to sever segments of the NC 12 roadway for several miles south of Bonner Bridge.

2.4.4 Pamlico Sound Bridge Corridor Alignment Alternatives Analysis

The alignment segments described in Section 2.4.2 can be combined into the following alignment alternatives:

- Alignment A – Segments F, D and A;
- Alignment B – Segments F, D, and B;
- Alignment C – Segments F, D and C;
- Alignment D – Segments F, E and A;
- Alignment E – Segments F, E and B; and
- Alignment F – Segments F, E and C.

A comparison of the alignment alternatives is shown in Table 2-5 and discussed below.

All alignment alternatives were considered similar in cost; therefore, cost was not a factor in the comparison of alignments. All of the alignment alternatives terminate on Bodie Island with Segment F. Wetlands were delineated at both the Bodie Island and Rodanthe bridge termini areas (see Figure E-2a through Figure E-2h in Appendix E). No wetlands would be filled to construct Segment F, although approximately 0.15 miles (0.24 kilometers) of wetlands would be bridged. It is estimated that there would be approximately 0.13 miles (0.21 kilometers) of SAV bridged by Segment F. There would be no residential or business displacements or historic property impacts associated with this segment.

The two segments over open water—Segments D and E—connect to Segment F at the southern end of Bodie Island and continue south in Pamlico Sound towards Rodanthe. Segments D and E are outside of areas of known SAV. Segment D, in depths of 6 to 7 feet (1.8 to 2.1 meters), is expected to require minimal dredging to float barges carrying bridge construction equipment and materials. Constructing Segment E, in shallower depths (3 to 4 feet or 0.9 to 1.2 meters), likely would necessitate more dredging to float construction barges than Segment D.

Differences among the three alignment alternatives for a replacement bridge terminus in Rodanthe (Segments A, B, and C) are evaluated in Sections 2.4.4.1 through 2.4.4.6.

2.4.4.1 Pamlico Sound Bridge Corridor Alignment Alternative A – Segments F-D-A

Alignment Alternative A begins at Segment F on Bodie Island, follows the more western, deeper Segment D in the Pamlico Sound, and curves onto land at Rodanthe where it terminates near the Liberty service station. During the alignment study, it was estimated that Alignment Alternative A would displace three homes. It also would displace a building adjacent to the service station that houses three commercial businesses: an auto repair shop, a restaurant, and a produce store.

Table 2-5. Pamlico Sound Bridge Corridor Alignment Alternatives Impact Comparison

Impacts	Alignment Alternatives Comparison					
	Alternative A (Segments F-D-A)	Alternative B (Segments F-D-B)	Alternative C (Segments F-D-C)	Alternative D (Segments F-E-A)	Alternative E (Segments F-E-B)	Alternative F (Segments F-E-C)
Estimated Total Length of Bridge in Miles (Kilometers)	18.0 (29.0)	18.1 (29.1)	17.9 (28.6)	17.0 (27.2)	17.1 (27.4)	16.9 (27.0)
Estimated Total Length of Bridge over Land in Miles (Kilometers)	Rodanthe 0.32 (0.51) Bodie Island 0.44 (0.70)	Rodanthe 0.45 (0.72) Bodie Island 0.44 (0.70)	Rodanthe 0.25 (0.40) Bodie Island 0.44 (0.70)	Rodanthe 0.32 (0.51) Bodie Island 0.44 (0.70)	Rodanthe 0.45 (0.72) Bodie Island 0.44 (0.70)	Rodanthe 0.25 (0.40) Bodie Island 0.44 (0.70)
Control of Access	Full	Full	Full	Full	Full	Full
Service Roads Locations	None[1]	None	None	None[1]	None	None
Utility Impacts[2]	Replace utilities on existing bridge and along NC 12					
Possible Construction Techniques	Mostly barge access	Mostly barge access	Mostly barge access	Mostly floating access with greater potential for construction-related dredging in Pamlico Sound	Mostly floating access with greater potential for construction-related dredging in Pamlico Sound	Mostly floating access with greater potential for construction-related dredging in Pamlico Sound
Adequate Level of Traffic Service at NC 12 Juncture in Rodanthe	Yes					
Residential Displacements[3]	Three[1]	One	None[1]	Three[1]	One	None[1]
Business Displacements[3]	Three[1]	One, and part of the auto storage area for the auto repair business	Part of the auto storage area for the auto repair business	Three[1]	One, and part of the auto storage area for the auto repair business	Part of the auto storage area for the auto repair business
Affect on Views from Homes on Sound in Rodanthe	Middle	Greatest	Least	Middle	Greatest	Least
Historic Properties Affected	No	Yes	No	No	Yes	No

Table 2-5 (concluded). Pamlico Sound Bridge Corridor Alignment Alternatives Impact Comparison

Impacts	Alignment Alternatives Comparison					
	Alternative A (Segments F-D-A)	Alternative B (Segments F-D-B)	Alternative C (Segments F-D-C)	Alternative D (Segments F-E-A)	Alternative E (Segments F-E-B)	Alternative F (Segments F-E-C)
Known Archaeological Resources Affected	No					
Recreational Facilities Directly Affected	No					
Estimated Impact to submerged aquatic vegetation (SAV) in Miles (Kilometers)	1.52 (2.43)	1.52 (2.43)	1.44 (2.30)	1.52 (2.43)	1.52 (2.43)	1.44 (2.30)
Accommodates Channel and Island Movement	Yes					
Estimated Fill in Wetlands[4] in Acres (Hectares)	None	None	Total: 0.53 (0.21) Man Dominated - 0.36 (0.14); Maritime Shrub Thicket - 0.17 (0.07)	None	None	Total: 0.53 (0.21) Man Dominated - 0.36 (0.14); Maritime Shrub Thicket - 0.17 (0.07)
Wetlands Bridged in Miles (Kilometers)	Rodanthe 0.23 (0.37) Bodie Island 0.15 (0.24)	Rodanthe 0.18 (0.29) Bodie Island 0.15 (0.24)	Rodanthe 0.14 (0.22) Bodie Island 0.15 (0.24)	Rodanthe 0.23 (0.37) Bodie Island 0.15 (0.24)	Rodanthe 0.18 (0.29) Bodie Island 0.15 (0.24)	Rodanthe 0.14 (0.22) Bodie Island 0.15 (0.24)
Access to Pea Island National Wildlife Refuge (Refuge)	NC 12 will extend to Refuge Boundary; Refuge will provide some type of access within the Refuge.					
Affect Hazardous Material/Underground Storage Tank Sites[5]	Yes	Possibly	Possibly	Yes	Possibly	Possibly

[1] After the selection of Pamlico Sound Bridge Corridor Alignments A and C for additional study, detailed roadway design drawings were prepared and included right-of-way information. Displacements increased, particularly for Alignment A, when a service road was included during conceptual design to maintain access to all properties.
[2] The utility companies will decide how to replace their services currently on Bonner Bridge; there would be an opportunity to attach utilities to the proposed bridge.
[3] Properties less than 50 feet (15.2 meters) from the alignment centerline (excluding outbuildings) were considered to be displaced.
[4] It was assumed that the first 500 feet (152.4 meters) of the project at each end is on fill. The maximum fill height is 10 feet (3 meters).
[5] Alternative Alignments A and D terminate within 50 feet (15.2 meters) of the Liberty service station pumps. All of the alignment alternatives cross, or are within 50 feet (15.2 meters) of crossing, an area used to store old cars and car parts.

No wetlands would likely need to be filled for this alignment alternative; approximately 0.38 miles (0.61 kilometers) of wetlands would be bridged. Alignment Alternative A would cross an estimated 1.52 miles (2.43 kilometers) of SAV. This is similar to the amount of SAV that would be crossed by the other alignment alternatives.

2.4.4.2 Pamlico Sound Bridge Corridor Alignment Alternative B – Segments F-D-B

Alignment Alternative B begins at Segment F on Bodie Island and follows the more western, deeper Segment D in the Pamlico Sound. Alignment Alternative B curves onto land at Rodanthe, where it terminates south of the Chicamacomico Life Saving Station.

Alignment Alternative B would displace one residence and would cross an area that was used to store cars that are utilized for auto parts by the automobile repair business just north of the Liberty service station. It also is probable that this alternative would displace a commercial business at the end of the alignment. Alignment Alternative B would require the acquisition of land from the NRHP-eligible historic district in Rodanthe.

Along with Alignment Alternative E, this alternative would have the most substantial effect on the views from the homes on the Pamlico Sound of the alignment alternatives. No wetlands would likely need to be filled for this alignment alternative; approximately 0.33 miles (0.53 kilometers) of wetlands would be bridged.

2.4.4.3 Pamlico Sound Bridge Corridor Alignment Alternative C – Segments F-D-C

Alignment Alternative C also begins at Segment F on Bodie Island and follows the more western, deeper Segment D in the Pamlico Sound. Alignment Alternative C makes a straight approach and landfall at Rodanthe, ending at an intersection north of the Liberty service station. A potential benefit of this connection would be a reduction in the amount of right-of-way necessary for the new alignment between the new bridge and existing NC 12 in Rodanthe. A signalized intersection could be designed to provide an adequate level of service for NC 12 traffic.

With this alignment alternative, residential displacements may be avoided. Along with Alignment Alternative F, Alignment Alternative C would have the least substantial effect on views from homes on Pamlico Sound. Alignment Alternative C would cross the area used to store cars by the auto repair business. This alignment alternative would fill approximately 0.53 acres (0.21 hectares) of wetlands and bridge an additional 0.29 miles (0.47 kilometers) of wetlands. The amount of wetlands filled is based on the assumption that as much as the first 500 feet (152.4 meters) of each endpoint would be on fill, and the area filled would be 100 feet (30.5 meters) wide.

2.4.4.4 Pamlico Sound Bridge Corridor Alignment Alternative D – Segments F-E-A

Alignment Alternative D and its impacts are identical to Alternative A except this alternative follows the shallower Segment E in Pamlico Sound. This alternative would increase the probability of needing to dredge the sound bottom during construction.

2.4.4.5 Pamlico Sound Bridge Corridor Alignment Alternative E – Segments F-E-B

Alignment Alternative E and its impacts are identical to Alternative B except this alternative follows the shallower Segment E in Pamlico Sound. This alternative would increase the probability of needing to dredge the sound bottom during construction.

2.4.4.6 Pamlico Sound Bridge Corridor Alignment Alternative F – Segments F-E-C

Alignment Alternative F and its impacts are identical to Alternative C except this alternative follows the shallower Segment E in Pamlico Sound. This alternative would increase the probability of needing to dredge the sound bottom during construction.

2.4.5 Pamlico Sound Bridge Corridor Alignments Selected for Detailed Evaluation

On July 23, 2003, the NEPA/Section 404 Merger Team selected the Pamlico Sound Bridge Corridor Alignment Alternatives A (Segments F-D-A) and C (Segments F-D-C) for detailed evaluation in Chapter 4 of the FEIS (see Section 8.3.1.3). In the rest of the FEIS, Alignment Alternative A is referred to as the Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus, and Alignment Alternative C is referred to as the Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus.

Alternatives B (Segments F-D-B) and E (Segments F-E-B) were not carried forward because Segment B would require the acquisition of land from the NRHP-eligible historic district in Rodanthe. Segment B within these two alternatives also would likely affect the Chicamacomico Life Saving Station property, which is listed on the NRHP.

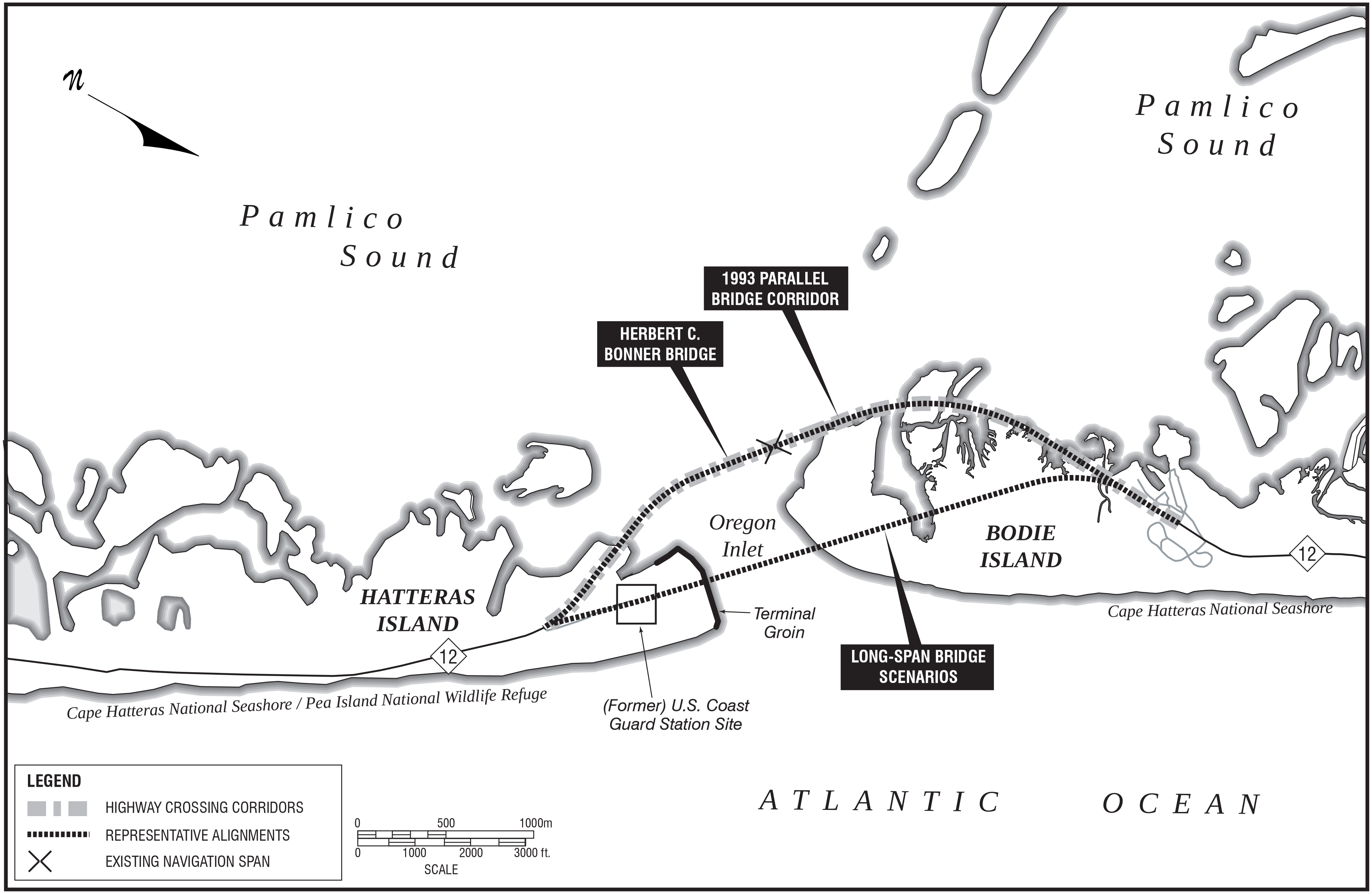
The NEPA/Section 404 Merger Team also did not select Pamlico Sound Bridge Corridor Alignment Alternatives D (Segments F-E-A) and F (Segments F-E-C) for detailed study, because Segment E is closer to shore and would require more dredging during construction of the bridge. This dredging could result in greater turbidity and greater SAV impacts than the other alternatives.

2.5 2004 Additional Replacement Bridge Scenarios

The Dare County Commissioners indicated concerns about the implementation of the Pamlico Sound Bridge Corridor, as selected for detailed evaluation in this FEIS by the NEPA/Section 404 Merger Team. Their concerns are:

- Continued road access to the full length of the Refuge, including the fishing area at the north end of Hatteras Island, would be threatened;
- If the replacement bridge is placed in a location where the groin is not required to maintain the southern bridge terminus, then the retention of the terminal groin could be jeopardized; and
- Funding for a replacement bridge within the Pamlico Sound Bridge Corridor was not fully secured at the time of the analysis. (See Section 2.12.4 on potential funding sources.)

The Dare County Commissioners prefer a replacement bridge that ends near the south terminus of Bonner Bridge and connects to existing NC 12. Specifically, they suggested to the NCDOT in early 2004 that the southern terminus of the replacement bridge be within a 10-acre (4-hectare) parcel that the State of North Carolina owns on the south side of Oregon Inlet, the site of the (former) Oregon Inlet US Coast Guard Station (see Figure 2-7). A replacement bridge ending at this location would pass over Refuge lands between the terminal groin and the State land (a



2004 ADDITIONAL REPLACEMENT BRIDGE SCENARIOS

Figure
2-7

distance of approximately 1,800 feet [549 meters]), thus avoiding a direct impact to Refuge lands. The Commissioners specifically asked in early 2004 that the NCDOT investigate suspension and cable-stayed structures. As with the alternatives considered in the 1993 DEIS, if a replacement bridge were constructed in this location, the NCDOT would have to take additional actions, such as beach nourishment or relocating NC 12, to maintain NC 12 between Oregon Inlet and Rodanthe.

In response to the Dare County Commissioners' concerns, five additional replacement bridge scenarios ending at the northern end of Hatteras Island were examined in early 2004. Four of these scenarios would terminate at the location suggested by the Commissioners. They differ by bridge span type (superstructure). These four scenarios are:

1. Multiple span cable-stayed bridge with the following spans on the main bridge: 750 feet - 1,800 feet - 1,800 feet - 1,800 feet - 1,800 feet - 750 feet (229 meters - 549 meters - 549 meters - 549 meters - 549 meters - 229 meters);

2. Single span cable-stayed bridge with the following spans on the main bridge: 1,800 feet - 4,000 feet - 1,800 feet (549 meters - 1,220 meters - 549 meters);

3. Suspension bridge with the following spans on the main bridge: 1,800 feet - 5,000 feet - 1,800 feet (549 meters - 1,524 meters - 549 meters); and

4. Multiple arch span bridge with the following spans on the main bridge: 270 feet-1,800 feet - 1,800 feet - 1,800 feet - 1,800 feet - 270 feet (82 meters - 549 meters - 549 meters - 549 meters - 549 meters - 82 meters).

The assumed location of these replacement bridge scenarios is shown in Figure 2-7. These four bridge scenarios would have main bridge spans with extended lengths; these are subsequently referred to as "long-span bridge scenarios." The longer spans allow the bridges to span the distance between the terminal groin and the State-owned land where they terminate. They also include long spans across Oregon Inlet. Both of these characteristics were requested by the Commissioners. The four long-span bridge scenarios were compared with a box girder bridge, with multiple navigation spans across Oregon Inlet, in the 1993 Parallel Bridge Corridor (i.e., the Preferred Alternative selected after the 1994 public hearings).

The fifth replacement bridge scenario considered was the combination of a box girder bridge in the Pamlico Sound Bridge Corridor and a connecting bridge between the Pamlico Sound Bridge Corridor and the northern end of Hatteras Island. This scenario also was compared with a bridge in the Pamlico Sound Bridge Corridor alone.

2.5.1 Construction Cost

The construction costs of the four long-span bridge scenarios and the 1993 Parallel Bridge Corridor are shown in Table 2-6 in 2003 dollars, current at the time this study was conducted.

Adding a connector from the north end of Hatteras Island to a Pamlico Sound Bridge Corridor bridge would cost an additional $58.4 million ($353.8 million instead of $295.4 million for a Pamlico Sound bridge alone) in 2003 dollars. The connector bridge and the Pamlico Sound bridge would intersect over Pamlico Sound to the northwest of Hatteras Island.

Table 2-6. Construction Cost Comparison of the Long-Span Bridge Scenarios and the 1993 Parallel Bridge Corridor

Replacement Bridge Scenario		Construction Cost (2003 dollars)[1]
Long-Span Bridge Scenarios	Multiple Span Cable-Stayed	$246,800,000
	Single Span Cable-Stayed	$363,100,000
	Suspension	$746,000,000
	Multiple Arch Span	$295,000,000
1993 Parallel Bridge Corridor (1993 Preferred Alternative)		$151,000,000

[1] Estimated bridge construction costs were presented in the memorandum *Cost Estimates for Bridges to the North End of Hatteras Island, TIP Project No. B-2500, Replacement of the Herbert C. Bonner Bridge (Bridge No. 11) over Oregon Inlet - Dare County, NC* (Parsons Brinckerhoff Quade & Douglas, Inc., May 20, 2004). Costs include approach roadway and bridge cost, as well as the main bridge cost.

The 1993 Parallel Bridge Corridor's costs are the final design costs of a box girder bridge in the 1993 Parallel Bridge Corridor (as discussed in Section 2.15), updated to 2003 dollars by the NCDOT for use in this comparison. These costs reflect either the bridge as described in Section 2.15, or a slightly shorter bridge that would end within the existing NCDOT easement at the northern end of Hatteras Island. The costs are the same because the cost savings associated with the shorter length of such a bridge would be offset by the higher construction costs associated with a temporary bridge erected to serve Bonner Bridge traffic while the new bridge is being built in Bonner Bridge's easement.

The main span cost estimates for the four long-span scenarios were prepared based on existing or planned similar bridges (Parsons Brinckerhoff Quade & Douglas, Inc., May 20, 2004). The costs for the approach roadway and bridges for the four long-span bridges were developed based on the per square foot cost of the 1993 Parallel Bridge Corridor bridge design. The average of the per-square-foot costs of the 1993 Parallel Bridge Corridor bridge and the 17.5-mile-long (28.2-kilometer) Pamlico Sound Bridge Corridor bridge were used to develop the cost for the approach roadway and bridge for the Hatteras Island connector to the Pamlico Sound Bridge Corridor bridge.

2.5.2 Comparison of Long-Span Bridges and 1993 Parallel Bridge Corridor

All four of these scenarios would accommodate the desires of Dare County Commissioners to have the replacement bridge terminating at the northern end of Hatteras Island. However, a box girder bridge in the 1993 Parallel Bridge Corridor would cost far less than any of the long-span bridges.

A new Oregon Inlet bridge in the 1993 Parallel Bridge Corridor could be designed and built so it would terminate within the state's existing NC 12 easement. No new NC 12 easement would be needed, so no Refuge compatibility determination would be needed for the south terminus of such a bridge. A compatibility determination would be needed for any long-term efforts to maintain NC 12 south of Oregon Inlet in areas where the maintenance activities would use Refuge lands outside the NC 12 easement (e.g., in areas where beach erosion threatens existing NC 12).

A long-span bridge would extend to the site of the state-owned (former) US Coast Guard Station by spanning over the sand accreted area behind the terminal groin that is Refuge land, thus also directly using only lands which the state has a right to use. However, by passing over Refuge land, these scenarios would be subject to a compatibility determination by the Refuge in order to get the necessary permits. This bridge alignment also would pass through a longer length of the Cape Hatteras National Seashore on Bodie Island, thereby increasing impacts to this resource rather than minimizing harm as is required by Section 4(f) of the Department of Transportation Act of 1966 (see Chapter 5).

Maintenance cost is an aspect that should be considered in the decision to implement any of the long-span bridge scenarios to the northern end of Hatteras Island. The NCDOT State Hydraulics Engineer has indicated that the selection of a location for the replacement of Bonner Bridge seaward of Bonner Bridge would subject a bridge to substantial adverse conditions associated with the dynamics of the deepwater inlet. The superstructures of the long-span schemes are invariably either all steel (in the case of the single span cable-stayed bridge and the suspension bridge) or composite steel/concrete designs (in the case of the multiple span cable-stayed bridge and multiple arch span bridge). Routine inspection, maintenance, and painting of the steel structural elements, especially where the superstructure is not too high above sea water, would need to be budgeted, scheduled, and diligently performed to ensure longevity of the structure.

2.5.3 Pamlico Sound Bridge Corridor with Hatteras Island Connector

The Pamlico Sound Bridge Corridor with a Hatteras Island Connector also would accommodate the desires expressed by most of the Dare County Commissioners to have a bridge alignment to the northern end of Hatteras Island. This bridge would twice cross the current navigation channel for Oregon Inlet, once with the connector and once with the replacement bridge in the Pamlico Sound Bridge Corridor. This bridge location also would affect the Refuge in a manner similar to the 1993 Parallel Bridge Corridor, including the retention of the terminal groin. It would add approximately $58.4 million (2003 dollars) to the construction cost of the Pamlico Sound Bridge Corridor. Without NC 12 maintenance, the connector bridge would eventually only serve the northern tip of Hatteras Island because NC 12 south of that point would be lost to future shoreline erosion (see Section 2.6.2.1).

2.5.4 Conclusion

Based on the above findings, the NCDOT dropped from further consideration the long-span bridge scenarios and the concept of a Pamlico Sound Bridge Corridor with a Hatteras Island Connector. The Pamlico Sound Bridge Corridor with the two termini options selected for detailed evaluation based on the studies described in Sections 2.3 and 2.4 remained the only alternatives under consideration. After further discussions with Dare County officials, the decision was made to revisit the Parallel Bridge Corridor but with the addition of a NC 12 maintenance component.

2.6 2005 Parallel Bridge Corridor with NC 12 Maintenance Alternatives Studies

The October 13, 2004 NEPA/404 Merger Agreement defined the Parallel Bridge Corridor as consisting of two components: 1) an Oregon Inlet bridge to the west of the existing Bonner Bridge from the northern end of Hatteras Island to Bodie Island; and 2) an NC 12 maintenance alternative designed to keep NC 12 between northern Rodanthe and Oregon Inlet open through 2060. The location of the Parallel Bridge Corridor is illustrated in Figure 2-8. The bridge over the Oregon Inlet was assumed to be that assessed in the 1993 DEIS, as modified in a subsequent bridge type study (1995) and final design development (1999), and including small alignment shifts at the bridge's southern terminus on Hatteras Island to accommodate the locations of various NC 12 maintenance alternatives, as well as 8-foot (2.4-meter) shoulders (as opposed to the 6-foot [1.8-meter] shoulders on the 1999 final design). The focus of the 2005 alternative study was on the NC 12 maintenance component.

There are several challenges associated with the development of a Parallel Bridge Corridor in conjunction with NC 12 maintenance, including the following:

- <u>Coastal Erosion and Potential Breach Formation</u>. There has been a high historic rate of shoreline erosion on parts of Hatteras Island to the north of Rodanthe, and much of NC 12 in the Refuge will be lost by 2060 if current trends continue. The potential exists for Hatteras Island within the Refuge to be breached by a storm.

- <u>Existing NC 12 Easement</u>. The existing NC 12 easement (or right-of-way) through the Refuge is 100 feet (30.5 meters) wide, and any improvements to NC 12 outside of the existing easement would require a Right-of-Way Permit from the USFWS.

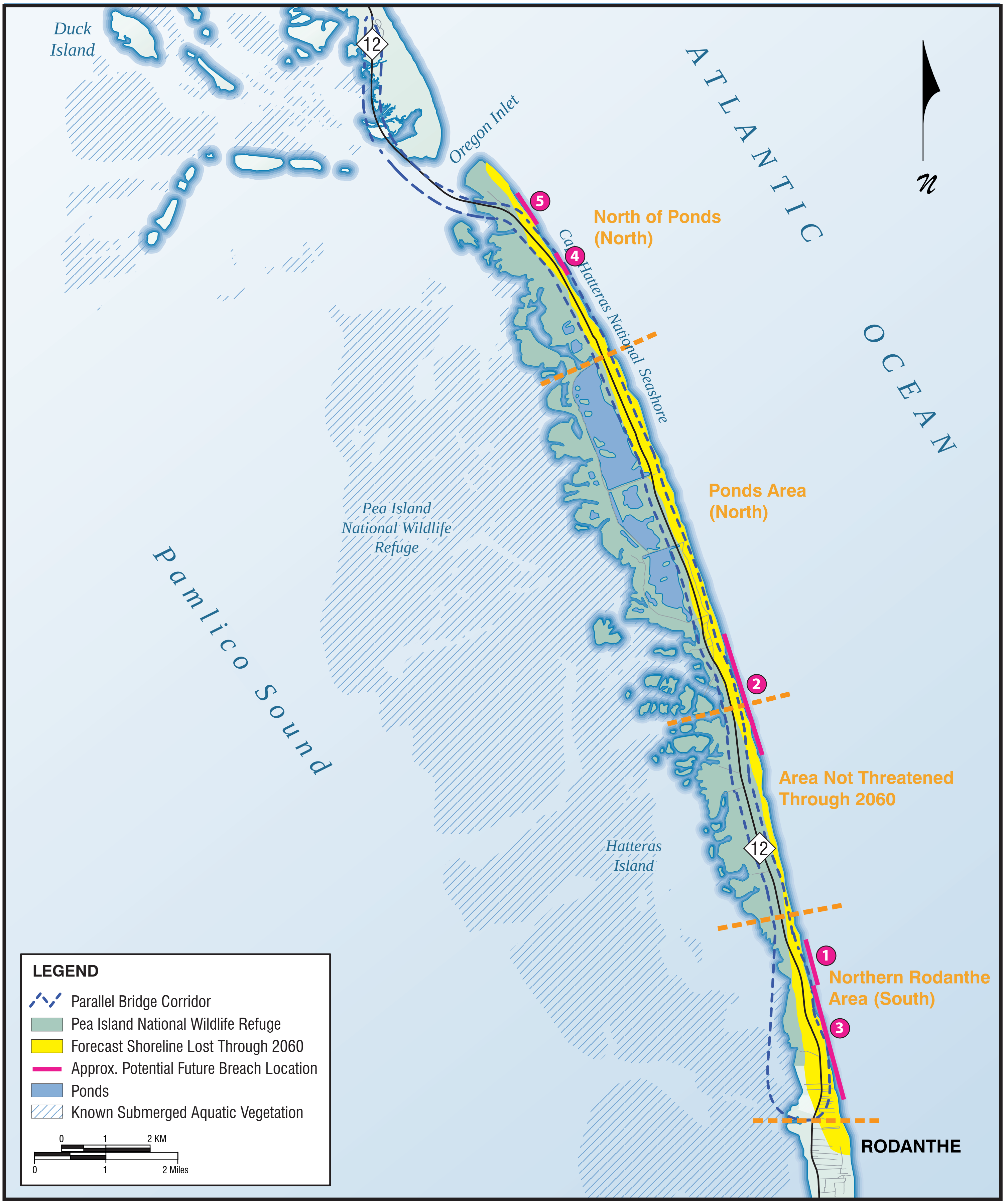
- <u>Wetlands</u>. Most of the land within the Refuge to the west of NC 12 is wetland, so any road relocation on fill to the west could have substantial wetland impacts.

- <u>Refuge Management Plan and Legal Requirements</u>. Any use of lands within the Refuge must be found compatible with the Refuge's Management Plan (e.g., the Plan's goals and objectives) and establishing legislation, as per the National Wildlife Refuge System Improvement Act of 1997. In 2001, Refuge management gave a preliminary determination that the Oregon Inlet bridge in the Parallel Bridge Corridor alone "cannot be found compatible [with their Management Plan] and a Right-of-Way Permit cannot be issued." A Comprehensive Conservation Management Plan for the Refuge was under development at the time. The then current long-range management strategy for the Refuge is found in the 1980 *Pea Island National Wildlife Refuge Master Plan* and was subsequently adopted in July 2006.

- <u>Disposition of the Terminal Groin</u>. The permit granted for the construction of the terminal groin states that the groin's purpose is "to protect the southern segment of the existing Herbert C. Bonner Bridge." Therefore, the USFWS has indicated that a new permit for the groin would be needed if it were to be retained after the demolition and removal of Bonner Bridge. The new permit also would require a compatibility determination.

- <u>Dare County Desire to Maintain Road Access to the Entire Refuge</u>. Any approach to long-term NC 12 maintenance selected for implementation must address Dare County's concerns over maintaining road access to the Refuge, recognizing that other stakeholders do not have the same desire.

Multiple approaches to long-term NC 12 maintenance were evaluated during this study. Based on study findings and coordination with resource and regulatory agency representatives, three alternatives for long-term NC 12 maintenance within the Parallel Bridge Corridor were selected for evaluation in detail in this FEIS. They are:



PARALLEL BRIDGE CORRIDOR FEATURES

Figure 2-8

- Nourishment. Maintenance of NC 12 in the existing easement through beach nourishment with new dunes at several locations;

- Road North/Bridge South. NC 12 relocation to the west as a road in the northern half of the Refuge and on a bridge in the Rodanthe area; and

- All Bridge. NC 12 relocation to the west on a bridge both in the northern half of the Refuge (with Refuge access points) and in the Rodanthe area.

2.6.1 Study Process

2.6.1.1 Coastal Modeling

Coastal modeling was completed in 2004. The coastal modeling process involved developing an analytical procedure to estimate the probability that NC 12 would be "vulnerable" to shoreline erosion through 2060 between Oregon Inlet and Rodanthe. Vulnerable, in this context, means that NC 12 is likely to be exposed to flooding, overwash, or possible damage. Previous NC 12-related erosion studies (associated with several TIP projects considering short-term solutions to the threat to NC 12 of shoreline erosion on Hatteras Island) indicate that damage or overwash is minimized when a 230-foot wide (70.1-meter) buffer is maintained between the road and the ocean, sometimes in association with protective dunes. The future location of the coastline and the required buffer was estimated in 10-year increments from 2010 to 2060 and mapped. The forecast 2010 to 2060 high erosion shoreline locations (in 10-year increments) are shown in Appendix E in Figure E-1a through Figure E-1g. The anticipated 2060 high erosion shoreline is illustrated in Figure 2-8. The analysis assumed that the terminal groin would remain in place through 2060. In addition, the potential for a storm to cause a breach in Hatteras Island within the Refuge was reviewed.

2.6.1.2 Identification of Potential Detailed Study Alternatives

A series of three meetings was held in January 2005 (see Section 8.5.1) to select an initial set of potential alternatives for NC 12 maintenance through 2060 for the Parallel Bridge Corridor. At the first meeting (January 4), which included NCDOT staff, shoreline erosion contours overlaid on aerial photographs of the study area were presented. Potential alternatives for NC 12 maintenance were identified for comparison based on the shoreline erosion information and associated buffers, as well as rough unit cost information, the attendees' understanding of Refuge policies related to NC 12, wetland locations, and other potential stakeholder issues. Also, in order to allow for possibly "mixing and matching" (e.g. using nourishment in one location, and road relocation in another) different options, NC 12 was divided into four segments. These four segments, shown in Figure 2-8, are as follows:

1. Northern Rodanthe Area. From just north of Rodanthe to a point in Rodanthe where NC 12 will be unaffected by erosion in 2060;

2. Area Not Threatened Through 2060. From the southern end of the freshwater ponds to just north of Rodanthe;

3. Ponds Area. From the northern end of the Refuge's freshwater ponds to the southern end of the freshwater ponds; and

4. North of Ponds. From south of Oregon Inlet to the northern end of the Refuge's freshwater ponds.

The second meeting (January 6) included study team members and NCDOT management. The purpose of the meeting was to discuss and refine, as needed, the NC 12 maintenance alternatives that were identified for comparison at the previous meeting.

The third meeting (January 7) included study team members and environmental resource and regulatory agency representatives. The purpose of this meeting was again to discuss and refine, as needed, the general NC 12 maintenance alternatives that were identified for comparison terms at the two prior meetings. The alternatives selected for further consideration following the third meeting were:

- Beach nourishment north of ponds, the ponds area, and northern Rodanthe;
- Relocating NC 12 on a road 230 feet (70.1 meters) (the buffer width defined in Section 2.6.1.1) west of the 2060 high erosion shoreline north of ponds and the ponds area;
- Relocating NC 12 on a bridge at least 230 feet (70.1 meters) west of the 2060 high erosion shoreline north of ponds and the ponds area;
- Relocating NC 12 west of the freshwater ponds on or adjacent to the ponds' dikes in the ponds area;
- Relocating NC 12 on a bridge immediately west of Hatteras Island in northern Rodanthe; and
- In the near term, relocating NC 12 on a road 230 feet (70.1 meters) west of the 2020 high erosion shoreline in northern Rodanthe, and later relocating NC 12 on a bridge immediately west of Hatteras Island in this area.

2.6.1.3 Evaluation of Potential Detailed Study Alternatives

Engineered horizontal alignments were developed for the selected NC 12 maintenance alternatives that included relocating NC 12 on road or bridge. In addition, a beach nourishment program and dune requirements were developed for the beach nourishment alternative. The NC 12 maintenance alternatives were then evaluated and compared by segment using the following evaluation parameters:

- Total cost (i.e., capital cost along with operations and maintenance cost) and discounted cost through 2060;
- Sand requirements (for both dune construction and beach nourishment);
- Potential wetlands impact (both bridged and filled);
- Potential protected species impact;
- Effect on historic resources;

- Potential compatibility with Refuge management objectives;
- Effect on Refuge facilities (both direct and because of change in access to those facilities);
- Effect on Refuge use (both direct and because of change in access);
- Permits or statutory requirements;
- Long-term risk of additional cost or NC 12 disruption by a breach of Hatteras Island in the Refuge; and
- Displacements (homes and businesses).

The results of comparing the alternatives using the above criteria were tabulated for the Oregon Inlet bridge, the four NC 12 maintenance segments listed in Section 2.6.1.2, and representative combinations of NC 12 maintenance alternatives.

2.6.1.4 Selection of Detailed Study Alternatives

A second round of three meetings to select the Parallel Bridge Corridor alternatives with NC 12 maintenance to be evaluated in detail in the FEIS was held in late-March and early-April 2005. Once again, the first meeting in the series (March 22) consisted of the study team members, the second (March 31) meeting included NCDOT management, and the third meeting (April 4) included environmental resource and regulatory agency representatives. The evaluation and comparison of the potential detailed study alternatives was presented and discussed. These discussions formed the basis for the selection of the alternatives to be evaluated in detail in the FEIS, which are described in Section 2.6.4.

2.6.2 Coastal Studies

2.6.2.1 Shoreline Erosion

The methodologies used to determine coastal morphological change through 2060 included both long-term and short-term shoreline change assessments. Long-term shoreline change (including that associated with sea level rise) was determined from an analysis of shoreline position data spanning a 58-year period from 1946 to 2004. Linear trends were determined for 106 transects (shoreline location cross-sections) within the study area between northern Rodanthe and Oregon Inlet.

The highest erosion rates occur in the northern Rodanthe area with an average of 11 feet (3.4 meters) per year. In the ponds area, the average rate is 7 feet (2.1 meters) per year. For the area north of the ponds, the erosion rate is approximately 5 feet (1.5 meters) per year.

The prediction of future shoreline position assumes that the trend in the shoreline change from the historical data will continue until 2060. Because of the complex interactions that cause shoreline change, a high erosion future shoreline was assumed in developing alternatives for NC 12 maintenance through 2060 (see Section 3.6.3.1 for a discussion of the identification and definition of the 2060 high erosion shoreline). Sea level rise associated with past changes in shoreline position was reflected in the forecast. The influence of accelerated sea level rise on the forecasts is discussed in Section 3.6.3.3.

In addition, highway vulnerability to long-term erosion is defined as being susceptible to flooding and overwash when the distance from the edge-of-pavement to the active shoreline (i.e., the mean high water line) becomes less than or equal to 230 feet (70.1 meters) (i.e., the buffer width between the road and the ocean discussed in Section 2.6.1.1). This distance of 230 feet (70.1 meters) was added to the 2060 high erosion shoreline in order to establish the closest point to the ocean appropriate for NC 12 relocation alternatives.

The predicted 2060 high erosion shoreline is illustrated in Figure 2-8. The forecast 2010 to 2060 high erosion shoreline locations (shown at 10-year intervals) are illustrated in Figure E-1a through Figure E-1g in Appendix E.

2.6.2.2 Dune Requirements

The road elevation for NC 12 varies between 3 and 9 feet (0.9 to 2.7 meters) (North American Vertical Datum [NAVD], 1988) from Oregon Inlet to Rodanthe. Mean high water is approximately 1.2 feet (0.4 meter) NAVD. When the distance from the edge of NC 12's pavement to the active shoreline becomes less than or equal to the buffer width of 230 feet (70.1 meters), the vulnerability of NC 12 to short-term storm impacts can be mitigated by the presence of dunes. Dunes protect the highway by providing a physical barrier between the ocean and the highway during storm events that cause flooding and sand inundation from ocean overwash.

The potential for short-term shoreline change was quantified using a shoreline and dune erosion model called SBEACH to estimate the volumes of sand appropriate for protective dunes. The point at which NC 12 would become vulnerable because of the loss of protective dunes was determined; this point was based upon a statistical estimate derived from a suite of storms representing the last 100 years of hurricane activity. Vulnerability is defined as having greater than a 50 percent (plus or minus 5 percent) chance of losing 50 percent of a dune's volume in a 12-year period. Dunes would need to be replenished once 50 percent of their volume was lost to help ensure on-going road protection by the dunes. Based on the modeling, it was concluded for alternatives defined as including dunes that in the northern Rodanthe area, a dune 20 feet (6.1 meters) above grade should be built. In the ponds area and north of the ponds, a dune 10 feet (3.0 meters) above grade should be built for alternatives defined as including dunes.

High erosion rates combined with narrow island width in several locations correspond with potential breach locations (see the next section). The processes described above do not include potential along-shore and cross-shore changes that might occur if a breach forms, and the breach is allowed to remain open.

2.6.2.3 Potential Breach Locations within Pea Island National Wildlife Refuge

The information on potential breach locations in the Refuge used in this study is based on a draft product of the ongoing East Carolina University, US Geological Survey, and NC Geological Survey sponsored Coastal Cooperative Research Program that has been intensively studying the northeastern North Carolina coastal system since 2000. There are five potential breach locations within the Refuge (see Figure 2-8). The word breach is used rather than the word inlet because, if a breach were to occur it would likely close eventually (although not necessarily immediately) and likely would not become a long-term phenomenon like Oregon Inlet. The characteristics of these breaches are described in Section 3.6.3.4. Based on the opinions of an expert panel (whose findings are also described in Section 3.6.3.4), the southern end of the Pea Island National Wildlife Refuge would be the most likely location for a breach to occur.

2.6.3 Evaluation of Potential Detailed Study Alternatives

The potential detailed study alternatives identified in January 2005 and listed in Section 2.6.1.2 were evaluated according to the criteria listed in Section 2.6.1.3 both by the four project segments listed in Section 2.6.1.2, and in representative combinations of the segments (i.e., combinations that would provide a complete Parallel Bridge Corridor Alternative). The representative combinations allowed decision-makers and reviewers to consider the total impact of complete alternatives, but the segment results were prepared so that other potential combinations could also be considered as needed. The results were documented in the *Parallel Bridge Corridor Alternatives Report* (Parsons Brinckerhoff Quade & Douglas, Inc., 2005). This section describes the representative combinations, the design assumptions, the data used in the evaluation, and the evaluation results.

2.6.3.1 Representative Combination Alternatives

Six representative combinations of the NC 12 maintenance alternative segments were presented and discussed at the late-March and early-April 2005 meetings and are described in this section. They all include an Oregon Inlet bridge located immediately west of Bonner Bridge, as well as an approach to NC 12 maintenance from Oregon Inlet to northern Rodanthe through 2060. The locations of the various components of these alternatives are shown in Figure 2-9a and Figure 2-9b. The six representative combinations are:

Nourishment

This alternative consists of maintaining NC 12 in its current location through beach nourishment, which would be sufficient to provide at least the 230-foot (70.1-meter) buffer between the shoreline and NC 12. New dunes would protect NC 12 from overwash at several locations.

Nourishment North (No New Right-of-Way)/Bridge South

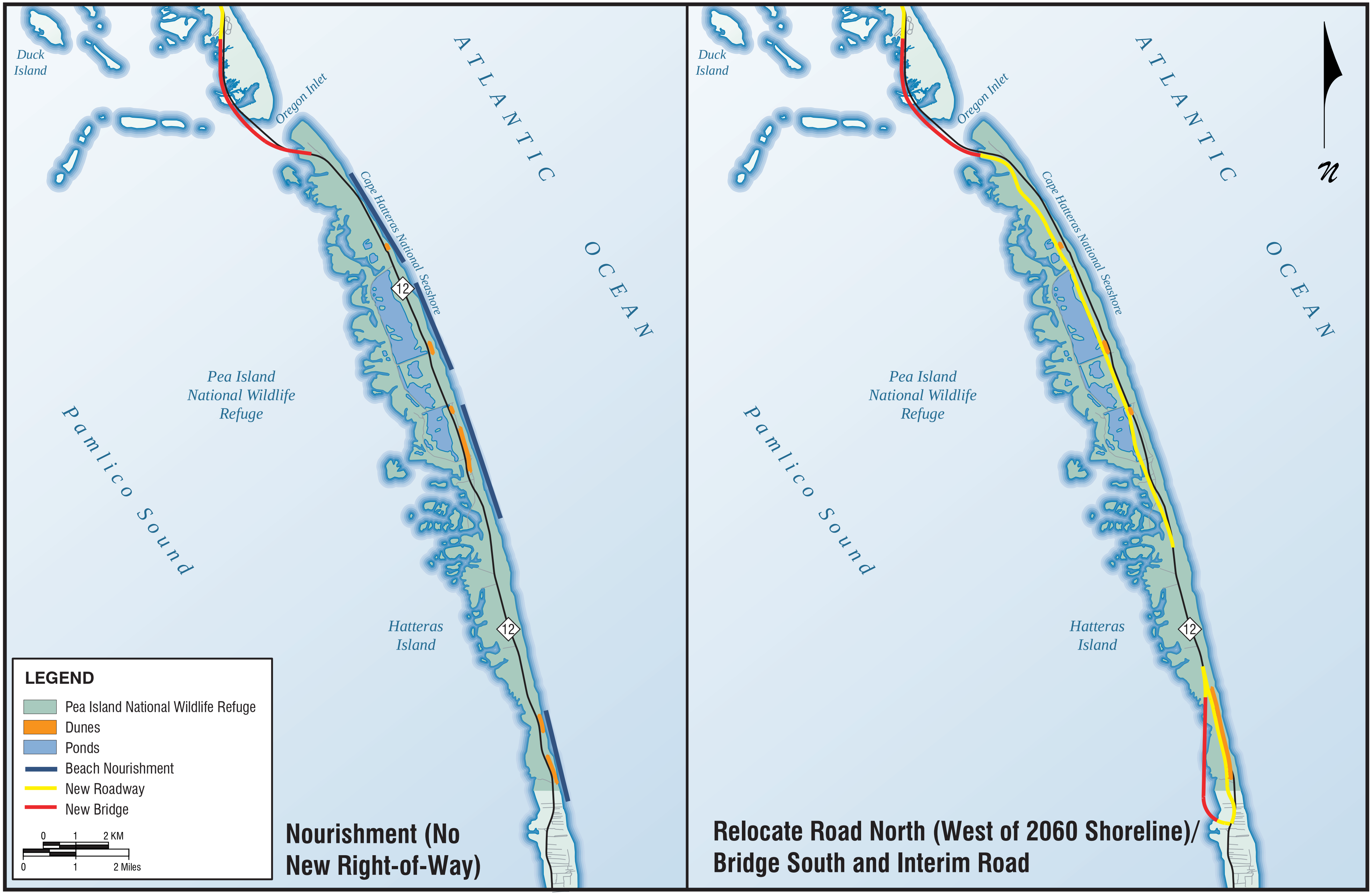
This alternative is the same as the Nourishment (No New Right-of-Way) Alternative except in the northern Rodanthe area. In the northern Rodanthe area, NC 12 would be relocated on an approximately 2.2-mile (3.5-kilometer) long bridge west of Rodanthe in Pamlico Sound that would rejoin existing NC 12 near the emergency ferry terminal in Rodanthe. The bridge would eliminate beach nourishment as an NC 12 maintenance strategy in an area where it would be the most extensive and where the availability of sand for nourishment is less certain. As noted in Sections 2.6.2.1 and 2.6.2.3, it is in the southern end of the Refuge and in the northern Rodanthe area where the forecast rate of erosion, as well as the potential for a breach to occur during a storm is the greatest.

Relocate Road North (West of 2060 Shoreline)/Bridge South

This alternative would relocate NC 12 on fill approximately 230 feet (70.1 meters) to the west of the predicted 2060 high erosion shoreline from Oregon Inlet to just south of the Refuge's freshwater ponds. Three new dunes would be built. This alternative also includes the bridge described for the previous alternative in the northern Rodanthe area. (This alternative is the same as the alternative shown in the second panel of Figure 2-9a but without the interim road relocation.)

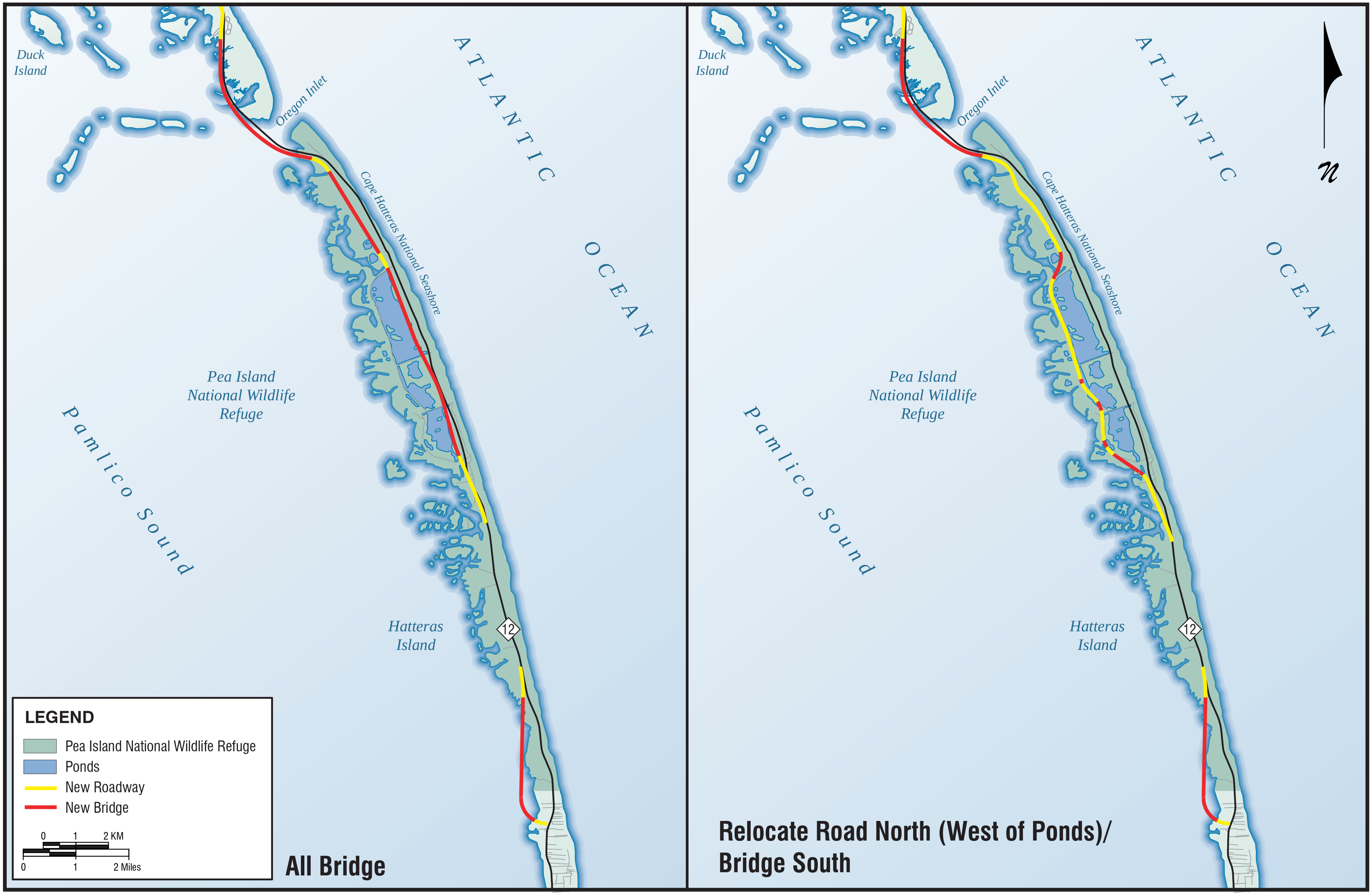
Relocate Road North (West of Ponds)/Bridge South

This alternative would relocate NC 12 on fill approximately 230 feet (70.1 meters) to the west of the predicted 2060 high erosion shoreline to the north of the Refuge's ponds, then along the existing dikes to the west of the ponds, before connecting back into existing NC 12 just south of the ponds. The relocated road to the west of the ponds would be mostly on top of the dikes, but several structures also would be needed in order to avoid introducing sharp curves. This alternative also includes the bridge described previously in the northern Rodanthe area.



POTENTIAL PARALLEL BRIDGE CORRIDOR ALTERNATIVES

Figure 2-9a



POTENTIAL PARALLEL BRIDGE CORRIDOR ALTERNATIVES

Figure 2-9b

Relocate Road North (West of 2060 Shoreline)/Interim Road then Bridge South

This alternative is the same as the Relocate Road North (West of 2060 Shoreline)/Bridge South Alternative as far south as the northern Rodanthe area. This alternative would then include relocating NC 12 to approximately the buffer width of 230 feet (70.1 meters) to the west of the forecast 2020 shoreline, with dune protection, as an interim measure to delay the expenditure of costs associated with the Rodanthe area bridge described above. The Rodanthe area bridge then would be built by 2020.

All Bridge

This alternative would relocate NC 12 on bridge to the west of the predicted 2060 high erosion shoreline between Oregon Inlet and just south of the Refuge's ponds. Access to the Refuge would be provided at Oregon Inlet, just north of the Refuge's ponds, and south of the ponds. This alternative also would use the Rodanthe area bridge.

2.6.3.2 Design Assumptions

Roads and Bridges

A horizontal alignment was developed for each NC 12 maintenance road and bridge alternative. The design criteria used are shown in Table 2-7. A constant footprint width of 90 feet (27.4 meters) was assumed for the road alternatives. The cost estimates, in 2005 dollars, were based on experience with other similar highway construction projects. The period used for operation and maintenance costs was through 2060.

Table 2-7. Design Criteria

	Oregon Inlet Bridge	NC 12 Roadway	NC 12 Bridge
Design Speed	60 mph (96.6 kph)	60 mph (96.6 kph)	60 mph (96.6 kph)
Max. Superelevation	6%	8% max super chart (AASHTO)	6%
Lane Width	12 feet (3.6 meters)	12 feet (3.6 meters)	12 feet (3.6 meters)
Shoulder Width	8 feet (2.4 meters)	8 feet (2.4 meters) (4 feet [1.2 meters] paved plus 4 feet [1.2 meters] earth on 8%)	8 feet (2.4 meters)
Bridge Width (Gutter to Gutter)	40 feet (12.2 meters)	N/A	40 feet (12.2 meters)
Max. Grade	3.5%	5.0%	3.5%
Max. Side Slopes	N/A	3:1	N/A
Max. Degree of Curve	Degree of curve should not cause superelevation to exceed 6% on any bridge	Minimum radius of 1,200 feet (365.9 meters)	Degree of curve should not cause superelevation to exceed 6% on any bridge

The Oregon Inlet bridge for the Parallel Bridge Corridor was assumed to have predominantly the same alignment and design features as a final design for the bridge developed in 1999; however, the design used in this analysis varied in two ways from the 1999 final design. First, the alignment was altered as needed at the Hatteras Island terminus to meet the relocated NC 12 alternatives. Second, a concept for ending the new bridge in the same right-of-way as Bonner Bridge was developed. Finally, 8-foot (2.4-meter) shoulders were assumed on the new Oregon Inlet bridge, as opposed to the 6-foot (1.8-meter) shoulders on the 1999 final design. Figure 2-10 shows the three alternative alignments for the Hatteras Island terminus of the Oregon Inlet bridge. For the alignment that ends in the existing easement, it is assumed that the new bridge would be built over the top of the old bridge for its last two or three spans. A temporary detour road would be necessary for a short distance south of Bonner Bridge so that the new bridge could be built in the existing easement. There would be no difference in cost and minimal difference in impacts between these two easement assumptions. Building the southern terminus of the new bridge in the existing easement would complicate the construction process.

The cost estimates for the Oregon Inlet bridge were based on the 1999 estimate revised to take into account the changes at the southern end, then escalated to 2005 dollars.

The bridges on Hatteras Island and the bridge at northern Rodanthe were assumed to have characteristics similar to the Pamlico Sound Bridge Alternative, including driven precast piles to support the bridge (substructure). Cost estimates assumed an average cost per square foot of deck, experience on other similar bridge construction projects, and 2005 dollars.

Beach Nourishment

The beach nourishment alternatives assume that NC 12 remains in its current location and beach nourishment (plus dune enhancement) would be used to maintain an adequate beach and dune system: 85 to 140 feet (25.9 to 42.7 meters) of beach and berm, 60 to 120 feet (18.3 to 36.6 meters) of dune base, and a 25-foot (7.6-meter) clearance to the edge of pavement. Dune sizes were noted in Section 2.6.2.2. Long-term erosion rates based on linear regression were used to determine the amount of fill required to build and maintain the beach to this design level. The key assumptions included:

- The minimum beach nourishment project length along the beach would be 5,000 feet (1,524 meters) with 500-foot (152.4-meter) tapers (transition from nourished beach to beach that does not require nourishment) on each side;
- Average erosion rates for the area to be nourished were used within each NC 12 maintenance segment;
- An erosion rate factor (the ratio of the faster erosion rates associated with nourished beaches and historic beach erosion rates) of 1.5 to 3.0 was applied;
- The depth of closure would be approximately 30 feet (9.1 meters) (sand used in nourishment when it is eroded by the ocean will not transport beyond the point where the ocean depth is 30 feet [9.1 meters]) and the berm (dry beach) height would be 7 feet (2.1 meters) above mean sea level;
- Nourishment projects would be renourished every four years; and
- Sand used would be suitable for nourishment from the perspective of minimizing natural resource impacts.

OREGON INLET BRIDGE ALTERNATIVES

Figure
2-10

With this design, for each segment of NC 12 there remains a location for which the road is within 230 feet (70.1 meters) of the current shoreline at the end of each 4-year nourishment cycle.

2.6.3.3 Evaluation Data Used

The evaluation data used to compare the Parallel Bridge Corridor alternatives was derived from a variety of sources. The data used was data readily available and was considered sufficient for the selection of detailed evaluation alternatives. This section describes the data used.

<u>Cost</u>

Capital cost estimate assumptions are described in Section 2.6.3.2. Roadway operation and maintenance costs through 2060 were obtained from the NCDOT Division 1 Office, which is responsible for road maintenance in the study area. Bridge operation and maintenance costs were obtained from NCDOT's Bridge Management Unit. Right-of-way costs were developed by the NCDOT's Right-of-Way Branch for Division 1 based on the horizontal alignments described in Section 2.6.3.2.

Both total and total-discounted capital, operation and maintenance, and right-of-way costs were calculated. Costs for new roads, bridges, dunes, and nourishment from 2007 to 2010 (the year in which the Oregon Inlet bridge was at that time assumed to be opened) were categorized as capital costs, whereas subsequent costs were categorized as operation and maintenance costs.

Costs were discounted using a discount rate of 5 percent (FHWA, 1998). Discounting is often done when comparing alternatives whose streams of expenditures are notably different. For example, for the road and bridge alternatives, most of their costs are expended in the first four years of the analysis period (2007 to 2010). With the nourishment alternatives, however, costs are spread out throughout the period through 2060.

Discounting recognizes that benefits and costs do not always take place in the same period. When they do not, consideration should be given to when they actually do occur because benefits or costs that occur sooner are generally considered more valuable. In addition, current consumption is more expensive than future consumption, since an expected return on investment is being given up by consumption today. While a benefit-cost analysis was not done for this alternatives study, it can be assumed that keeping NC 12 open will result in a stream of benefits through 2060 that would be nearly identical for all of the Parallel Bridge Corridor alternatives.

When the cost streams for the various alternatives are discounted, the costs of alternatives with higher up-front expenditures (e.g., bridges) drop the least, and the costs of alternatives with expenditures spread-out through 2060 (e.g., nourishment) drop the most. With the latter, the costs are occurring closer to the time in which the benefits to the traveling public actually occur. Constant dollars are always used when discounting.

<u>*Sand Requirements*</u>

Sand availability and assumptions related to the estimated sand requirements for dunes and nourishment are described in Section 2.6.3.2.

<u>*Wetlands*</u>

The best wetland information available was used to estimate wetland impacts. This represented a combination of delineated wetlands (known primarily from the ocean to a point 300 to 500 feet [91.5 to 152.4 meters] west of NC 12), determined wetlands (primarily in the Rodanthe area), and wetlands identified in the State of North Carolina's Geographic Information Systems (GIS) database and developed by the NCDENR Division of Coastal Management.

Protected Species

Preliminary biological conclusions on the potential for adversely affecting protected species were developed based on federally protected species listings for Dare County and the characteristics of the habitat in the study area.

Historic Resources

Historic resources listed on or eligible for inclusion in the NRHP were identified and approved by the SHPO during the impact evaluation for the Pamlico Sound Bridge Corridor in 2003 and 2004.

Refuge Facilities/Permits and Statutory Limits

Refuge facilities and the characteristics of their use were identified from aerial photography and other mapping, field observation, and conversations with Refuge staff. Permits and statutory limits were identified during past studies in the project area and communications with the agencies responsible for issuing the permits and enforcing the statutes.

Long-Term Risks

Information related to the potential for faster erosion than forecast and a storm-caused breach in the Refuge was developed during the coastal modeling described in Section 2.6.2.

Displacements

Displacement counts were developed by the NCDOT's Right-of-Way Branch based on the horizontal alignments described in Section 2.6.3.2.

2.6.3.4 Evaluation Results

The comparison of the representative combinations of Parallel Bridge Corridor alternatives for cost, sand requirements, and wetland use is presented in Table 2-8. The information presented includes an Oregon Inlet bridge located immediately west of Bonner Bridge and an approach to NC 12 maintenance from Oregon Inlet to northern Rodanthe through 2060. The alternatives also were compared from three additional perspectives: legal factors, risk, and other environmental factors. These comparisons are presented in the paragraphs that follow.

Cost

The costs in Table 2-8 include both the cost of the Oregon Inlet bridge and the NC 12 maintenance component listed in the heading. As shown in Table 2-8, beach nourishment is the most expensive alternative at $644.0 million. When discounted using the 5 percent discount rate, nourishment becomes much closer in cost but is still more expensive than the other Parallel Bridge Corridor alternatives; however, as will be seen in Section 2.12, it would be less than the Pamlico Sound Bridge Corridor alternatives. Alternatives with lower discounted costs could be viewed as providing a better return on the investment of state resources.

Relocating NC 12 as a roadway on fill in the northern part of the Refuge is the least expensive solution with the combined cost of the Oregon Inlet bridge, the road relocation, and a bridge at Rodanthe being $285.4 million. The cost of using the bridge at Rodanthe along with nourishment in the northern half of the Refuge is substantially less than the alternatives that use nourishment exclusively.

Table 2-8. Comparison of Cost, Sand Requirements, and Wetland Use for Representative Combinations

Factor	Parallel Bridge with NC 12 Maintenance					
	Nourishment	Nourishment North / Bridge South	Relocate Road North (West of 2060 Shoreline) / Bridge South	Relocate Road North (West of Ponds) / Bridge South	Relocate Road North (West of 2060 Shoreline) / Interim Road then Bridge South	All Bridge
Cost in 2005 dollars						
Capital Cost (2007-2010)	$222,500,000	$251,907,000	$271,300,000	$296,700,000	$242,700,000	$358,900,000
Capital Cost (2011-2060) and O&M Cost (2007-2060)	$421,500,000	$187,543,000	$14,100,000	$11,200,000	$67,100,000	$7,000,000
TOTAL Cost	**$644,000,000**	**$439,450,000**	**$285,400,000**	**$307,900,000**	**$309,800,000**	**$365,900,000**
TOTAL Discounted Cost (5% discount rate)	$312,100,000	$268,374,000	$232,800,000	$253,600,000	$235,700,000	$305,100,000
Sand Requirements in cubic yards (cubic meters) to 2060						
Dunes	1,033,300 (790,015)	166,600 (127,375)	155,600 (118,965)	0	377,800 (288,849)	0
Beach Nourishment	45,600,000 (34,863,700)	18,050,000 (13,800,220)	0	0	0	0
TOTAL	**46,633,300 (35,653,715)**	**18,216,600 (13,927,595)**	**155,600 (118,965)**	**0**	**377,800 (288,849)**	**0**
Wetlands Affected in acres (hectares)						
Wetlands Filled	3.6 (1.5)	1.8 (0.7)	67.5 (27.3)	32.3 (13.1)	76.4 to 79.4 (30.9 to 32.1)	8.5 (3.4)
Wetlands Bridged	0.2 (0.1)	1.4 (0.6)	1.6 (0.6)	6.2 (2.5)	1.6 (0.6)	25.8 (10.4)

Sand Requirements and Sources

Table 2-8 shows that large sand requirements are associated only with the beach nourishment component of the nourishment alternatives. If nourishment and dunes are the sole form of NC 12 maintenance, nearly 40 percent of the sand required through 2060 is associated with the nourishment of beaches in northern Rodanthe. A sand source near the north end of Hatteras Island, as well as sand from Oregon Inlet dredging, could be used for beach nourishment in the northern part of the Refuge. Sand from annual Oregon Inlet dredging alone would meet the forecast nourishment needs in the northern part of the Refuge. A sand source also is off the coast near Rodanthe, but its quality, quantity, and suitability are not adequately known.

Any nourishment program will need to consider the effect of sand placement on beach and near-shore invertebrate populations and their recovery. Also, it is possible that Oregon Inlet ocean bar dredging sand could be used for beach nourishment in the Refuge; a cost-sharing arrangement between the NCDOT and the USACE is possible.

Wetlands

The Refuge area to the west of the forecast 2060 high erosion shoreline is almost entirely wetland. Thus, as shown in Table 2-8, approximately 70 to 80 acres (28.3 to 32.4 hectares) of wetlands would be filled by the NC 12 maintenance alternatives that involve relocating NC 12 west of the 2060 high erosion shoreline as a road. The alternatives including only nourishment and bridges would fill 1.8 to 8.5 acres (0.7 to 3.4 hectares) of wetland, substantially less than the road alternatives. The All Bridge Alternative, however, also would shade 25.8 acres (10.4 hectares) of wetland and its associated vegetation. By comparison, the Pamlico Sound Bridge Corridor Alternative would fill 1.2 to 1.8 acres (0.5 to 0.7 hectares) of wetland and bridge an additional 1.2 acres (0.5 hectares).

Section 404(b)(1) Guidelines of the Clean Water Act (CWA) (40 *Code of Federal Regulations* [CFR] 230), mitigation policy mandates articulated in the USACE/US Environmental Protection Agency (USEPA) MOA, and Executive Order 11990 (Title 42, *Federal Register* [FR] 26961 [1977]) all stress avoidance and minimization as primary considerations for protection of wetlands. Practicable alternatives must be evaluated fully before filling wetlands and associated compensatory mitigation for the wetland loss can be discussed. USFWS mitigation policy directives (46 FR 7644-7663 [1981]) also emphasize avoidance and minimization. Thus, the practicality of the bridging alternatives is an important consideration in making a decision to implement the alternatives that involve relocating NC 12 as a road rather than on a bridge.

Legal and Permit Requirements

In addition to Section 404 of the Clean Water Act (as noted in the previous section), the requirements of several other environmental protection laws apply to the assessment and selection of alternatives. Permits or certifications would need to be obtained from the USFWS, NCDENR's Division of Coastal Management, NCDENR's Division of Water Quality, and the NPS. Also, with any of these alternatives, since they all would involve a new utilization of Refuge land, the USFWS must find them compatible with the April 1938 Executive Order 7864, which reserved the Refuge to advance the purposes of the Migratory Bird Conservation Act and the National Wildlife Refuge System Improvement Act of 1997 in order to issue its permits. In addition, a US Coast Guard bridge permit would be required for either the Oregon Inlet bridge with the Parallel Bridge Corridor alternatives, or the Pamlico Sound bridge.

Section 4(f) of the Department of Transportation Act of 1966, as amended (49 USC 303), states that the US Department of Transportation may not approve the use of land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site, unless a determination is made that the project will have a *de minimis* impact or unless a determination is made that:

- There is no feasible and prudent alternative to the use of land from the property; and
- The action includes all possible planning to minimize harm to the property resulting from such use.

Significant publicly owned park, recreation area, wildlife and waterfowl refuge, or any significant historic sites are known as Section 4(f) properties.

The Cape Hatteras National Seashore is a publicly owned park and recreation area. Both the Parallel Bridge Corridor discussed in this section and the Pamlico Sound Bridge Corridor would use land from the Seashore.

The Pea Island National Wildlife Refuge meets all four Section 4(f) criteria; it is a publicly owned park, a recreation area, a wildlife and/or waterfowl refuge, and a significant historic site. As such, since all of the Parallel Bridge Corridor alternatives examined in 2005 would involve a new utilization of Refuge land, the selection of any of them for implementation will require that the above determination be made.

Risk

The concept of risk includes any other factors that in the long-term could affect the viability and the cost of the Parallel Bridge Corridor alternatives under consideration. Two primary risks were identified: the potential for a storm-caused breach in the Refuge and accelerated erosion of nourished beaches.

Five potential breach locations are within the Refuge, so there is risk that a relocated road could be broken by a breach. Based on the opinions of the expert panel described in Section 3.6.3.4, the southern end of the Refuge is the most likely location through 2060 for a breach to occur. A breach in the Refuge would separate almost all of Hatteras Island and its associated communities, tourism businesses, and the Seashore from Bodie Island and the mainland. If a breach opens in an area where NC 12 is a surface road, the federal government or the state would then incur the additional cost of closing the breach. In addition, there would be the associated economic loss, challenges for maintaining community services, and disruptions to daily living until the breach is closed. Until the breach could be closed, a temporary ferry service using the emergency ferry docks in Rodanthe and Stumpy Point would be able to make 18 trips a day, transporting between 1,100 and 1,300 vehicles per day (vpd). The crossing time would be 1 hour and 40 minutes. However, the average annual daily traffic across Bonner Bridge in 2002 was 5,400 vpd, and it is forecast to increase to 9,600 vpd by 2025. Average summer weekend traffic across the Bonner Bridge was 10,900 vpd in 2002, and it is expected to rise to 19,200 vpd by 2025. The risk of a breach forming would be reduced with beach nourishment. Potential breach areas, particularly at the southern end of the Refuge, could be bridged as a part of the Parallel Bridge Corridor alternative.

A risk that should be considered with respect to beach nourishment is that faster erosion than forecast is possible, which would result in more nourishment and therefore raise both the associated cost and sand required. The risk of changes in sand requirements, and thus nourishment's cost being more or less than that presented in Table 2-8, was examined. It was concluded that potential differences in the rate of erosion could decrease the $644.0 million cost of the Nourishment Alternatives by $111.8 million, or increase it by as much as $137.7 million.

<u>Other Environmental Impacts</u>

The following additional environmental impact factors were found to be important to deciding which of the Parallel Bridge Corridor alternatives, including NC 12 maintenance, to evaluate in detail in the FEIS.

1. Threatened and endangered species could occur in the project area and will need to be considered in terms of the timing of construction and placement and dredging of sand.

2. Road relocation outside the existing easement in the ponds area would affect the NRHP-eligible Refuge. The Refuge was found to be eligible for the NRHP under Criterion A of the National Historic Preservation Act of 1966, as amended, in the areas of conservation and social history (see Section 3.4.1.1). A letter dated September 17, 2003 from the North Carolina SHPO that affirms this finding is contained in Appendix A.

3. Based on the 1999 final design of the new Oregon Inlet bridge, the catwalks on Bonner Bridge were assumed to not be replaced. The deck of the new bridge, as depicted in the 1999 final design, would be approximately 40 feet (12.2 meters) above the water at the shoreline and approximately 65 feet (19.8 meters) above the water by the end of the first span (approximately 400 feet [121.9 meters] offshore). However, Dare County would like to see the catwalks replaced on the new bridge, or a piece of the existing Bonner Bridge retained as a fishing pier.

4. NC 12 relocation would affect the Refuge's wildlife trails, boat ramp parking, and access to the Refuge Visitor Center and Headquarters. Relocation of NC 12 west of the ponds would have the greatest effect on trails, crisscrossing the existing North Pond dike trail and forcing bird watchers and walkers to walk along the road. Also, a location west of the ponds would reduce the accessibility of the beach in this area.

5. An interim road relocation at Rodanthe, in order to delay construction of a Rodanthe area bridge, would displace 8 to 13 homes.

2.6.4 Parallel Bridge Corridor Alternatives Defined for Detailed Evaluation

Based on the study findings presented above, coordination with resource and regulatory agency representatives, and the October 13, 2004 Merger Agreement, three Parallel Bridge Corridor with NC 12 Maintenance alternatives were defined in 2005 for detailed evaluation in this FEIS. They are:

- <u>Nourishment</u>. Maintenance of NC 12 in the existing right-of-way through beach nourishment with dunes at several locations;

- <u>Road North/Bridge South (identified in Section 2.6.3.1 as Relocate Road North (West of 2060 Shoreline)/Bridge South)</u>. NC 12 relocation to the west as a road in the northern half of the Refuge and on a bridge in the Rodanthe area; and

- <u>All Bridge</u>. NC 12 relocation to the west on a bridge both in the northern half of the Refuge and in the Rodanthe area.

The alternatives selection meetings in late-March and early-April 2005 yielded the conclusion that most of the alternatives had both merit and concerns from different perspectives. For example, nourishment would allow NC 12 to remain in its existing right-of-way, but would be expensive and could adversely affect beach organisms in both the short- and long-term. Relocating NC 12 as a road is the least costly option, but would require filling the most wetlands. Relocating NC 12 on a bridge would minimize wetland loss but would be expensive. Therefore, it was decided that the broad range of NC 12 maintenance options reflected by the three selected alternatives should be evaluated and contrasted in detail in this FEIS.

Three of the preliminary alternatives were dropped from further consideration. Relocating NC 12 west of the freshwater ponds in the Refuge was dropped because meeting participants agreed that it would have the greatest impact on Refuge operations and use. A short-term relocation of NC 12 in the northern Rodanthe area, followed by a later second relocation of NC 12 on a bridge, was also dropped because it increased wetland impacts, displaced homes, and increased the total cost of maintaining NC 12 through 2060. These concerns were judged to offset the desirability of delaying the cost of the bridge in the Rodanthe area by initially building the short-term road relocation, given that a new road costs less than a new bridge. Nourishment North/Bridge South also was dropped because its components would be assessed within the context of the Nourishment and Road North/Bridge South alternatives.

The NEPA/Section 404 Merger Team was briefed on this decision at a meeting on May 24, 2005.

2.7 2006 Parallel Bridge Corridor with NC 12 Maintenance Alternatives Studies

An additional set of Parallel Bridge Corridor with NC 12 Maintenance studies was conducted in 2006. These studies focused on the development of what are called the Phased Approach alternatives (including the Preferred Alternative). The Phased Approach alternatives (including the Preferred Alternative) were developed in response to a proposal made during the comment period following the release of the SDEIS. As suggested, the Phased Approach alternatives (including the Preferred Alternative) assume an Oregon Inlet bridge (the design of which is slightly different from the other Parallel Bridge Corridor alternatives) and elevating parts of NC 12 through the Pea Island National Wildlife Refuge (the Refuge) to new bridges within the existing NC 12 easement. The bridges built for NC 12 would be constructed in several phases, based on the forecast high erosion shoreline, as well as the location and likelihood of future breaches on Hatteras Island. The goal of these alternatives was to avoid the use of Refuge lands for which Section 4(f) of the Department of Transportation Act applies (see the introduction to Chapter 5 for a description of the requirements of Section 4(f)), while at the same time spreading the cost of the project over a longer time period given limits of annual transportation improvement funding.

The initial design assumptions for the Phased Approach alternatives (including the Preferred Alternative) were developed by NCDOT and FHWA in March 2006, based on the parameters defined in the SDEIS comment discussed in the previous paragraph. These assumptions were used to develop a rough cost estimate for comparison with the detailed study alternatives assessed in the SDEIS. When considering the total expenditure through the year 2060, these cost estimates indicated that the Phased Approach alternatives (including the Preferred Alternative) would be higher in cost than the other detailed study alternatives. The primary advantage, unlike the other alternatives, except the Parallel Bridge Corridor with Nourishment Alternative, was that the construction cost could be spread over many years instead of concentrated between the start of construction and 2013. Construction would be phased to correspond to forecast shoreline erosion trends, maintaining a buffer distance between existing NC 12's edge of pavement and the active shoreline. The cost estimates were presented for discussion at a June 15, 2006 meeting of the project's NEPA/Section 404 Merger Team (see Section 8.8.1.1).

In order to examine the technical feasibility of the Phased Approach alternatives (including the Preferred Alternative), the NCDOT held a Constructability Workshop from August 29 to 31, 2006. The workshop was modeled after the Accelerated Construction Technology Transfer (ACTT) process championed and implemented by FHWA for notable projects nationwide. The workshop began with a general session that introduced the project history, the dynamics of the site, and the concept of a Phased Approach Alternative. Days two and three of the workshop were devoted to a brief site visit followed by numerous discussion sessions.

Attendees at the workshop included engineers and other technical staff from FHWA and NCDOT. In order to gain a broader perspective on feasibility, national experts in the fields of shoreline migration, geotechnical engineering, structural engineering, hydraulic engineering, coastal engineering, and bridge construction also participated. Other disciplines represented included roadway engineering, traffic control, intelligent transportation systems, pavement design, planning, maintenance, materials, and utility engineering. Contractors, consultants, and academics were represented.

The workshop concluded that a Phased Approach Alternative was technically feasible, although technically challenging (NCDOT, September 2006). A description of a design and construction approach at the southern terminus of a new parallel bridge over the Oregon Inlet, as well as the bridges along NC 12 in the Refuge were developed. Design and constructability issues discussed at the workshop were predicated on the assumption that construction must occur fully within the NCDOT's existing 100-foot (30.5-meter) easement within the Refuge. The recommendations of this workshop served as the basis for the design assumptions used in assessing the Phased Approach alternatives (including the Preferred Alternative) in this FEIS. The workshop results were presented for discussion at a September 21, 2006 meeting of the project's NEPA/Section 404 Merger Team (see Section 8.8.1.2).

Following the workshop and the September 21, 2006 Merger Team meeting, the NCDOT decided to evaluate the alternatives in this FEIS. Two variations of the Phased Approach alternatives (including the Preferred Alternative) were defined for detailed evaluation:

- Phased Approach/Rodanthe Bridge Alternative (Preferred); and
- Phased Approach/Rodanthe Nourishment Alternative.

The design assumptions associated with the Phased Approach alternatives (including the Preferred Alternative) are discussed in Section 2.10. The project's NEPA/Section 404 Merger Team was given an opportunity to discuss the design assumptions at a December 14, 2006 meeting (see Section 8.8.1.3).

2.8 2006 Long Bridge Operations and Safety Study

A Long Bridge Operations and Safety Study (Parsons Brinckerhoff Quade & Douglas, Inc., June 2006) was conducted in 2006 to address questions about the safe operation of long bridges that were raised at the November 2005 public hearing and during SDEIS review. These concerns dealt specifically with the proposed Pamlico Sound Bridge Corridor Alternatives that include a 17.5-mile bridge crossing of the Sound. Its findings, however, also apply to the Parallel Bridge Corridor's All Bridge and Phased Approach alternatives (including the Preferred Alternative). The study focused on several factors: operational; weather; crash and vehicular safety; and other issues related specifically to long bridges.

The study involved the use of the results of internet research, an examination of crash statistics, and interviews with officials responsible for other existing long bridges. Four long bridges were considered: the Chesapeake Bay Bridge-Tunnel (CBBT) in Virginia; the Lake Pontchartrain Causeway in Louisiana; the Confederation Bridge in Prince Edward Island, Canada; and the Seven Mile Bridge in the Florida Keys.

2.8.1 Operational Concerns

Interviews with bridge officials determined that safety and response time to vehicular incidents were paramount operational concerns. The two primary issues were:

- Vehicles and passengers on the bridge are isolated from emergency assistance. Emergency response times can be long because of the bridge distance involved, and it is crucial to reduce total response time by reducing incident detection times.

- Stalled vehicles on long bridges introduce additional safety issues, both to other cars that must avoid the stopped vehicle and to the passengers in the stopped car that are exposed to potential hazards caused by high speed traffic operations.

All of the interviewees said that an important consideration in operating a long bridge is rapid response to emergencies and incidents with proper equipment and personnel. Specific considerations for emergency services and incident response included incident detection (which consists of multiple methods, including closed circuit television (CCTV) cameras to monitor all locations on the bridge); incident response, removal of stalled vehicles, ability of emergency vehicles to turn around on a bridge; variable message signs; other intelligent transportation system (ITS) technologies; and a dedicated staff for incident detection and response.

2.8.2 Weather

Another safety factor to consider is adverse weather, particularly wind, fog, and winter weather. The long bridges examined have various restrictions during occurrences of high wind. The most comprehensive wind standards are in place at the CBBT. Prior to April 1999, the CBBT was a two-lane structure, and the original wind policy on the two-lane and shoulder-less facility was developed to reduce the risk of vehicles being blown partially or completely across the center-line and causing a head-on collision. The separate southbound structure opened in 1999, and the wind policy was updated at that time for the four-lane structure. Both the two-lane and the four-lane wind policies call for the restriction of certain vehicles based on wind speed; however, the current four-lane policy is less restrictive (i.e., the minimum wind speeds at which each type of vehicle restriction occurs were increased) because it reflects the fact that there are now two bridges with traffic flowing in one direction on each bridge.

Wind conditions on a potential Bonner Bridge replacement were compared to wind condition restrictions with the original two-lane wind policy on the CBBT. The CBBT's two-lane wind restriction policy was used in this comparison because the Bonner Bridge replacement project alternatives are all two-lane structures, although the Bonner Bridge replacement would have shoulders whereas the two-lane CBBT had no shoulders. The two-lane wind restriction policy on the CBBT was as follows:

- 17.3 to 28.7 mph (27.8 to 46.2 kph) – no car-top carriers or loaded roof racks;

- 28.8 to 40.2 mph (46.3 to 64.7 kph) – no recreational trailers or lightweight recreational vehicles;

- 40.3 to 45.9 mph (64.8 to 73.9 kph) – no recreational vehicles of any type or canvas-topped semi-trailers;

- 46.0 to 51.7 mph (74.0 to 83.2 kph) – no empty semi-trailers or empty six-wheel trucks;

- 51.8 to 57.4 mph (83.3 to 92.4 kph) – no motorcycles;

- 57.5 to 68.9 mph (92.5 to 110.9 kph) – no passenger cars, light trucks, or busses (only heavily loaded semis allowed); and

- 69 mph (111.0 kph) or greater – closed to all traffic.

For comparison, in Dare County the goal is to complete hurricane evacuations before the arrival of gale force winds, which are defined as sustained winds at 39 to 54 mph (62.7 to 86.9 kph). It was determined that the same levels of wind speed were reached on Hatteras Island as on the CBBT; however, the length of time each year experiencing these wind speeds was far greater on the CBBT than on Hatteras Island. The percentage of the total hours exceeding 17.3 mph (27.8 kph) for the CBBT (26.39 percent) is more than three times the percentage of Hatteras Island (7.83 percent).

The daily occurrence of moderately high winds in the Hatteras Island area, as well as the experience and wind policies of existing long bridges, indicate a likely need for a wind monitoring system, a wind policy, procedures and facilities needed to enforce that policy, and safety features to reduce the potential for crashes on a long Bonner Bridge replacement. The details would be developed during final design, taking into consideration the unique setting and characteristics of the replacement bridge.

Another potential issue in the operation of a long bridge is fog. Fog conditions, and existing policies to address fog conditions on the other long bridges, were reviewed. It was determined that, given the potential Pamlico Sound bridge's design criteria and the visibility experience at the Hatteras Island weather station, low visibility because of fog would seldom be a problem on a replacement bridge.

Winter conditions present a third consideration in terms of long bridge operation. Current NCDOT experience and maintenance practices in the Outer Banks area indicate that winter weather can be an issue but does not occur frequently. Currently, sand and salt applications are utilized for snow and ice in the winter.

2.8.3 Crashes and Safety

Using NCDOT crash data, crash rates were reviewed for NC 12, including Bonner Bridge and other longer bridges in eastern North Carolina. The crash rate on NC 12, except in the Rodanthe area, was very low (below 52 crashes per 100 million vehicle miles) compared with the two-lane statewide average (171.66 to 184.65 crashes per 100 million vehicle miles). Crashes on Bonner Bridge are of a limited number of types (i.e., head on, rear end, sideswipe, and fixed object) because there are no access points to introduce turning traffic. North and south of Bonner Bridge and in Rodanthe, the majority of crashes involved turning vehicle or animals.

Crash rates on long bridges in North Carolina, as well as on the CBBT were compared to both the average and critical crash rates on two and four lane roads in North Carolina. The crash rates on these bridges for a three year period (2002 to 2005) were much lower (30 to 50 crashes per 100 million vehicle miles) than the average and critical crash rates observed statewide on two and four lane roads. Average crash rates for two and four-lane roads in North Carolina are 171.66-184.65 crashes per 100 million vehicle miles and 137.56 crashes per 100 million vehicle miles, respectively. Critical crash rates for two and four-lane roads in North Carolina are 211.43 to 315.73 crashes per 100 million vehicle miles and 161.74 to 173.21 crashes per 100 million vehicle miles, respectively. The low crash rate on long bridges is because of the lack of turning traffic and access points on the bridges.

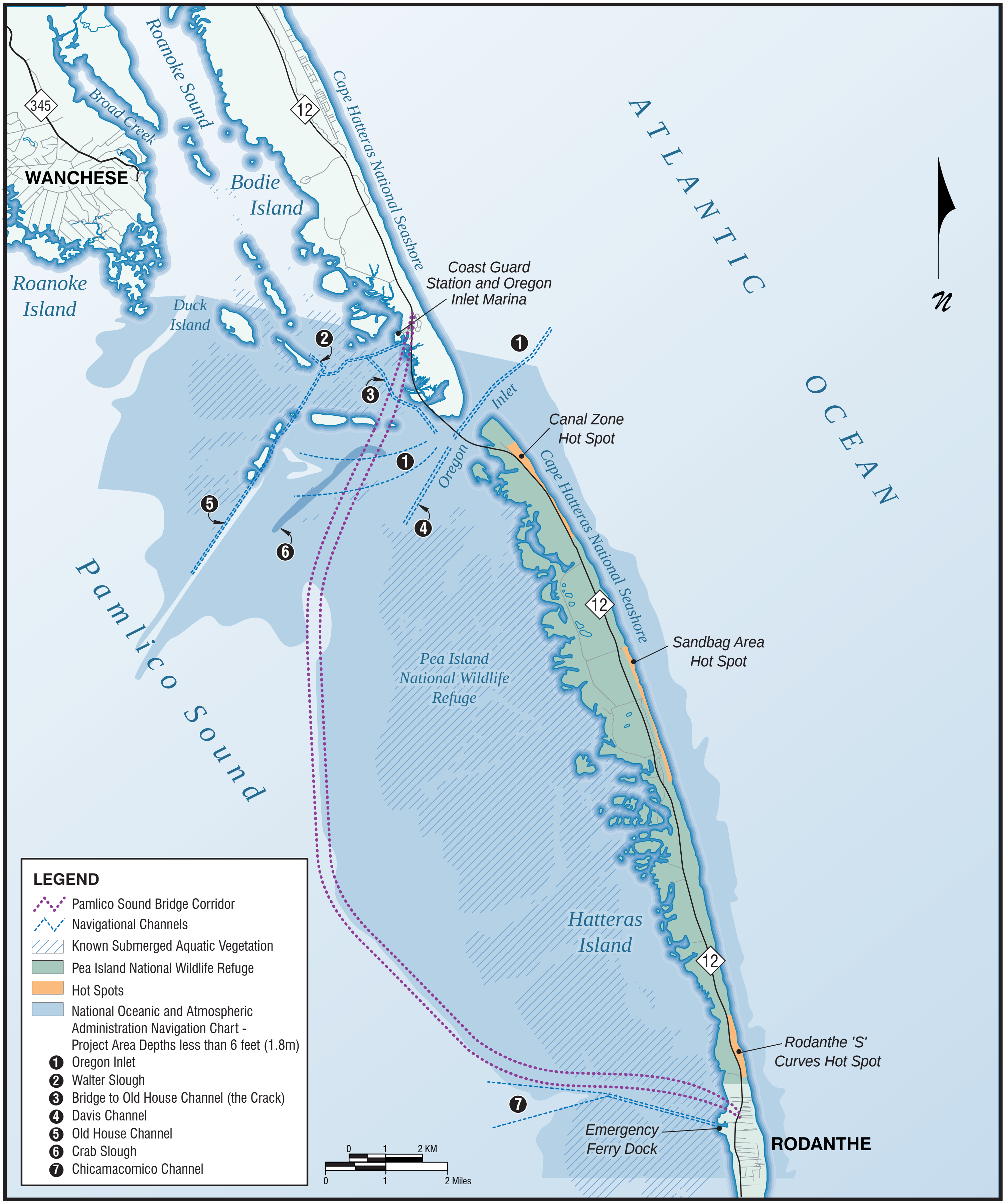
2.8.4 Application to the Detailed Study Alternatives

Based on the findings of the Long Bridge Operations and Safety Study, the detailed study alternatives in the Pamlico Sound Bridge and Parallel Bridge corridors are assumed to include turnouts every 3 miles (4.8 kilometers). These are included in the bridge costs so that a disabled vehicle can be moved out of the way of traffic. During final design, the NCDOT also would consider implementation of the following ITS devices to provide motorists with advance notification as to travel conditions in the NC 12 corridor and on the replacement bridge: Highway Advisory Radio (HAR), Roadway Weather Information Systems (RWIS), Variable Message Signs (VMS), and CCTV cameras, as well as fiber optic cabling to link the technologies and incident management patrols.

2.9 Description of Pamlico Sound Bridge Corridor Alternative (Selected for Detailed Study)

The Pamlico Sound Bridge Corridor Alternative includes a replacement bridge that begins approximately 1,200 feet (366 meters) north of the emergency ferry dock in Rodanthe and extends west into Pamlico Sound and turns to the north to parallel Hatteras Island for approximately 9 miles (14.4 kilometers), approximately 5 miles (8 kilometers) west of Hatteras Island. The bridge would then turn to the northeast and terminate at the northern terminus of Bonner Bridge on Bodie Island. The location of this corridor is illustrated in Figure 2-11.

The design features and approaches to construction described in this FEIS were developed based on the best available data at the time. These descriptions were prepared to provide the readers of this FEIS with an understanding of the expected characteristics of each alternative and for use in estimating project cost, level-of-service, and environmental impact. It is assumed that the specific design features (including, bridge span types and arrangements) and approaches to construction described here could change during final project design or by the design-build



PAMLICO SOUND BRIDGE CORRIDOR

Figure 2-11

contractor, preparation of permits, and the development of final mitigation measures, should this alternative be selected as the Preferred Alternative. It is not anticipated, however, that such refinements would result in substantial changes to project costs or impacts, or changes to the commitments that are contained in the Project Commitments section of the FEIS.

It is assumed that if it were decided that maintaining paved road access the full length of the Refuge is essential, a Parallel Bridge Corridor with NC 12 Maintenance alternative likely would be selected for implementation. The implementation of a combination of the Pamlico Sound Bridge Corridor and long-term maintenance of NC 12 as a paved road the full length of the Refuge would achieve no travel or environmental benefits over the implementation of a Parallel Bridge Corridor with NC 12 Maintenance alternative, but would have a substantially greater long-term cost.

If the Pamlico Sound Bridge Corridor had been selected as the Preferred Alternative, the Refuge and the NPS had indicated that they intended to maintain some type of access for visitors to the Refuge. However, based on the USFWS's concerns about the affect of the existing paved NC 12 on the Refuge, the method of access likely would have been something different than a paved road. NCDOT indicated that it would seek an opportunity to participate in the decision-making process to determine what that access will entail. In coordination meetings with USFWS and NPS, representatives gave no indication that they expect the State of North Carolina to contribute to the cost of their alternate access program; it would, however, have been a public cost (funded with public monies). Options for alternate access could include permitting visitors to drive on the beach or other designated sand route, a jitney service along a designated sand route, moving some visitor facilities (such as the Visitor Center) closer to Rodanthe, or some combination of options. If a storm-caused breach were to occur at the southern end of the Refuge, it would either need to be closed or ferry service implemented if the USFWS wished to continue to get visitors and their vehicles to and from the Refuge.

Two possible Rodanthe termini design options are evaluated in this FEIS, as illustrated in Figure 2-12. With the Curved Rodanthe Terminus, the proposed bridge would end in a curve that connects the bridge directly to NC 12. With the Intersection Rodanthe Terminus, the proposed bridge would end with a signalized intersection at NC 12. The merits of these two termini options are discussed in this section from a traffic operations perspective. Their differences from an environmental impact perspective are described in Chapter 4. The subsections that follow in this section describe the:

- Pamlico Sound Bridge Corridor location;
- Bridge characteristics;
- Approach roadway characteristics;
- Rodanthe terminus options; and
- Construction procedures.

Demolition and removal of Bonner Bridge and the disposition of parts of NC 12 replaced by the alternatives are discussed in Section 2.11 Costs and funding for the alternatives associated with both bridge replacement corridors evaluated in detail in this FEIS are discussed in Section 2.12. Environmental Protection during construction of the proposed project is discussed in Section 2.13. Permits and approvals are discussed in Section 2.14.

PAMLICO SOUND BRIDGE CORRIDOR - RODANTHE CURVED AND INTERSECTION TERMINUS OPTIONS

Figure 2-12

2.9.1 Pamlico Sound Bridge Corridor Location

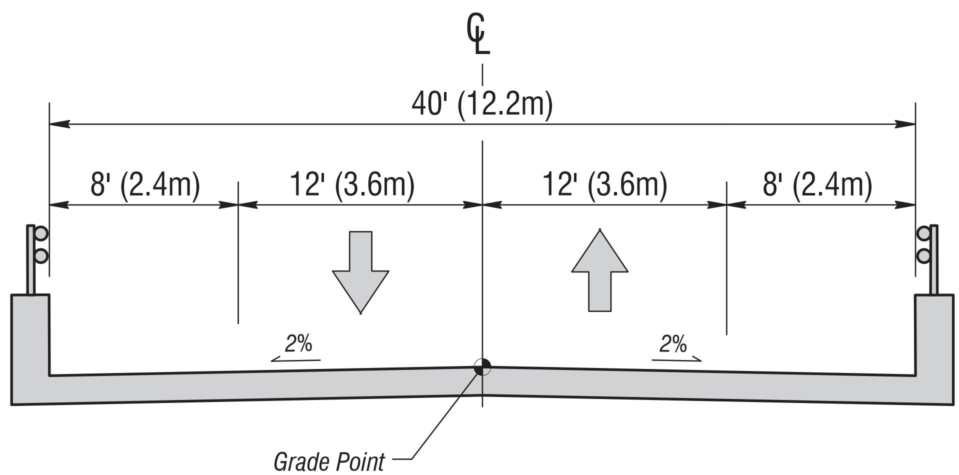
The proposed bridge would be approximately 17.5 miles (28.2 kilometers) in length, and, if constructed, would be the third longest bridge behind the Lake Pontchartrain Causeway in Louisiana, which is the longest bridge in the world at 23.9 miles (38.5 kilometers) in length. The only other bridge in the world that would be longer than the proposed 17.5-mile (28.2-kilometer) Pamlico Sound Bridge Corridor bridge is the 22.3-mile (35.9 kilometer) Hangzhou Bay Bridge in China, which was completed in 2008. There are only two other bridges in the world that are over 11 miles (17.7 kilometers) in length: the Saudi-Bahrain Causeway over a portion of the Persian Gulf between the countries of Saudi Arabia and Bahrain (16.2 miles [26.1 kilometers]), and the Chesapeake Bay Bridge-Tunnel on US 13 over the mouth of the Chesapeake Bay in Virginia (15.0 miles [24.1 kilometers]).

The location of the Pamlico Sound Bridge Corridor is illustrated in Figure 2-11. The proposed bridge would:

- Begin in Rodanthe in an area that is less developed, beginning either at a signalized intersection (Intersection Rodanthe Terminus) or a sweeping curve that connects the bridge directly with NC 12 (Curved Rodanthe Terminus).
- Continue west from Rodanthe and north of the channel used by ferries when the emergency ferry dock in Rodanthe is operated.
- Turn north and continue north parallel and up to approximately 5 miles (8 kilometers) west of Hatteras Island. This location is west of known SAV beds and in an area that generally is deep enough for a construction barge to operate without the need for dredging. This location would help minimize impacts to the sound bottom and increase the efficiency of the construction process.
- Cross the existing navigation channel for vessels using Oregon Inlet approximately 6,500 feet (1,981 meters) west of Bonner Bridge.
- Cross Bridge to Old House Channel, commonly known as “the crack,” at a point approximately 4,900 feet (1,494 meters) south of the proposed bridge’s northern endpoint, and continue north on the east side of that channel. The channel is used informally by the recreational fishing fleet. This is the point where, as of year 2003, Bonner Bridge enters open water, and “the crack” turns briefly east and then south to closely parallel Bonner Bridge.
- Terminate at the existing Bonner Bridge terminus on Bodie Island, following a route between Bonner Bridge and the parking lot for the Oregon Inlet Marina and Fishing Center (see Figure 2-12).

2.9.2 Bridge Characteristics

The bridge’s typical section would provide two 12-foot (3.6-meter) travel lanes and two 8-foot (2.4-meter) shoulders. The bridge’s typical section is illustrated in Figure 2-13. The proposed bridge’s navigation spans in the Oregon Inlet area would provide a minimum navigation opening of 200 feet (61 meters) horizontally and 75 feet (23 meters) vertically. The navigation zone (area with spans of the navigation span height and width) would be 1,600 to 2,000 feet (488 to 610 meters) long. The NCDOT anticipates that the typical bridge span outside the navigation zone



BRIDGE TYPICAL SECTION

Figure 2-13

would be 140 to 150 feet (42.7 to 45.7 meters). Outside the navigation zone, the vertical clearance of the bridge currently is expected to be approximately 10 feet (3.1 meters) above mean high water. These are considered reasonable span and clearance assumptions for the purpose of analysis in this FEIS, but could change in project design.

One navigation zone would be built to serve boats passing through Oregon Inlet. The location of the zone would be determined in coordination with the USACE and the US Coast Guard. The USACE currently maintains the Oregon Inlet/Old House navigation channel. As discussed in Section 3.6.3, movement of Oregon Inlet over the life of the proposed bridge could shift the natural channel gorge to the Davis Channel area. The NCDOT's goal would be to place the navigation zone of the proposed bridge in a location that reduces channel maintenance over the full life of the proposed bridge. The navigation channel(s) would be marked (i.e., with buoys, lighting, etc.) for navigation in accordance with the requirements of the US Coast Guard, the USACE, and the NCDOT.

A design speed (maximum safe speed that can be maintained under favorable driving conditions) of 60 miles per hour (96.6 kilometers per hour) was assumed for the bridge, as well as a maximum 5 percent grade and a bicycle-safe bridge rail.

For the bridge superstructure (spans between piers), the use of precast concrete segmental box girders is anticipated (see Section 2.9.5). It is, however, possible outside the navigation zone that the winning Design-Build (D-B) Contractor could choose to use precast concrete girders ("I" shape) similar to that used on Bonner Bridge. A box girder is a concrete girder with a typical-section shaped like a box. Box girder spans would be manufactured in segments (segmental construction) and assembled at the construction site. Precast segments (or concrete girders ["I" shape]) are anticipated, however, because of the following factors: faster construction, the higher quality of the precast elements, longer life, lower maintenance requirements, the ability to maintain segment casting production through the winter, and the difficulties of providing ready-mix concrete in a remote setting where water flow, wind, and exposure to the environment are constant forces.

For the bridge substructure (foundation and support for the superstructure), precast piles are anticipated. These piles would be jetted (high-pressure water is used to move sand aside so the pile can drop into place) or, in some cases, driven (hit with a large hammer or vibrated to drive the piles into the ground). With jetted piles, it is common to use a pile driver to seat the pile (to bring it to its final stopping point).

In the navigation zone, a footing could be cast near the waterline on top of the piles. A column or columns would be placed on top of the footing, which would in turn support the bridge superstructure. Outside the navigation zone, piles would extend out of the water to a point just under the bridge superstructure. Pile caps would be cast on top of the piles to support the superstructure.

The NCDOT would incorporate Best Management Practices (BMPs) for storm water management into the bridge design.

A preliminary examination of potential safety features for the proposed bridge in the Pamlico Sound Bridge Corridor was conducted in June 2006 (Parsons Brinckerhoff Quade & Douglas, Inc.) (see Section 2.8). It focused on several factors: operational considerations, weather considerations, crash and vehicular safety considerations, and other issues related specifically to long bridges. The cost estimates assume that turn-outs, where a disabled vehicle can be moved out of the way of traffic, are built on the bridge. The maximum desirable distance between these turn-outs was assumed to be 3 miles (4.8 kilometers). ITS is the term for the use of technology to operate transportation facilities more efficiently, as well as to provide road condition information to the traveling public. During final design, NCDOT also would consider implementation of ITS devices to provide motorists with advance notification as to travel conditions in the NC 12 corridor and on the replacement bridge. Examples of ITS devices are: HAR, RWIS, VMS, and CCTV cameras, as well as fiber optic cabling to link the technologies and incident management patrols. Costs for such features are included in the cost estimates for this alternative in Section 2.12.

Helicopters used to evacuate seriously injured accident victims would be able to land on the 40-foot-wide (12.2-meter) proposed bridge. (Personal communication, January 6, 2004, Larry Mimms, Dare County EMS.) In addition, the 40-foot (12.2-meter) width of the proposed bridge would provide adequate space for other emergency vehicles to turn around and return to their station after responding to an emergency on the proposed bridge. (Personal communication, January 6, 2004, John Jones, Dare County EMS.)

Cable television and telephone lines could be accommodated on the proposed bridge. New transmission lines would be placed on, or adjacent to, the proposed bridge to replace those on Bonner Bridge. The Cape Hatteras Electric Cooperative would prefer to attach cables or aerial lines to the proposed bridge. If that option is not available to the Cooperative, an independent structure adjacent to the proposed bridge would be constructed. The aerial lines would be attached to the independent structure and maintained from the shoulder of the proposed bridge. Disruption of service as it is switched from the existing lines to the replacement lines would be minimal.

The 8-foot (2.4-meter) wide shoulders on the proposed bridge would be safer for use by bicycle and pedestrian traffic than Bonner Bridge’s 2-foot (0.6-meter) wide shoulders. In addition, the planned bicycle-safe bridge rail on the proposed bridge would also provide increased safety for bicyclists.

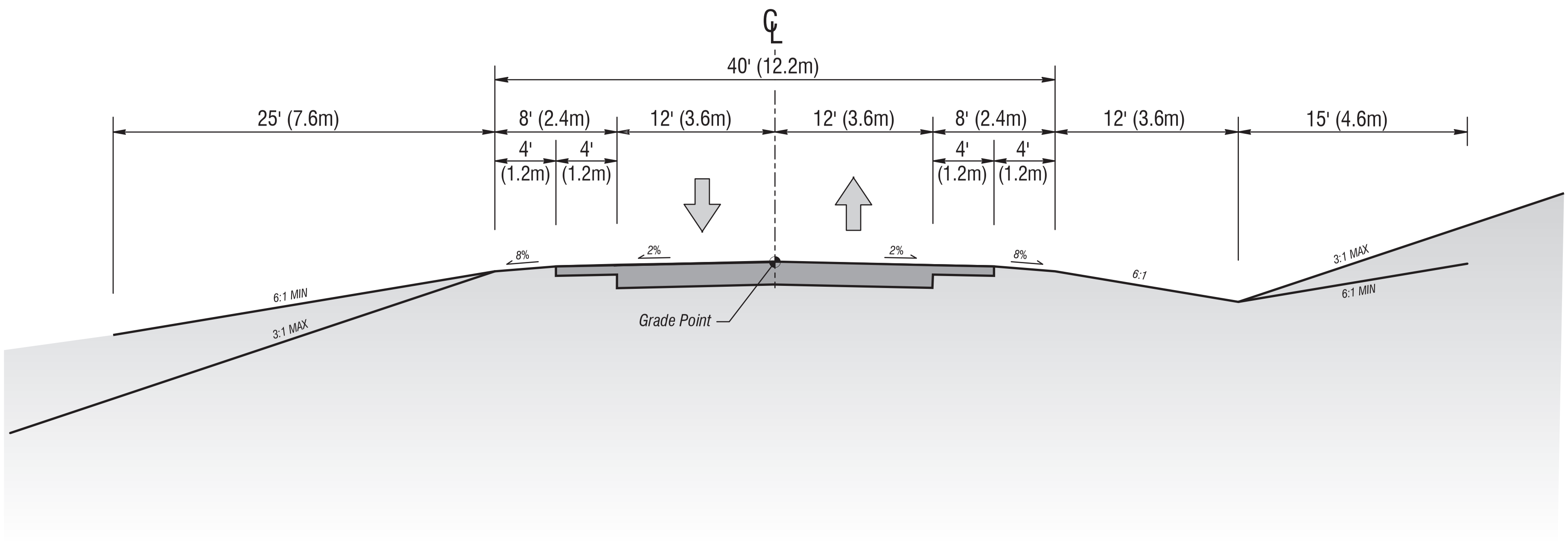
2.9.3 Approach Roadway Characteristics

Approach roadway on fill at each end of the bridge structure would be:

- Approximately 1,550 feet (472 meters) long on Bodie Island;
- Approximately 968 feet (295 meters) on Hatteras Island with the Curved Rodanthe Terminus; and
- Approximately 680 feet (207 meters) on Hatteras Island with the Intersection Rodanthe Terminus.

Thus, total project length would be 18 miles (29 kilometers) long, including the bridge and the approach roadways.

The approach roadway typical section would have two 12-foot (3.6-meter) travel lanes with 8-foot (2.4-meter) shoulders (4-foot/1.2-meter paved). Eight feet (2.4 meters) of clearance from the edge of the travel lane to the face of the guard rail would be provided (see Figure 2-14). Fill is expected to be a maximum height of 12 feet (3.6 meters).



ROADWAY TYPICAL SECTION

Figure 2-14

On the Bodie Island approach roadway, a 60 mile per hour (96.6 kilometers per hour) design speed was assumed. On Hatteras Island approach roadway, a 50 mile per hour (80 kilometers per hour) design speed was assumed. Side slopes of 6:1 (minimum) to 3:1 (maximum) were assumed for fills on the approach roadways (1 foot [0.3 meters] of height for every 3 to 6 feet [0.9 to 1.8 meters] of width).

2.9.4 Rodanthe Terminus Options

Two terminus options are being considered where the Pamlico Sound Bridge Corridor ends in Rodanthe (see Figure 2-12):

- A curved terminus; and
- An intersection terminus.

The differences in community, cultural resource, natural resource, and other impacts of these two options are described in Chapter 4. Two options are being evaluated because they have differing advantages and disadvantages.

From a traffic operations perspective, the two Rodanthe termini options differ as follows:

- The Curved Rodanthe Terminus would connect the bridge directly to NC 12. Users of the bridge would not have to make a turn to enter onto or exit the bridge. With the Intersection Rodanthe Terminus, users of the bridge would turn at an intersection of NC 12 to enter or leave the bridge.
- With the Intersection Rodanthe Terminus, all southbound bridge traffic would have to at least slow down to turn at the signalized intersection before leaving the bridge and entering the Rodanthe section of NC 12 with its slower speeds and numerous cross streets and driveways intersecting NC 12. With the Curved Rodanthe Terminus, southbound bridge traffic would not be forced to slow before entering Rodanthe.
- With the Curved Rodanthe Terminus, a traffic signal could be installed in the future, if necessary, to aid traffic movement to and from the existing segment of NC 12 north of the Rodanthe bridge terminus. The level of service at the possible future signalized intersection with local roads would be:
  - A on a 2025 peak season weekday;
  - B on a 2025 peak season weekend; and
  - D on a 2025 peak season Saturday.
- With the Intersection Rodanthe Terminus, a traffic signal would be provided at the intersection with existing NC 12. With the signalized intersection, this option would carry NC 12 traffic at a desirable level of service during forecast peak season weekday traffic for 2025. The level of service with the Intersection Rodanthe Terminus at the signalized intersection would be:

– B on a 2025 peak season weekday;

– D on a 2025 peak season weekend; and

– E on a 2025 peak season Saturday.

The signalized intersection with the Intersection Rodanthe Terminus was assumed to include a single exclusive left-turn lane for northbound NC 12 traffic turning to reach the proposed bridge and a single exclusive right-turn lane for southbound traffic turning to continue south on NC 12. Level of service (LOS) B on a 2025 peak season weekday exceeds the NCDOT's and the FHWA's LOS objectives (i.e., LOS D) for a signalized intersection on a peak season weekday in a location with a seasonal population. Dual exclusive left turn lanes for northbound NC 12 traffic would improve conditions to LOS D for the 2025 peak season Saturday period with the Intersection Rodanthe Terminus. (See Section 1.5.7 for a definition of the LOS measures and additional discussion of LOS along NC 12.)

- The Curved Rodanthe Terminus would require the addition of a service road to maintain road access to adjoining properties. A service road is not needed with the Intersection Rodanthe Terminus.

2.9.5 Construction Procedures

2.9.5.1 Likely Construction Procedures

Construction of the proposed bridge would involve primarily the assembly of large precast concrete units. Precast units would be manufactured at a precast plant and shipped to the construction site. Smaller components could be delivered by truck or barge. The least costly method for shipping all parts probably would be by barge.

Substructure

When building the substructure (the portion of the bridge that supports the bridge spans and deck), the easiest way to move erection cranes from place to place is by attaching them to a barge and moving the barge from place to place. In general, the substructure would be erected by a crane on a barge. Generally, Oregon Inlet's bottom would only be dredged in water depths less than 6 feet (1.8 meters) where SAV is not present. This situation occurs for approximately 8 miles (12.8 kilometers) of the project's 17.5-mile (28.2-kilometer) length), primarily near the southern terminus and in the Oregon Inlet area. Where dredging is needed, the dredging would be to a depth of 8 feet (2.4 meters) to 10 feet (3.0 meters) to provide more flexibility for construction barge operations and to reduce the frequency of any maintenance dredging (since sand could shift and begin to fill in the dredged area over the course of construction).

Where SAV is present, erection equipment would be placed on a work bridge (a temporary short-span, low-elevation structure) to avoid dredging and directly affecting the SAV. Assembly of the work bridge would be span-by-span using top-down construction. In top-down construction, the last span built is used by construction equipment to place the piers, girders, and decking for the next span.

Disturbance to the sound bottom below would be caused by pile-driving operations at work bridge pier locations, ongoing construction operations, and equipment maintenance. On land, erection equipment would operate adjacent to this proposed bridge.

Superstructure

Assuming a segmental box girder superstructure, the superstructure (or spans) outside of the navigational zone (140 to 150 feet [42.7 to 45.7 meters] long) could be built using a "span-by-span" placement of the segmental boxes. Segments could be delivered to, and stored at, a staging area (work platform or anchored barges) in Pamlico Sound and then transported along the constructed sections of the permanent bridge to their final destinations where the bridge would be erected using an erection truss (see Figure 2-15 and Figure 2-16). Two such staging areas of about 5.0 acres (2.0 hectares) in size likely would be used. A similar approach would be used if concrete girders ("I" shape) are used. Span lengths in this case would be shorter, perhaps 120 feet (36.7 meters).

Segmental box girder spans within the navigation zone (minimum 200 feet [61 meters] of horizontal clearance) would be erected by "balanced cantilever" construction. Balanced cantilever construction would involve the erection of box-girder segments beginning at a pier and then erecting segments alternating each side of the pier as segments are added. The cantilevers would be built and joined ultimately with the cantilever that has been constructed previously on the adjoining piers. An overhead gantry, beam and winch on the bridge deck, or barge-mounted cranes could be used to erect the segments. See Figure 2-17 for an illustration of these balanced cantilever erection methods.

If an overhead gantry is used, segment delivery could be made over the completed portion of the bridge, to the back of the gantry, where the gantry would lift and transport the segment for erection. The size of the project and speed of erection could justify the investment to fabricate a gantry if the contractor chooses to make such an investment. With the beam-and-winch method of construction, segment delivery would be by barge.

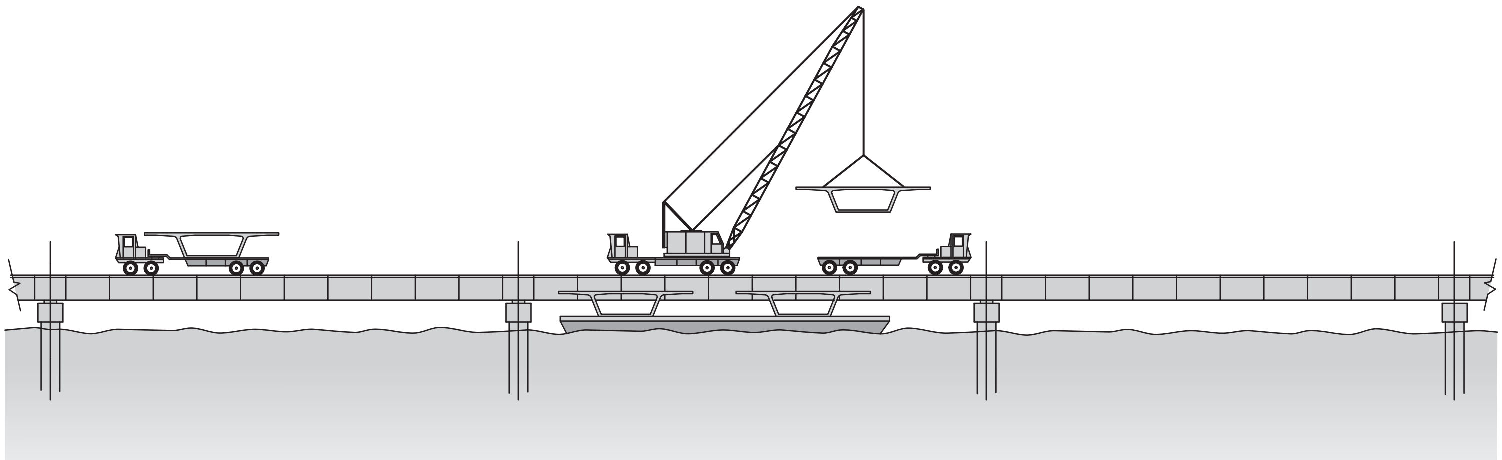
On land, span erection equipment would operate adjacent to the proposed bridge.

2.9.5.2 Planned Construction Timing

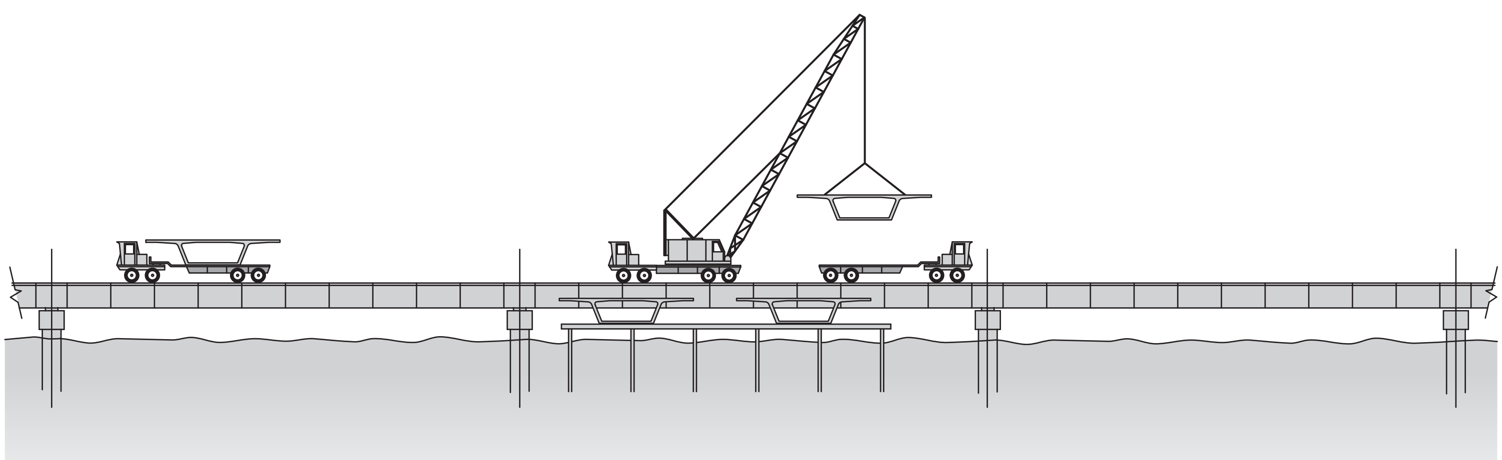
The NCDOT plans to let the proposed bridge project for construction as a "design-build" project in 2009. As a design-build project, contractors would submit bids to both design and build the bridge based on specifications and other requirements defined by the FHWA and NCDOT.

Construction of the bridge would begin while portions of the design are still underway. This process would reduce the time needed to design and build the project. Initial construction activities would be completed over a four year period.

Construction could take place throughout the year. Bridge construction operations could likely take place 24 hours a day so that the bridge could be opened to traffic in 2013. Severe weather or water conditions could stop construction temporarily. If requested by permitting agencies, subaqueous (i.e., underwater) construction activities and dredging within the deepest portions of the Oregon Inlet could be reduced or avoided during the spring seasonal migration period.



Segments Stored on Barge at Staging Area and Transported along Permanent Bridge

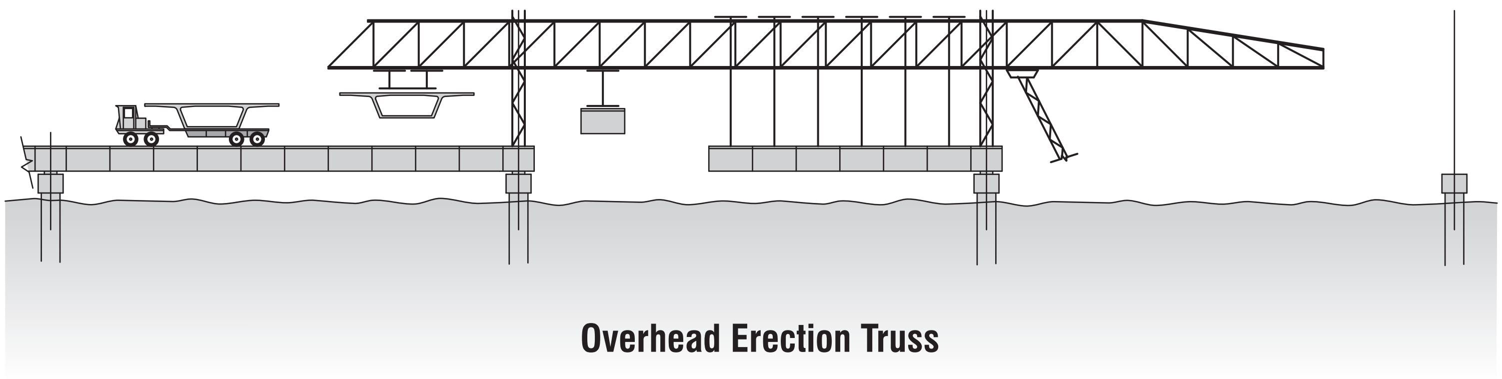


Segments Stored on Platform at Staging Area and Transported along Permanent Bridge

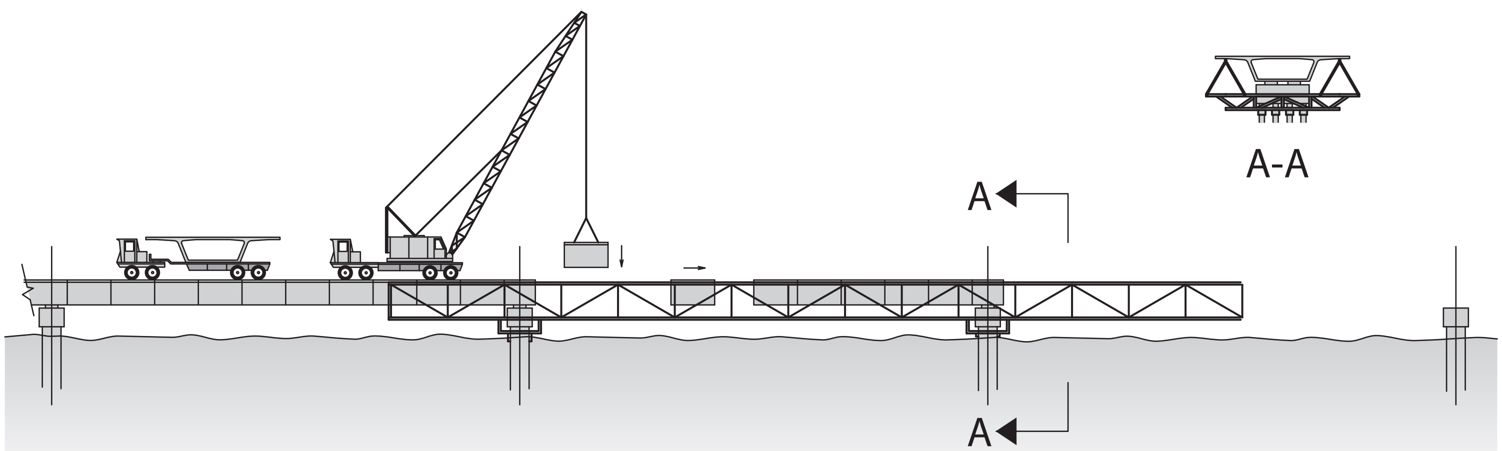
PAMLICO SOUND BRIDGE CORRIDOR
BRIDGE SUPERSTRUCTURE STAGING AREA

Figure 2-15

SPAN-BY-SPAN METHOD



Overhead Erection Truss

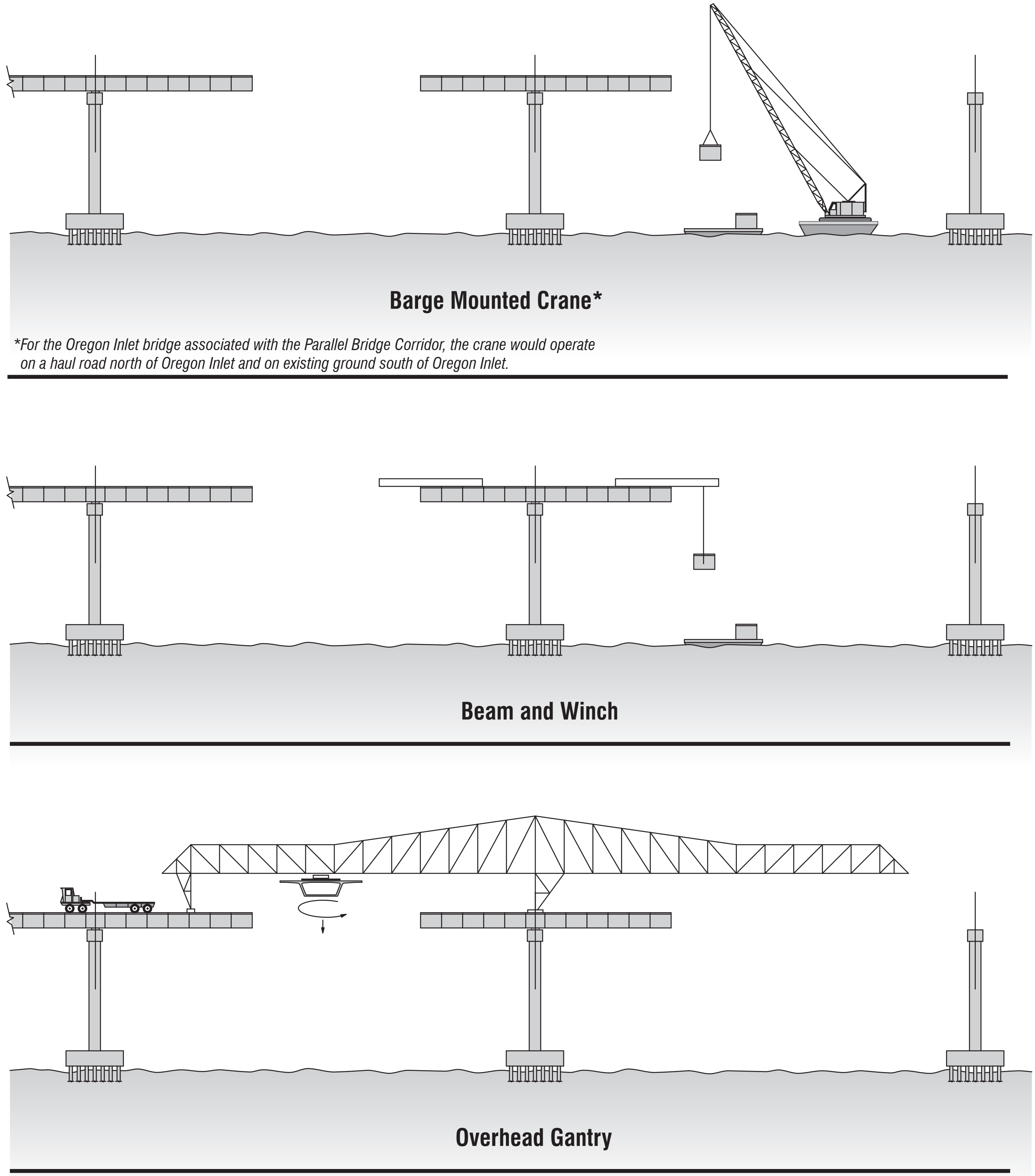


Underneath Erection Truss

Note: These approaches to bridge erection apply to short 140.0 to 150.0-foot (42.7 to 45.7-meter) spans associated with non-navigation spans with the Pamlico Sound Bridge Corridor and all bridges except the Oregon Inlet bridge with the Parallel Bridge Corridor.

BRIDGE SUPERSTRUCTURE ERECTION FOR SHORT SPANS

Figure 2-16



3 METHODS OF BALANCED CANTILEVER ERECTION OF LONG SPANS ASSOCIATED WITH THE PAMLICO SOUND BRIDGE CORRIDOR'S NAVIGATION SPANS AND THE PARALLEL BRIDGE CORRIDOR'S BRIDGE OVER OREGON INLET

BRIDGE SUPERSTRUCTURE ERECTION OPTIONS FOR LONG SPANS	Figure 2-17

2.10 Description of Parallel Bridge Corridor Alternatives with NC 12 Maintenance (Selected for Detailed Study)

The Parallel Bridge Corridor with NC 12 Maintenance alternatives include a replacement bridge that begins at the southern terminus of Bonner Bridge on Hatteras Island. The bridge would extend north across Oregon Inlet for approximately 2.7 miles (4.3 kilometers), ending near the northern terminus of Bonner Bridge on Bodie Island. The NC 12 maintenance component would keep NC 12 open from the community of Rodanthe to the Oregon Inlet bridge's southern terminus, a distance of approximately 12.5 miles (20.1 kilometers).

Five alternatives for the NC 12 maintenance component are considered. They are:

- Nourishment. Maintenance of NC 12 in the existing easement through beach nourishment with dunes at several locations;

- Road North/Bridge South. NC 12 relocation to the west as a road in the northern half of the Refuge and on a bridge in the Rodanthe area; All Bridge. NC 12 relocation to the west on a bridge both in the northern half of the Refuge and in the Rodanthe area;

- Phased Approach/Rodanthe Bridge (Preferred). Maintenance of NC 12 in the existing easement by building a bridge as needed in the existing easement; and

- Phased Approach/Rodanthe Nourishment. Maintenance of NC 12 in the existing easement by building a bridge as needed in the existing easement, except in Rodanthe where NC 12 would be maintained in the existing right-of-way through beach nourishment.

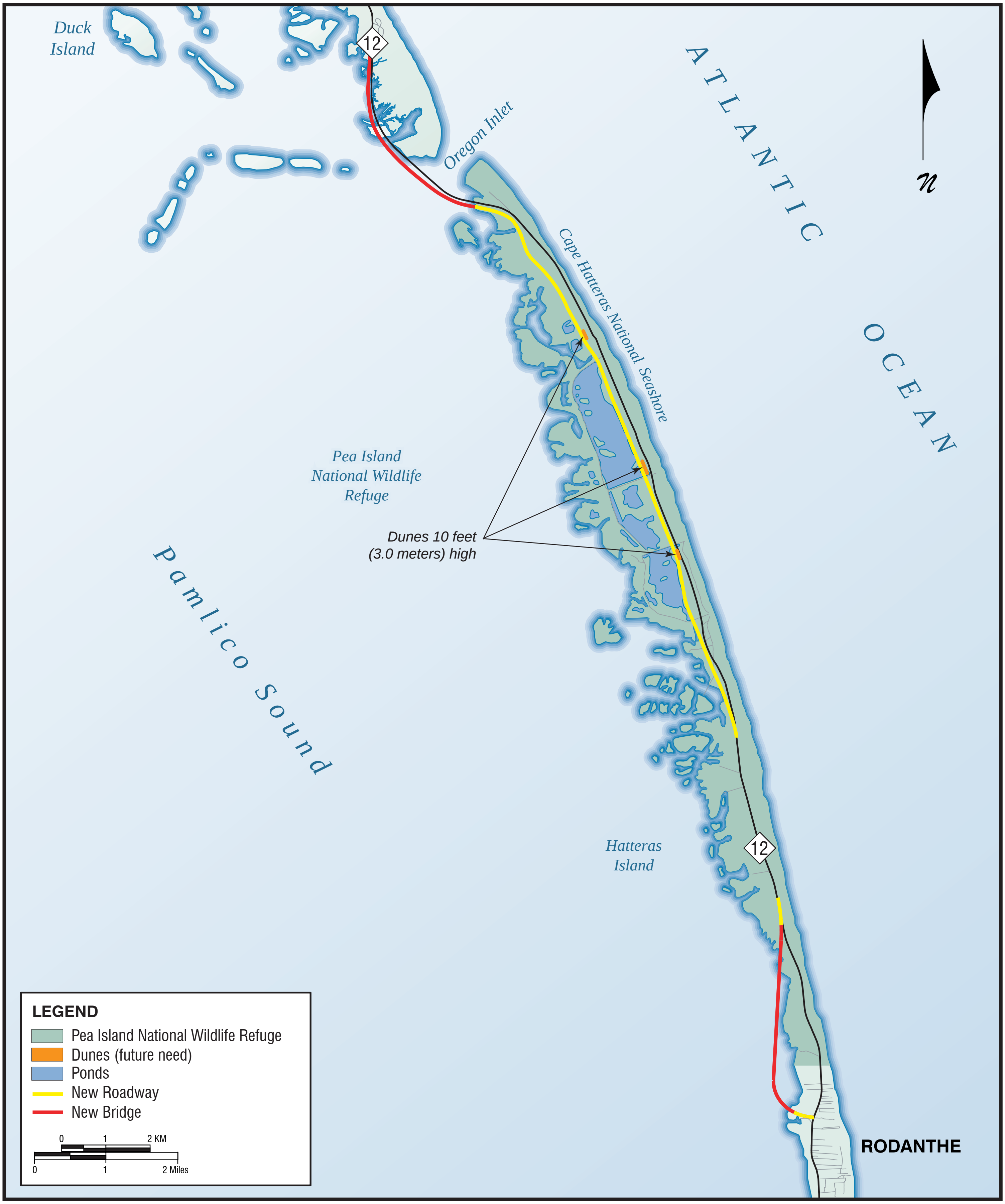
The Parallel Bridge Corridor with NC 12 Maintenance alternatives are illustrated in Figure 2-18 to Figure 2-21.

Although the NC 12 Maintenance alternatives are described and addressed in this FEIS as five separate alternatives, their components could be mixed and matched geographically along the length of NC 12 to create other variations. For example, NC 12 could be relocated on a road immediately south of a new Oregon Inlet bridge and relocated on a bridge in the area of the large ponds within the Refuge and at Rodanthe. NC 12 also could be protected by beach nourishment in the northern part of the Refuge and relocated on a bridge in the Rodanthe area. The Bridge South component of the Road North/Bridge South Alternative could be used in place of the Phased Approach alternatives' components at the south end of the Refuge and at Rodanthe. Other combinations are also possible. As such, the assessment of the five NC 12 Maintenance alternatives is representative of all possible combinations of their components.

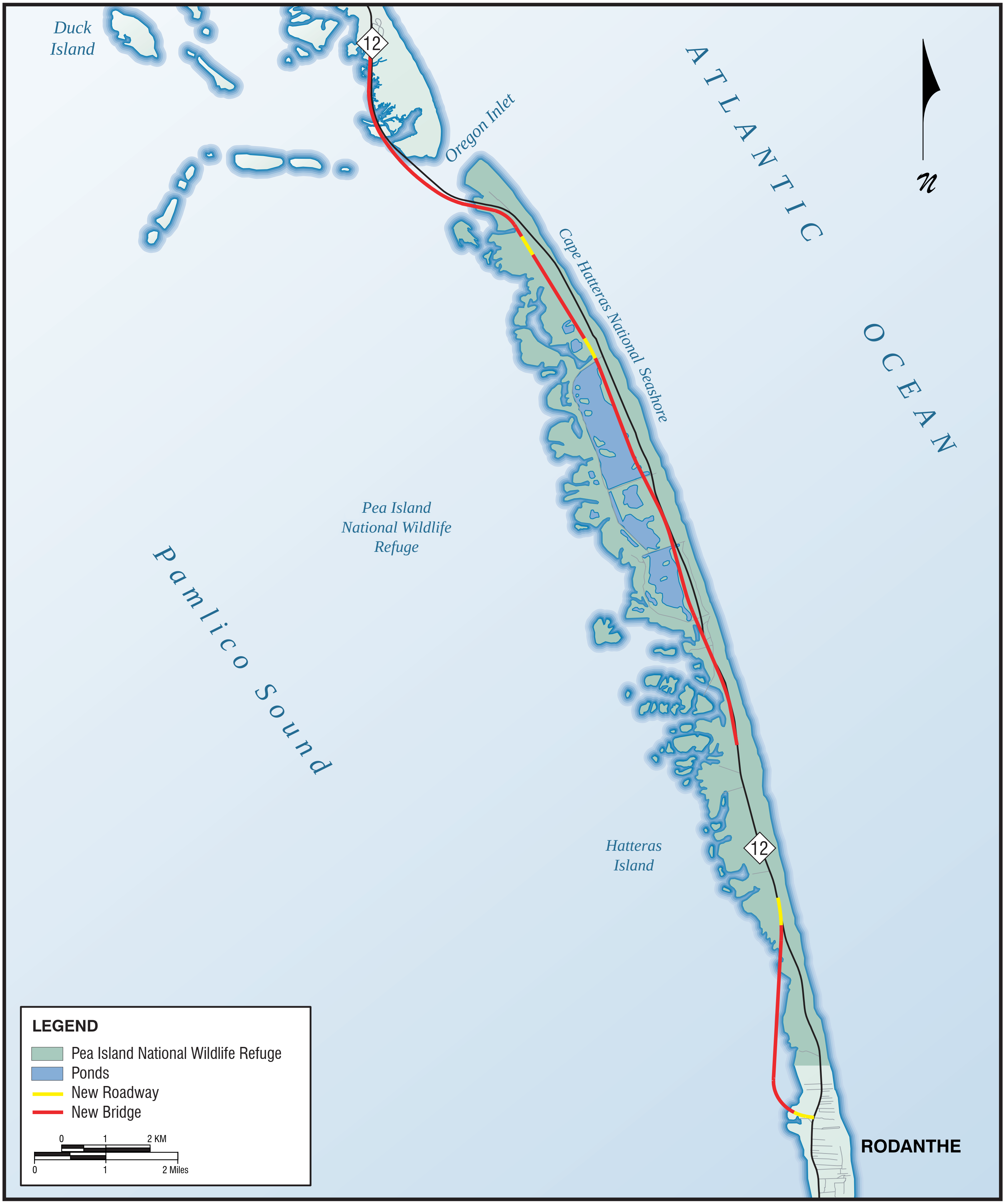
The two Phased Approach alternatives (including the Preferred Alternative) are described and addressed in this FEIS with specific locations and lengths for the phases. These details could be adjusted based on funding availability and changing coastal conditions within the project area, recognizing the uncertainty of predicting future shoreline conditions. For example, if a storm related breach were to occur, or if shoreline erosion accelerated or decelerated in a particular location, implementation of any individual phase could be accelerated or delayed. Opportunities

PARALLEL BRIDGE CORRIDOR WITH NOURISHMENT

Figure 2-18

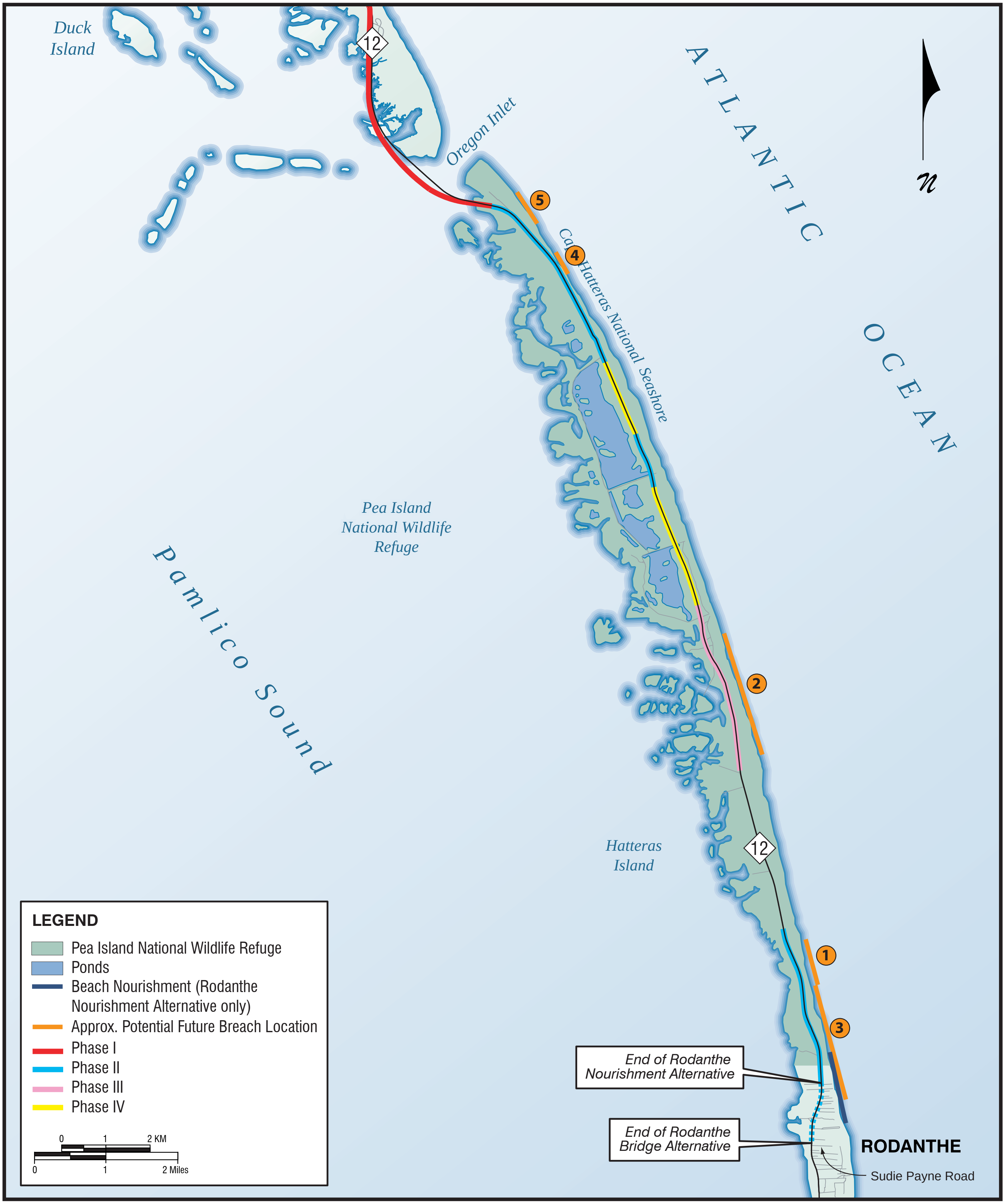


PARALLEL BRIDGE CORRIDOR WITH NC 12 RELOCATION ON ROAD NORTH/BRIDGE SOUTH	Figure 2-19



PARALLEL BRIDGE CORRIDOR WITH NC 12 RELOCATION ON ALL BRIDGE

Figure 2-20



PARALLEL BRIDGE CORRIDOR WITH PHASED APPROACH

Figure 2-21

for phasing the NC 12 maintenance component of the Parallel Bridge Corridor alternatives assessed in the FEIS are presented in Section 2.10.2.5 under “Opportunities for Phasing the Road North/Bridge South and All Bridge Alternatives.”

The subsections that follow describe first anticipated characteristics and construction procedures associated with a new Oregon Inlet bridge in a parallel corridor and then anticipated NC 12 Maintenance alternatives characteristics and construction procedures, including phasing for the Phased Approach alternatives (including the Preferred Alternative). Like the Pamlico Sound Bridge Corridor, safety features would be incorporated into the bridges associated with the Parallel Bridge Corridor alternatives. The All Bridge Alternative and the Phased Approach alternatives (including the Preferred Alternative) would include turnouts for disabled vehicles, as needed, with a maximum distance between these turn-outs of 3 miles (4.8 kilometers). ITS devices would be considered for all bridges.

The design features and approaches to construction described in this FEIS for the Parallel Bridge Corridor with NC 12 Maintenance alternatives were developed based on the best available data at the time. These descriptions were prepared to provide the readers of this FEIS with an understanding of the expected characteristics of each alternative and for use in estimating project cost, level-of-service, and environmental impact. It is assumed that the specific design features (including, bridge span types and arrangements) and approaches to construction described here could change during final project design or by the design-build contractor, preparation of permits, and the development of final mitigation measures. It is not anticipated, however, that such refinements would result in substantial changes to project costs or impacts, or changes to the commitments contained in the Project Commitments section of this FEIS.

Demolition and removal of Bonner Bridge and the disposal of parts of NC 12 are discussed in Section 2.11. Costs and funding for the alternatives associated with both bridge replacement corridors evaluated in detail in this FEIS are discussed in Section 2.12. Environmental protection during construction of the proposed project is discussed in Section 2.13. Permits and approvals are discussed in Section 2.14.

2.10.1 Oregon Inlet Parallel Bridge Characteristics

The proposed Oregon Inlet bridge would be approximately 2.4 to 2.7 miles (3.9 to 4.3 kilometers) in length. Its location is illustrated in Figure 2-10, and in Figure 2-18 to Figure 2-21. The proposed bridge would:

- Begin at or near the southern terminus of Bonner Bridge. With the Nourishment Alternative and the Phased Approach alternatives (including the Preferred Alternative), the bridge would terminate within the existing NC 12 easement on Hatteras Island. With the Road North/Bridge South Alternative, it would enter Hatteras Island 260 feet (79.2 meters) west of Bonner Bridge. With the All Bridge Alternative, it would enter Hatteras Island 350 feet (106.7 meters) west of Bonner Bridge.

- Follow a curved alignment immediately west of Bonner Bridge. The bridge would cross the existing navigation channel for vessels using Oregon Inlet approximately 500 feet (152.4 meters) west of Bonner Bridge. The bridge would cross Bridge to Old House Channel, commonly known as “the crack” where the channel closely parallels Bonner Bridge.

- Terminate at the Bonner Bridge terminus on Bodie Island and follow a route between Bonner Bridge and the parking lot for the Oregon Inlet Marina and Fishing Center.

2.10.1.1 Horizontal Alignment

The Oregon Inlet bridge would consist of a southern approach roadway, a southern approach bridge, main bridge, a northern approach bridge, and a northern approach roadway. These components would be the following lengths:

	Nourishment	*Road North/ Bridge South*	*All Bridge*	*Phased Approach**
Southern Approach Roadway	1,428 feet (435 meters)	1,500 feet (457 meters)	0 feet (0 meters)	0 feet (0 meters)
Southern Approach Bridge	1,370 feet (418 meters)	700 feet (213 meters)	800 feet (244 meters)	0 feet (0 meters)
Main Bridge	9,270 feet (2,826 meters)	10,098 feet (3,078 meters)	10,131 feet (3,088 meters)	9,998 feet (3,047 meters)
Northern Approach Bridge	3,730 feet (1,137 meters)	3,730 feet (1,137 meters)	3,730 feet (1,137 meters)	3,730 feet (1,137 meters)
Northern Approach Roadway	3,295 feet (1,004 meters)	3,295 feet (1,004 meters)	3,295 feet (1,004 meters)	3,295 feet (1,004 meters)

*including the Preferred Alternative

The approach fills (pile of soil upon which the approach roadway is built) would be between the natural ground and a point where the bottom of the bridge girder can be a minimum of 3 to 6 feet (0.9 to 1.8 meters) above the ground. This limited amount of distance between the ground and the bottom of the girder is needed for maintenance, so girder support bearings are kept above the ground.

2.10.1.2 Design Characteristics

This section discusses key Oregon Inlet bridge design characteristics related to design criteria, traffic service, wave energy, storm surge, scour protection, navigational clearances, ship impact, superstructure types, foundation types, use of fill, access to recreation opportunities, and utility relocation. Unless specified, the design characteristics of the Oregon Inlet bridge would accommodate all five NC 12 Maintenance alternatives.

Design Criteria and Traffic Service

As with the bridge in the Pamlico Sound Bridge Corridor (described in Section 2.9.2), the typical section of the new Oregon Inlet bridge would provide two 12-foot (3.6-meter) travel lanes and two 8-foot (2.4-meter) shoulders, for a 40-foot (12.2-meter) clear roadway width. This bridge's typical section is illustrated in Figure 2-13. The total outside width of the bridge would be 42.6 feet (13.0 meters), with the additional 2.6 feet (0.8 meter) being required to accommodate the bridge rails.

The proposed bridge shoulders would accommodate bicyclists and pedestrians more safely than the existing 2 feet (0.6 meters) of clearance and allow room for movement around stranded vehicles and accidents. A bicycle-safe bridge rail would be utilized. The 40-foot (12.2-meter) clear roadway width on the bridge could allow for the temporary emergency designation of three lanes during evacuations, with two lanes of traffic moving off the island.

The approach roadway (on fill) to the bridge would have 8-foot (2.4-meter) shoulders (4-foot [1.2-meter] paved) and provide 8 feet (2.4 meters) of clearance from the edge of the travel lane to the face of the guard rail. The 4-foot (1.2-meter) paved shoulders on the approach roadway were assumed to taper to match the 6 feet (1.8 meter) of lateral clearance on each side of the replacement structure (see Figure 2-14).

With the Phased Approach alternatives (including the Preferred Alternative), the bridge would not come down to grade at its south end. Ramps would bring travelers down to NC 12 until the bridge is extended as a part of Phase II (see Figure 2-22). After the completion of Phase II, these ramps would remain and be paired with two more ramps at the same location to provide access to the northern end of Hatteras Island.

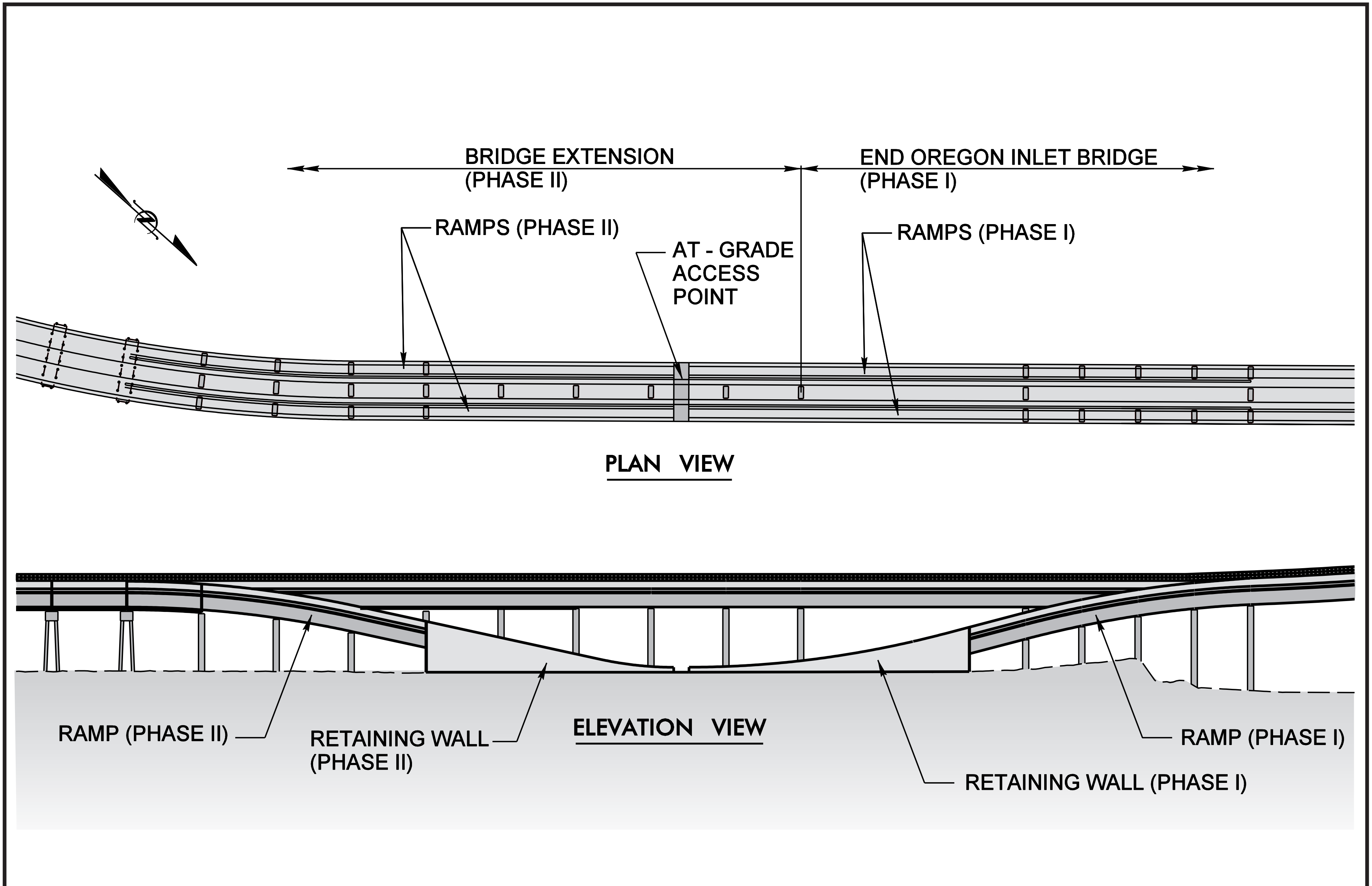
Wave Energy, Storm Surge, and Scour

Scour is a characteristic of the dynamic nature of the Oregon Inlet, and it has the potential to threaten crossing structures. For this FEIS, the following scour protection depths were assumed to be used with the Oregon Inlet bridge:

- Southern bridge approach—61.0 to 70.9 feet (18.6 to 21.6 meters) below mean sea level;
- Main bridge—105.0, 109.9, and 84.0 feet (32.0, 33.5, and 25.6 meters) below mean sea level with the lesser depths at the south and north ends of the main bridge, respectively; and
- Northern bridge approach—55.1 to 63.0 feet (16.8 to 19.2 meters) below mean sea level.

The destruction of many bridges in the Gulf Coast region resulting from Hurricane Katrina demonstrates the significance of wave and water forces on bridges. The effects of wave energy, storm surge, and scour would be accounted for in the Oregon Inlet bridge final design, as well as in the final design of the bridges associated with the NC 12 maintenance components over or expected to be over waterways, which are described in Section 2.10.2. This would be done in accordance with the latest version of the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications, recommendations outlined by the FHWA-AASHTO Wave Task Force, and NCDOT requirements. The Wave Task Force is developing interim guidance for quantifying wave forces on bridges, structural design approaches for wave forces, and deployment of countermeasures for existing bridges. The task force's report titled "Guide Specifications for Bridges Vulnerable to Coastal Storms" was approved by the AASHTO Subcommittee on Bridges in May 2008, but is still waiting to be published, so there could be modifications to the guidance (e.g., technical queries, editorial changes, etc.) before the report is published. These AASHTO and NCDOT specifications and requirements also would apply to the Pamlico Sound Bridge Corridor.

Foundation and substructure elements for project bridges would be designed with the assumption that no new revetments would be constructed at the time the bridges are initially built and that no new revetments would be constructed in the future. It is well documented that the Oregon Inlet is in a dynamic environment that produces highly complex hydraulic conditions. In addition, the erosion of the existing shoreline south of the Oregon Inlet presents difficulty in predicting future conditions as related to hydraulic, geotechnical, and structural engineering design for the new bridges associated with the Parallel Bridge Corridor alternatives. Therefore, hydrodynamic studies and analyses of coastal processes that are required to supplement or to provide parameters for the structure design would be developed in accordance with the latest edition of the USACE Coastal Engineering Manual. The new analyses would be accomplished as part of the final



OREGON INLET BRIDGE SOUTHERN TERMINUS WITH THE PHASED APPROACH ALTERNATIVE

Figure 2-22

design of the Oregon Inlet Bridge and other bridges over or expected over waterways. These analyses would include a site-specific hydrologic model to assist in determining design parameters related to scour and to predict coastal erosion.

These analyses also would incorporate, with the Parallel Bridge Corridors alternatives that include bridges through the northern part of Hatteras Island, the potential for terminal groin removal after bridges are completed or the groin's flanking. The hydrologic, hydraulic and scour analyses would be developed in accordance with the latest relevant FHWA guidelines including, but not limited to, HEC-18 Evaluating Scour at Bridges, HEC-25 Tidal Hydrology, Hydraulics and Scour at Bridges, and NCDOT requirements for bridges over waterways. The bridges over or expected to be over waterways would require hydraulic analysis using a FHWA accepted two-dimensional hydrodynamic model such as FESWMS-FST2DH. In the case of a future inlet developing and remaining open in the Phase II to IV bridge areas, the complexity of the hydraulics of a two (or more) inlet system would require large scale 3D modeling of the hydrodynamics, sediment transport and morphological change in order to quantify the interaction of the multi-inlet system and establish design conditions.

Plans developed in accordance with NCDOT requirements would provide computations of scour critical elevations for all bridge foundations within or expected to be within waterways. These critical elevations would be used by inspectors to gauge the severity of scour as the scour conditions are monitored over the service life of the bridge.

Corrosive Environmental Conditions

Coastal environmental conditions, including but not limited to, high wind speeds, brackish water and air, humidity, wetting/drying cycles, and storm conditions would be factored into the final design and detailing of the Oregon Inlet bridge and other bridges associated with the Parallel Bridge Corridor alternatives. Bridge components would be designed for these conditions.

Navigational Clearances

A new bridge across Oregon Inlet must take into account the migratory nature of the navigational channel. Thus, the bridge should provide the required navigational clearances at spans within the range of probable channel locations. The proposed bridge would include a series of navigational spans across Oregon Inlet, a distance up to 5,000 feet (1,524 meters) with a minimum vertical clearance of 75 feet (22.9 meters). Spans in the navigation zone would have a minimum of 200 feet (60.1 meters) of horizontal clearance.

The length of the navigation zone (approximately 3,300 feet [1,006 meters]) with the Phased Approach alternatives (including the Preferred Alternative) would be less than the Oregon Inlet bridge associated with the other Parallel Bridge Corridor alternatives (up to 5,000 feet [1,524 meters]). The shorter distance with the Phased Approach alternatives (including the Preferred Alternative) is necessitated by the inclusion of the ramps noted above to provide access to the north end of Hatteras Island from the alternative's bridges.

Coordination with the US Coast Guard and USACE would facilitate the establishment of location(s) for navigation spans, channels, and clearances. The location(s) of the navigation span(s) would be considered when designing for potential vessel collision.

Ship Impact

A hopper dredge was selected during the 1995 bridge type study as the design vessel for ship impact. Design for vessel collision would be in accordance with the latest version of the

AASHTO LRFD Bridge Design Specifications, the AASHTO Guide Specification and Commentary for Vessel Collision Design of Highway Bridges, and NCDOT requirements. The effects of scour also would be accounted for when designing for vessel collision in accordance with the LRFD Bridge Design Specifications and NCDOT requirements.

Superstructure Types

In general, the bridge type assumed for this corridor was determined by navigational span requirements, ship impact requirements, scour requirements, and constructability. Long-span precast concrete segmental box girders built using the balanced cantilever construction method could be used.

With the Parallel Bridge Corridor with Nourishment Alternative, the new Oregon Inlet bridge would end in the existing Bonner Bridge easement. In order to accomplish this, it is assumed that the new bridge would be built over the top of the old bridge for the new bridge's last two southern spans. The foundation and piers of this part of the new bridge could straddle Bonner Bridge. The superstructure could be placed on a straddle cap that would span the piers on either side of Bonner Bridge. The Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) also would end in the existing Bonner Bridge easement. In this case, it was assumed that a traffic maintenance bridge would be used to accomplish this objective. Thus, unlike the Nourishment Alternative, no special superstructure configuration would be needed or was assumed at the south end of the bridge. These approaches are two possible options for building the southern end of a new Oregon Inlet Bridge in the same easement as Bonner Bridge. Another option could prove prudent during project design.

Foundation Types

Based on the scour and ship impact criteria, the foundations for the Oregon Inlet Bridge would be both deep and substantial in construction. Large piles would be required. Based on a design prepared in 1999, for the main bridge 66-inch (165-centimeter) diameter pre-stressed concrete cylinder piles are assumed in the impact assessment. Sixteen to 24 piles were assumed to be used for each foundation on the main bridge, and eight were assumed to be on the approach spans. These piles could be placed by a combination of jetting and driving. A footing would be cast just above the waterline on the cylinder piles. A precast segmental box column was assumed to be placed on the footing to support the superstructure. The footing size for the main bridge was assumed to be 80.1 feet (24.4 meters) wide by 52.5 feet (16.0 meters) long.

In addition to the requirements established in the latest version of the NCDOT's Structure Design Manual and the latest AASHTO LRFD Bridge Design Specifications, the final design pile lengths would be determined for both the Oregon Inlet bridge and other bridges associated with the Parallel Bridge Corridor alternatives based on the following:

- Results from a hydrologic, hydraulic, and scour analyses.
- Results from a coastal engineering model that predicts subsurface elevations in the vicinity of the bridge at the end of the bridges' theoretical design life.
- Subsurface exploration program.
- Structural design requirements including, but not limited to, vessel collision, scour and water loads.

- Results from bridge foundation and substructure analyses that include the effects of soil-structure interaction behavior. Finite element analysis software intended to analyze soil-structure interaction such as FB-Pier (Florida Pier).

As described above for the Oregon Inlet bridge, it is anticipated that different pile lengths would be required at different reaches along all bridge alignments. The bridges would be sub-divided to achieve economical foundation designs and pile lengths at different regions along the structure. The range of predicted scour depths could be used as a means of sub-dividing the zones of the structure. The pile lengths also would be determined assuming that no future revetments or stabilizing measures would be constructed over the design life of the bridges.

Use of Fill

As with all bridges, at each end of the bridge in this corridor fill would be used instead of structure for the approach roads between the natural ground and a point where the bottom of the bridge girder can be a minimum of 3 to 6 feet (0.9 to 1.8 meters) above the ground. The two approach road fills would have a continuous grade downward from each bridge abutment to natural ground. A maximum 3:1 slope would occur on Hatteras Island. Fill slopes generally would be 4:1 on Bodie Island. With the Phased Approach alternatives (including the Preferred Alternative), a fill slope would be used only at the Bodie Island (north) end of the bridge as noted above.

Access to Recreation Opportunities

A connection from NC 12 to the unpaved beach access road, which is south of the Oregon Inlet Campground on Bodie Island, would be provided.

Bonner Bridge has catwalks that are used by fishermen. For safety reasons, access via catwalks on a new bridge in this corridor is not assumed because the height of the new bridge would put the catwalks at least 40 feet (12.2 meters) above the water. The height of such a catwalk increases the likelihood of serious, if not fatal, injuries resulting from falls.

Opposition to discontinued fishing access also was expressed at the public hearings because fishing is a popular tourist recreational activity on this part of Hatteras Island. The NPS and the USFWS have indicated that their objective is to provide for fishing access at the north end of Hatteras Island at Oregon Inlet but the access does not have to be provided from catwalks mounted on the new bridge. One viable approach (except with the Nourishment and Phased Approach alternatives [including the Preferred Alternative]) appears to be leaving a portion of existing Bonner Bridge for fishing. A "boardwalk" under and around the new bridge also is a possible option with all the Parallel Bridge Corridor alternatives. A boardwalk would be on top of the riprap that currently blankets the northern shore of Hatteras Island.

With the Phased Approach alternatives (including the Preferred Alternative), it was assumed that a temporary bridge approximately 2,600 feet (793 meters) long for maintenance of Bonner Bridge traffic would be built east of Bonner Bridge to divert NC 12 traffic during construction off the southern end of the new Oregon Inlet bridge. Once construction of the new Oregon Inlet bridge is completed, the traffic maintenance bridge could be retained as a fishing pier to replace the fishing catwalks on Bonner Bridge. The new fishing pier would be much wider than the catwalks (26 feet [7.9 meters] versus 4.5 feet [1.4 meters]), providing fishermen with more room to move about than on the current catwalks.

Accommodating fishing from the terminal groin is not considered a viable option. Fishing from the groin is considered very dangerous because of the rapid currents adjacent to the groin, as well as the uneven surface of the groin.

Utility Relocation and Intelligent Transportation Systems Devices

Telephone and power cables could be placed on the new bridge to replace those now on Bonner Bridge. As with the Pamlico Sound Bridge Corridor, during final design the NCDOT would consider implementation of ITS devices (see Section 2.9.2) to provide motorists with road condition information in the NC 12 corridor and on the replacement bridge.

2.10.1.3 Construction

Construction of an Oregon Inlet bridge could take up to 3.5 years to complete. The Oregon Inlet bridge could be completed in less time than a Pamlico Sound Bridge because of its shorter length. Like the Pamlico Sound Bridge Corridor, the NCDOT plans to let a Parallel Bridge Corridor project for construction as a "design-build" project in 2009. Theoretically, construction could take place throughout the year. Severe weather or water conditions could stop construction temporarily.

The following sections describe the construction techniques for the Oregon Inlet bridge and NC 12 Maintenance alternatives assumed in the assessment of impacts in Chapter 4. Unless specified, the construction techniques of the Oregon Inlet bridge would apply to all five NC 12 Maintenance alternatives.

For the Preferred Alternative, the specific methods used in the construction of the project would be determined by the design-build contractor. Those methods would be consistent with environmental protection requirements established by FHWA and NCDOT based on the impact mitigation programs, and project commitments presented in Chapter 4 and the Project Commitments sections of this FEIS, as well as the requirements of environmental regulatory agency permits.

Manufacture and Transport of Components

Construction of an Oregon Inlet bridge in the Parallel Bridge Corridor would involve primarily the assembly of large precast concrete units. Precast units, weighing up to 100 tons (90.7 metric tons), would be manufactured at a precast plant and shipped to the construction site. The substructure also would have precast column and cap components. The footings would be cast-in-place concrete. Materials for the footings would be delivered by truck and/or barge. North Carolina highway regulations include a maximum allowable shipping length; parts exceeding this length would be shipped by barge. The least cost method for shipping all parts probably would be by barge.

Construction of Proposed Structure

The bridge superstructure would be built utilizing the balanced cantilever construction method from barges and a haul road (see Figure 2-17). Top-down construction and construction from a work bridge are not practical (as discussed later in this section).

For the main bridge, the method of construction would be from barge. Barges and fixed cranes must be used to build the main bridge because the pre-cast piles would be too heavy to be lifted into place by crawler cranes. When building over a water body, the easiest way to move a fixed crane from place to place is by attaching it to a barge and moving the barge from place to place.

Where the southern approach of the bridge passes over Hatteras Island, the smaller pre-cast piles would be used to avoid digging a canal into the Island. With smaller piles on land, lighter, more maneuverable equipment operating on the ground can be used. Construction of the southern end of the bridge under the Nourishment Alternative and the Phased Approach alternatives (including the Preferred Alternative) would have unique characteristics because the southern approach would be built in the existing Bonner Bridge easement. Thus, in the case of the Nourishment

Alternative a temporary detour road was assumed to be used to move traffic out of the existing easement so the new approach could be built. In the case of the Phased Approach alternatives (including the Preferred Alternative), a traffic maintenance bridge within the existing NC 12 easement and parallel to the new bridge was assumed.

For the northern approach, construction would likely involve temporary construction of a haul road on geotextile fabric. Here foundations would be lighter and crawler cranes operating on a haul road could be used to erect the precast piles.

Main Bridge. Construction of the substructure for the main bridge can be accomplished best by working directly from barges. Material would be delivered by barge. Additional barges would be needed for construction platforms and construction equipment such as cranes, forms, and other equipment. Pile leads attached to cranes would be used as guides for precast concrete pile installation. Piles would be unloaded from the barges and placed into the leads. Different methods could be used to install the piles to a predetermined elevation and set by impact drivers to the final pile tip elevation. The piles would be cut just above the water line and concrete footings cast on them.

The inlet bottom would be dredged wherever the water depth is less than 6 feet (1.8 meters). Dredging also likely would occur behind Bodie Island up to the point where the north approach begins. The proposed channel would be 8 feet (2.4 meters) deep and approximately 120 feet (36.6 meters) wide. The components of the segmental box girder superstructure also would be brought to the construction site by barges. Balanced cantilever construction of the superstructure would involve erecting box-girder segments beginning at a pier and then alternatively erecting segments on each side of the pier. The cantilevers are built and joined ultimately with the cantilever that has been constructed previously on the adjoining piers. An overhead gantry, beam and winch on the bridge deck, or barge-mounted cranes could be used to erect the segments (see Figure 2-17). If an overhead gantry is used, segment delivery could be made over the completed portion of the bridge, to the back of the gantry, where the gantry would lift and transport the segment for erection. The size of the project and speed of erection could justify the investment to fabricate a gantry if the contractor chooses to make such an investment. With the beam and winch method of construction, segment delivery would be by barge.

Southern Approach. Smaller piles would be used for the southern bridge approach of the Oregon Inlet bridge with all NC 12 Maintenance alternatives. Construction equipment used to install the south approach bridge foundations would operate on the ground.

Construction of the southern end of the bridge under the Nourishment Alternative and the Phased Approach alternatives (including the Preferred Alternative) would have unique characteristics because the southern approach would be built in the existing Bonner Bridge easement.

For the Nourishment Alternative, it was assumed that the last two or three spans of the south end of the Oregon Inlet bridge could be built over the final spans of Bonner Bridge so the Bonner Bridge easement in the Refuge could be used by the new bridge. A new right-of-way permit, therefore, would not be needed from the USFWS. If this approach is used, periodic short-term closings of NC 12, presumably at night and in the off-season, at a minimum during construction as new precast bridge components are maneuvered into position over or adjacent to Bonner Bridge. Once a component is placed, Bonner Bridge would be reopened to traffic until constructors are ready to place the next component. On land, where Bonner Bridge ends and the approach road to Bonner Bridge begins, a temporary detour would divert NC 12 traffic out of the existing easement.

For the Phased Approach alternatives (including the Preferred Alternative), it was assumed that a temporary bridge approximately 2,600 feet (793 meters) long would be constructed for maintenance of Bonner Bridge traffic. This temporary bridge would be built east of Bonner Bridge. The traffic maintenance bridge would allow the southern end of Bonner Bridge to be demolished so that the new Oregon Inlet bridge could be tied into existing NC 12 at the north end of Hatteras Island.

Northern Approach. At this time, construction from a temporary access road is anticipated to be the most flexible and economical way of constructing the north approach of the Oregon Inlet bridge and all NC 12 Maintenance alternatives. Piles for the approach span foundations would be placed from the haul road as described for piles for the main bridge. Crawler cranes would be used. The segmental box girder superstructure could be erected using crawler cranes on the temporary access road. The balanced cantilever construction method similar to that described previously for the main bridge spans would be used to erect the superstructure. Segments could be delivered to the work area on the temporary access road.

Pile Placement

The different types of foundation pile installation methods are described below. These descriptions apply both to the placement of piles with the Oregon Inlet Bridge, as well as the other bridges that comprise the Parallel Bridge Corridor alternatives. Each of these installation methods would result in different levels of disturbance and sediment release. Not all of these methods can be applied at all locations along the project. Decisions on methods for pile installation and on the exact procedures for minimizing pile placement impact would be developed by the design-build contractor based on criteria established by NCDOT. The methods for minimizing pile placement impacts below serve as examples of potential approaches.

Jetting. The technique of jetting-during-driving, is a pile installation technique that uses pressurized water that is “sprayed” from the tip of the pile as it is progressed through the ground. The jetting water erodes the soil immediately beneath the pile to allow the pile to pass easily through the subsurface material. Typically the jetting operation is terminated when the pile tip is approximately 5 feet (1.52 meters) above its target tip elevation. The pile is then mechanically driven (“seated”) down to its final position. NCDOT only permits jetting-during-driving and not re-jetting, which is a different procedure.

The limit of the bottom disturbance around the pile(s) is a key factor in the extent of the impact of jetting on the surrounding area. One conclusion that research performed by North Carolina State University’s (NCSU) Department of Civil, Construction, and Environmental Engineering (Characterization of Jetting-Induced Disturbance Zone and Associated Ecological Impacts, Report No. FHWA/NC/2006-09) yielded was that the diameter of the zone of disturbance, at all pile test locations, was found to be approximately equal to the jetted pile length (assuming material distribution is unaffected by currents). For example, if a pile was jetted for a distance of 30 feet (9.1 meters), the diameter of the disturbed area was measured to be approximately 30 feet (9.1 meters) centered on the pile. In addition, based on the field test results from the NCSU research, it was found that typically the volume of spoil was approximately equal to, or slightly greater than, the volume of the jetted pile.

In areas with swift water currents, such as in the Oregon Inlet, collection and disposal of jetting spoils would be very difficult. However, given the high volume of sediment transported through the inlet as a result of daily tidal action, it is anticipated that the volume of jetting spoils would be a small fraction of the volume of material moving in and out of the inlet on a daily basis.

In areas where the water is less turbulent, such as behind Bodie Island, collection and disposal of jetting spoils likely would be required to protect submerged aquatic vegetation and other ecological entities. For example, erosion control devices, including turbidity curtains, could be used around the piles during their installation to minimize and control sediment release and the limits of bottom disturbance. One means of collecting the spoils generated for disposal after jetting is complete would be a high powered vacuum system.

Spoils generated by jetting for bridges over Hatteras Island could be collected and disposed during the pile installation process by use of conventional excavation and hauling equipment on site since these piles would be installed on-land and not underwater. An approved disposal site for the spoil material would need to be identified by the design-build contractor. Erosion control measures such as silt fence and straw bales positioned around the pile location would assist in containing the jetting spoils to a limited area around the pile. It will be important that jetting spoils not leave the NC 12 easement in the Refuge. One option the contractor could use to avoid this is constructing a protective wall system adjacent to the existing right-of-way boundary at the foundations. The wall would deflect and prevent jetting spoils from leaving the easement.

Finally, to minimize the disturbed zone resulting from jetting spoils, a site-specific jetting program (pump flowrate, pump pressure, etc.) could be designed taking into account the actual soil characteristics at the site and the anticipated jetted pile lengths. Developing this type of program would likely involve performing testing at intermittent locations along the proposed project to categorize potentially different soil conditions.

Driving. The most conventional and least expensive pile installation technique is driving. Negligible bottom disturbance and sediment release results from pile driving operations. However, driving piles, regardless of the driving technique implemented, typically produces noise levels in the range of 82 to 105 dBA. Given the nature of the project area, high levels of noise during construction would not be desirable. Also, it probably not possible to drive large diameter cylinder piles, which are assumed for the Oregon Inlet bridge in this FEIS.

Drilling. Piles can be installed in pre-drilled holes (on land only) or drilled shaft foundations could be used. Drilled shaft spoils can be collected and disposed only when generated on land. The use of drilled shafts can result in lower noise levels than pile driving depending on the technique used to install the associated steel casings, but the volume of drilling spoils would be substantial.

Alternatives for Erecting the Bridge Behind Bodie Island.

During the bridge type study in 1995, four methods were considered for bringing span units to erection points behind Bodie Island: a dredged barge canal, a temporary access (haul) road, a work bridge, and top-down construction. The characteristics and feasibility of each method are described below. That study found that use of top-down construction is not practical, and a work bridge would be practical only in some situations. The four practical methods assessed in 1995 are described as follows:

Dredged Barge Channel. A dredged channel is planned for the portion of the main span behind Bodie Island and in the inlet only where the water depth is less than 6 feet (1.8 meters). This approach was used for construction of Bonner Bridge, as well as for emergency repair when spans were lost on October 26, 1990.

The channel would be about 120 feet wide (36.6 meters) and placed approximately 30 feet (91 meters) west of the proposed structure. The channel likely would require continuous dredging because of shifting sands and currents; this phenomenon was experienced by the contractor who built Bonner Bridge in 1962. The channel would be marked by the Coast Guard. Once all the construction for the north approach and the far span of the main bridge has been completed, the contractor would move to the next main bridge span and the preceding portion of the channel would be allowed to fill in naturally. Dredging spoil would be pumped or transported by barge to an in-water disposal site near the project area. If the spoil exhibits the necessary properties, it could be used for beach nourishment or disposal. The appropriate location for spoil disposal would be determined based on coastal conditions at the time of construction. The required USACE permit would be obtained, per Section 103 of the Marine Protection Research and Sanctuaries Act. NCDOT would work with the USACE, the USFWS, the NMFS, and the NCDENR to develop a dredging technique and disposal plan that would minimize harm to natural resources. If requested by appropriate agencies, attempts would be made to reduce dredging activities as much as possible during the spring to avoid minor effects to the fisheries resources.

<u>Haul Road</u>. A haul road is expected for construction of the north approach. During discussions with contractors, it was indicated that temporary haul road construction, instead of a dredged channel, might be preferred for the construction of approach spans. This interest was based on the possibility that a haul road might prove more economical because less maintenance might be required. Such a road would be 65 feet (19.8 meters) wide with 40-foot (12.2 meter) wide "fingers" perpendicular to the 65-foot (19.8 meter) main road at each foundation. It would be placed on the west side of the new bridge near the outside edge of the foundations. The haul road could be composed of fill obtained from the inlet or sound. The fill would be placed on a geotextile fabric. The fabric also would be on the slopes of the fill to minimize erosion. A top surface (if required) could be brought in from a mainland location. Dikes could be placed along the edge of the fill's upper surface or around equipment to prevent liquid materials associated with construction from spilling into the adjoining waters and wetlands. At the end of construction, the top surface of the fill would be removed and disposed of in accordance with NCDOT requirements, and the remaining fill would be disposed of in the inlet or sound. The fabric would be removed and the area it covered revegetated. The appropriate location for obtaining and disposing of the fill material would be determined based on coastal conditions at the time of construction. The required USACE permit would be obtained.

Under a haul road construction scenario, bridge components could be shipped and transported by truck to where they would be lifted into place by a crane. Some maintenance of the haul road would be required because of tidal action or storms.

The potential for compaction (the compression of the existing ground) exists with a haul road construction scenario. In this case, however, the likelihood of there being a substantial area of organic material under the haul road is remote. There is only a thin layer of organic material covering sand, which is not compactable. Therefore, the possibility of compaction would be minimized.

<u>Work Bridge</u>. A work bridge must support a live load, such as cranes and trucks, greater than that for the proposed permanent structure. It would have to be used by vehicles carrying piles and segments weighing up to 100 tons (90.7 metric tons) and equipment capable of hauling and placing the components. A work bridge could be one of two types:

1. A temporary short span, low elevation structure built adjacent to the new bridge site. Assembly of this type of work bridge would begin at the abutment and be built span-by-span using the top-down approach. In top-down construction, the last span built is used by construction equipment to place the piers, girders and decking for the next span. Disturbance to the ground below would be caused by pile driving operations at pier locations, ongoing construction operations, and equipment maintenance.

2. A bridge founded on a row of anchored barges, spaced closely together. Where the water is shallow, the barges would have to be dragged into position and dredging may be required to keep the barges floating and to remove them. The potential for loss of the work bridge during a storm would be greater with this type of foundation than the temporary short span, low elevation structure described above.

A work bridge would not be practicable for replacing the dredged canals expected in some locations for construction of the main bridge. The concrete piles used in the main bridge's foundation would be too large to be lifted by a conventional crawler crane.

A work bridge would not be practicable for completely replacing the haul road planned for construction of the north approach for several reasons. A work bridge could be more expensive. In addition, the risks of materials falling into the surrounding waters would be greater with the work bridge than the haul road. Scour likely would occur around the numerous bents (25-foot [7.6-meter] spans) that would make up the work bridge's foundation. A work bridge instead of a haul road for short distances at critical locations, such as SAV locations, could be used and in the case of SAVs, is assumed in the impact assessment in Chapter 4.

Top-Down Construction. Construction equipment is situated near the last span built and is used to place the piles, piers, and superstructure components for the next span. Span lengths, pile sizes, and weights are limited by the capacity and reach of construction equipment and the capacity of the permanent or temporary structure to carry the construction loads. The penalties usually associated with this type of construction are additional costs, additional construction time, shorter approach spans, and an increased number of piers. Very strict tolerances are required for pile locations for top-down construction. Thus, pile driving requires more construction equipment, a longer construction time, and increased cost. The construction duration is longer than that of other methods because the construction of each span must be completed before construction of the succeeding span can begin.

Top-down construction would not practicable for the replacement of the bridge over Oregon Inlet because bridge span lengths would have to be substantially reduced. Reducing the span length would increase project costs.

Construction of Temporary Construction Fills and Permanent Approach Road Fills

Except for the top surface, temporary haul road and permanent approach road fills would consist of fill dredged from the inlet or sound. A portion could come from the dredged channels used in construction. The top surface (e.g., clay or gravel), if required, could be obtained from:

- A mainland location. For the replacement of the bridge over Roanoke Sound/Muddy Channel, the NCDOT obtained fill from the Manns Harbor area, the nearest mainland location to Oregon Inlet.
- Material excavated during the creation of new wetlands under a wetland replacement program.
- An upland location on Hatteras or Bodie islands. Material from Bonner Bridge's approach embankment would be used to replace the material borrowed and restore the borrow site. Existing approach road embankment material also could be used to replace material borrowed from a mainland location.

As an alternative to using dredged material for all but the top surface, the entire approach fill could be obtained from one or more of the three sources listed above.

Staging Area(s)

Land area for construction staging would be desirable near the project. A staging area(s) near the construction project would make it easier to manage the construction process, make it easier to respond to emergencies, be less costly, and reduce construction-related traffic on NC 12. Both water and road access would be desirable. Mostly upland site(s) would be selected.

A staging area would be used for one or more of the following:

- Receipt of concrete and other construction materials by truck;
- Loading various components onto construction barges;
- Receiving major approach span components;
- Construction management and worker trailers;
- Storage of construction equipment not in use; and
- Minor maintenance of construction equipment.

The most likely location available for staging on Hatteras Island would be the access road to the (former) Oregon Inlet Coast Guard Station. The Coast Guard Station site, itself also could be used because it is owned by the State of North Carolina. It is, however, a NRHP-listed site and the station building would need to be relocated within the context of the project's Memorandum of Agreement with the State Historic Preservation Office before it could be used as a staging area. Use of land from the Pea Island National Wildlife Refuge would have to be found by the USFWS to be compatible with Refuge's mission. With the Preferred Alternative, NCDOT does not plan to request the use of Refuge lands for construction staging. Construction associated with the Preferred Alternative would remain within the NC 12 easement and other state-owned land as the project passes through the Refuge. A staging area on Bodie Island would need to be approved by the NPS prior to commencement of construction. Coordination with NPS and obtaining necessary permits would be the responsibility of the construction contractor (including any mitigation measures stipulated). Any approved staging areas permitted by the NPS would be indicated on construction sequencing plans and submitted to the NCDOT and permitting agencies for review and comment.

Following completion of the Oregon Inlet bridge in the Parallel Bridge Corridor, the staging area(s) would be restored to a condition similar to that prior to the start of construction. Specifics regarding staging operations would be developed during the project's design.

2.10.2 NC 12 Maintenance Alternative Characteristics

2.10.2.1 Nourishment

The Nourishment Alternative assumes that NC 12 would remain in its current location and beach nourishment plus dune enhancement would be used to maintain an adequate beach and dune system: 85 to 140 feet (25.9 to 42.7 meters) of beach and berm, 60 to 120 feet (18.3 to 36.6

meters) of dune base, and a 25-foot (7.6-meter) clearance to the edge of pavement. The new Oregon Inlet bridge would enter the Refuge within the easement of the Bonner Bridge terminus. Thus, a new NC 12 easement would not be needed with this alternative. The location of proposed nourishment areas and new dunes are shown in Figure 2-18.

The minimum beach nourishment project length along the beach would be 5,000 feet (1,524 meters) with 500-foot (152.4-meter) tapers (transition from nourished beach to beach that does not require nourishment) on each side. The total length of beach to require regular nourishment would be approximately 6.3 miles (10.1 kilometers). Nourishment would occur in four locations, as shown in Figure 2-18.

When the distance from the edge of NC 12's pavement to the active shoreline is less than or equal to the buffer width of 230 feet (70.1 meters) as described in Section 2.6.1.1, NC 12 would be vulnerable to short-term storm impacts. This potential factor would be mitigated by the presence of dunes. Dunes would protect the highway by providing a physical barrier between the ocean and the highway during storm events that cause flooding and sand inundation from ocean overwash. In the southern part of the Refuge, dunes 20 feet (6.1 meters) above grade with 1:3 side slopes and a 25-foot (7.6-meter) offset from the edge of pavement would be built and maintained. Building a dune of this size on a 230-foot (70.1-meter) footprint would leave a beach width of 85 feet (25.9 meters). Two such dunes would be built in locations shown in Figure 2-18.

In the ponds area and north of the ponds, a dune 10 feet (3.0 meters) above grade with 1:3 side slopes and a 25-foot (7.6-meter) offset from the edge of pavement would be built and maintained. On a 230-foot (70.1-meter) footprint, this would leave a beach width of 145 feet (44.2 meters). Four such dunes would be built in locations shown in Figure 2-18. The dunes would be sized so no more than 50 percent of each dune's volume would be lost over 12 years. The dunes would be restored to their original size every 12 years. The difference in the size of the dune required for the same level of protection in different locations is related to the variance in the offshore slope of the ocean bottom at the different locations. In the northern Rodanthe area, the offshore slope is steeper than elsewhere in the project area, which causes increased wave run-up during storms, thereby resulting in increased erosion and necessitating a larger dune in order to maintain 50 percent of the dune's volume over 12 years.

Sand requirements for nourishment and dunes would vary by location, with the greatest requirements for sand (61 percent) occurring at the southern end of the Refuge. Sand requirements through 2060 in cubic yards (cubic meters) would be:

	South End of Refuge	*Refuge Ponds Area*	*North of Refuge Ponds*	*Total*
Dunes	866,700 (662,640)	144,400 (110,402)	22,200 (16,973)	1,033,300 (790,015)
Nourishment	27,550,000 (21,063,490)	12,200,000 (9,327,569)	5,850,000 (4,472,646)	45,600,000 (3,486,370)
TOTAL	28,416,700 (21,726,130)	12,344,400 (9,437,971)	5,872,200 (4,489,619)	46,633,300 (35,653,720)

Approximately 61 percent of the cost of nourishment and associated dunes (see Section 2.12) would occur near the southern end of the Refuge.

Nourishment areas would be renourished every four years. The nourishment program assumes that no part of NC 12 is ever less than 230 feet (70.1 meters) from the active shoreline. The four-year cycle could be repeated by either a single renourishment program every four years or annual nourishment programs affecting a quarter of the area to be nourished.

In July and August 1994, the NCDOT, acting through the auspices of the OBTF (the interagency group charged with developing short-term and long-term solutions to threats to NC 12 from beach erosion on Hatteras and Ocracoke islands), conducted preliminary sand searches offshore of Hatteras and Ocracoke islands using a combination of seismic profiling (a sea floor mapping technique) and vibracores (a technique for obtaining sediment samples). The results of the sand search for northern Hatteras Island were reported by Boss and Hoffman (2000). Based on these preliminary results, two potential borrow areas (PBAs) were identified, one off the north end of Hatteras Island near Oregon Inlet approximately 2.2 miles (3.5 kilometers) seaward (PBA-A), and the other approximately 1.7 miles (2.7 kilometers) seaward of Rodanthe (PBA-B). The preliminary assessment of the amount of material available from these two PBAs is 69.0 million cubic yards (52.8 million cubic meters) for PBA-A and 56.0 million cubic yards (42.8 million cubic meters) for PBA-B. A detailed assessment of the compatibility of the borrow material with the native beach material has not been accomplished; however, the grain size analysis performed on sediment samples collected from the vibracores appeared to indicate that the material would be suitable for nourishment as well as minimizing the environmental impacts to the beach associated with nourishment. Accordingly, cost estimates for the nourishment alternatives were made based on the assumption that there would be enough suitable material in the two PBAs to support beach nourishment over the next 50 years. In the absence of a detailed compatibility analysis, an overfill factor of 1.2 was assumed for the offshore borrow material (i.e., in order to obtain 1 cubic yard [0.8 cubic meter] of compatible beach fill material in place along the beach, 1.2 cubic yards [0.9 cubic meter] of material would have to be removed from the borrow areas). NCDOT has contracted with the NC Geological Survey to analyze additional sand source information from US Geological Survey sources.

Another borrow source could be the USACE's annual Oregon Inlet ocean bar channel maintenance program. Sand dredged annually from the ocean bar could be adequate for most of the sand needed for nourishment in the northern part of the Refuge (at the ponds and north of the ponds). The channel across the ocean bar is authorized to a depth of 14 feet (4.3 meters) below mean low water (MLW) over a width of 400 feet (121.9 meters). To obtain all of the material needed for the northern part of the Refuge, a channel depth of 18 feet (5.5 meters) would be needed. Material for nourishment at the southern end of the Refuge would still be obtained from offshore borrow areas.

Access to the existing parking lot immediately south of Oregon Inlet would be provided by a driveway that would combine the existing road in the area leading to the (former) Oregon Inlet US Coast Guard Station with a new connection immediately south of the station between that road and the parking lot.

2.10.2.2 Road North/Bridge South

With this alternative, NC 12 would be placed on a bridge west of Hatteras Island beginning at a new intersection created at the driveway that leads to the temporary ferry terminal in Rodanthe and continuing to a point approximately 2 miles (3.2 kilometers) north of the Refuge's southern boundary where the project would meet existing NC 12. This part of the island is expected to remain stable with respect to NC 12 through the year 2060; therefore, the alignment of NC 12 would remain unchanged for 2.6 miles (4.2 kilometers). Beginning at a point approximately 1.3

miles (2.1 kilometers) south of the Refuge's ponds NC 12 would be relocated to a point 230 feet (70.1 meters) west of the forecast 2060 high erosion shoreline. This relocation would continue 7 miles (11.4 kilometers) north until the relocated NC 12 would meet the Oregon Inlet bridge. The location of improvements is illustrated in Figure 2-19.

The existing dunes along the oceanside of NC 12 would not be re-built (i.e., they would be allowed to erode naturally). Not re-building the dunes would support Refuge and Seashore policies to let natural processes take their course. However, three 10-foot-high dunes, totaling 2,100 feet (640 meters) in length would be built east of and near the new road in the future as conditions warrant. They would be built as the shoreline erodes towards the relocated road and approaches a distance of 230 feet (70.1 meters) from the pavement. The first one is expected to be built by 2030.

Access to the existing parking lot immediately south of Oregon Inlet would be provided in the same manner as the Nourishment Alternative.

As with the bridge in the Pamlico Sound Bridge Corridor (described in Section 2.9.2), the typical section of the bridge in the Rodanthe area would provide two 12-foot (3.6-meter) travel lanes and two 8-foot (2.4-meter) shoulders. This bridge's typical section is illustrated in Figure 2-13. The NCDOT anticipates that the typical bridge span would be 100 feet (30.5 meters). For the bridge superstructure (spans between piers), the use of girders is likely expected. For the bridge substructure (foundation and support for the superstructure), precast piles are planned.

As with the approach roads of the bridge in the Pamlico Sound Bridge Corridor (described in Section 2.9.3), the relocated roadways' typical sections would have two 12-foot (3.6-meter) travel lanes with 8-foot (2.4-meter) shoulders (4-foot/1.2-meter paved) (see Figure 2-14). The roadway would be built within a 100-foot (30.5-meter) right-of-way. The elevation of the roadway would be similar to the elevation of existing NC 12, generally 2 to 5 feet (0.6 to 1.5 meters) above mean sea level. The final design of the bridge portion would account for wave energy, storm surge, scour, and corrosive environmental conditions in a manner similar to that described in Section 2.10.1.2 as applicable to the sound-side, Rodanthe area setting of this bridge.

A design speed (maximum safe speed that can be maintained under favorable driving conditions) of 60 miles per hour (96.6 kilometers per hour) would be used for both bridge and roadway. The posted speed would remain at 55 miles per hour (89 kilometers per hour).

As with the Intersection Rodanthe Terminus for the Pamlico Sound Bridge Corridor, a traffic signal would be provided at the intersection of the new bridge in the Rodanthe area with existing NC 12. All southbound bridge traffic would have to at least slow down to turn at the signalized intersection before leaving the bridge and entering the Rodanthe section of NC 12 with its slower speeds and numerous cross streets and driveways intersecting NC 12. This intersection would carry NC 12 traffic at a desirable level of service (LOS) during forecast peak season weekday traffic for 2025. The level of service would be:

- B on a 2025 peak season weekday;
- D on a 2025 peak season weekend; and
- E on a 2025 peak season Saturday.

The signalized intersection would include a single exclusive left-turn lane for northbound NC 12 traffic turning to reach the proposed bridge and a single exclusive right-turn lane for southbound bridge traffic turning to continue south on NC 12. LOS D on a peak season weekday meets the NCDOT's and the FHWA's LOS objectives for a location with a seasonal population and is the same LOS expected on the rest of NC 12 within the project area in 2025. Dual exclusive left turn lanes for northbound NC 12 traffic would improve conditions to LOS D for the 2025 peak season Saturday period. (See Section 1.5.7 for a definition of the LOS measures and additional discussion of LOS along NC 12.)

2.10.2.3 All Bridge

This alternative would include the same bridge in the Rodanthe area described in the previous section (see Section 2.10.2.2) for the Road North/Bridge South Alternative. Instead of relocating NC 12 as a roadway in the central and northern part of the Refuge, NC 12 would be relocated on a bridge. Two road segments would be included in this relocation, one near Oregon Inlet and one just north of the Refuge's ponds where access from NC 12 to the Refuge would be provided. Access to the Refuge also would be available in a 1.8-mile (2.9-kilometer) section of NC 12 that would be left unchanged between the Rodanthe area bridge and the beginning of the next bridge south of the ponds. The bridges associated with this alternative would span the five potential breach locations described in Section 2.6.2.3 and would be at least 230 feet (70.1 meters) west of the forecast 2060 high erosion shoreline. The location of improvements is illustrated in Figure 2-20.

The bridges in the central and northern part of the Refuge would begin approximately 1.7 miles (2.7 kilometers) south of the Refuge's ponds. A bridge would continue north for 5.2 miles (8.4 kilometers) to the northern dike of the northern-most pond where a 1,000-foot (305-meter) section of roadway would be placed. At this location, the Refuge could provide an access point to the beach and the hiking trails along the perimeter of the northernmost pond. NC 12 would then continue an additional 1.4 miles (2.3 kilometers) to a second 1,000-foot (305-meter) section of roadway. Here the relocated NC 12 would be connected to the existing roadway, which would be retained from this point north to the parking lot just south of Oregon Inlet. North of this second short roadway section, NC 12 would continue northward 0.4 mile (0.6 kilometer) on bridge to meet the Oregon Inlet bridge.

The existing dunes along the oceanside of NC 12 would not be re-built (i.e., they would be allowed to erode naturally). Not re-building the dunes would support Refuge and Seashore policies to let natural processes take their course.

Road and bridge design characteristics, as well as traffic characteristics at the new Rodanthe intersection, would be identical to those described for the road and bridge components of the Road North/Bridge South Alternative described above. Final design of bridges would account for wave energy, storm surge, scour, and corrosive environmental conditions in a manner similar to that described in Section 2.10.1.2 as applicable to the on-shore and the sound-side, Rodanthe area setting of the bridges associated with this alternative.

2.10.2.4 Phased Approach

Two NC 12 maintenance alternatives are under consideration with the Phased Approach Alternative. They are identical until their southern end within Rodanthe. They are:

- Phased Approach/Rodanthe Bridge Alternative (Preferred); and

- Phased Approach/Rodanthe Nourishment Alternative.

Characteristics of Phased Approach/Rodanthe Bridge Alternative (Preferred)

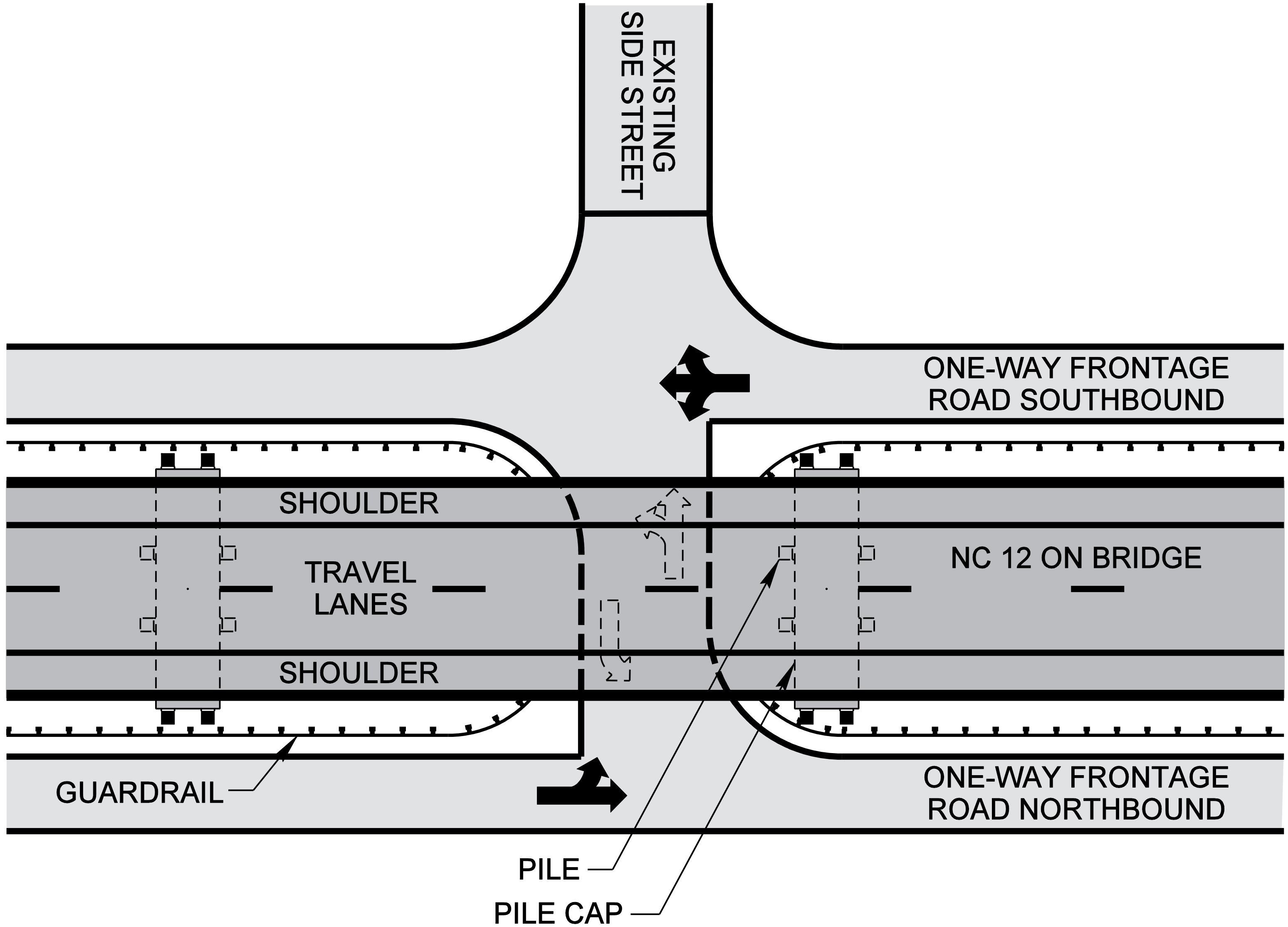
This alternative proposes maintenance of NC 12 in the existing easement by building bridges as needed. The total constructed length of the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be 14.0 miles (22.5 kilometers). It would begin in Rodanthe just to the north of Sudie Payne Road (see Figure 2-21), extend to the north through the Refuge and across Oregon Inlet, and end on the southern end of Bodie Island approximately 0.2 mile (0.3 kilometer) north of the Oregon Inlet Campground driveway. The total length of the alternative between the two termini is approximately 16.1 miles (25.9 kilometers), but the constructed length is only 14.0 miles (22.5 kilometers) because of a 2.1-mile (3.4-kilometer) section of NC 12 in the southern half of the Refuge that is not expected to be threatened by erosion prior to 2060. The bridge would extend a total of approximately 1.1 miles (1.8 kilometers) south of the Refuge boundary into Rodanthe. Access to properties adjacent to the bridge in Rodanthe would be provided by a one-lane, one-way frontage road on each side of the NC 12 bridge. The two frontage roads would flare out and connect with NC 12 at a four-legged intersection approximately 400 feet (121.9 meters) south of the end of the project. Crossovers to provide access between the two frontage roads underneath the NC 12 bridge were assumed to be provided in three locations: just south of the Refuge boundary; across from SR 1445 (Cross of Honor Way); and just north of America Drive. The frontage roads and a typical crossover are illustrated in Figure 2-23.

A small amount of new right-of-way would be required in Rodanthe along most of the length of the alternative to accommodate the two frontage roads in Rodanthe. In general, the right-of-way width would increase from 100 feet (30.5 meters) to 107 feet (32.6 meters). However, for approximately 600 feet (182.9 meters) near the southern end of the alternative (starting at approximately the entrance to the mobile home park shown on Figure 3-1 and continuing south), the existing right-of-way width is only 60 to 68 feet (18.3 to 20.7 meters), so it would increase from this width to 107 feet (32.6 meters). In addition, the right-of-way width would increase to a maximum width of approximately 147 feet (44.8 meters) for a short distance at the intersection of the two frontage roads and existing NC 12 at the southern end of the alternative. A temporary construction easement approximately 5 feet (1.5 meters) wide could be needed on both sides of NC 12 for most of the length of the alternative through Rodanthe. The right-of-way would not be widened and no construction easement purchased within the National Register-eligible Rodanthe Historic District (see Section 3.4.1).

Characteristics of Phased Approach/Rodanthe Nourishment Alternative

The Phased Approach/Rodanthe Nourishment Alternative would be similar to the Phased Approach/Rodanthe Bridge Alternative with one exception. The southern end of the alternative would only extend a total of approximately 0.3 mile (0.5 kilometer) south of the Refuge boundary into Rodanthe. Because it is substantially shorter than the Rodanthe Bridge Alternative, only one crossover between the one-way frontage roads would be provided immediately south of the Refuge boundary.

The same minor amount of additional right-of-way (i.e., approximately 7 feet [2.1 meters]) would be required along most of the length of this alternative in Rodanthe, with a maximum width of approximately 147 feet (44.8 meters) required for a short distance at the intersection of the frontage roads with existing NC 12. The approximately 5-foot-wide (1.5-meter-wide) temporary construction easement could be needed on both sides of NC 12 for most of the length of this alternative in Rodanthe.



PHASED APPROACH BRIDGE IN RODANTHE WITH FRONTAGE ROADS

Figure
2-23

South of the bridge, NC 12 in Rodanthe would be protected through 2060 by beach nourishment. The total required beach nourishment length would be approximately 6,000 feet (1,829 meters), including 500-foot-long (152.4-meter-long) tapers on each end. Nourishment would extend approximately 1,500 feet (457 meters) into the Refuge including the taper of 500 feet (152.4 meters). As with the other alternatives involving beach nourishment, it was assumed that nourishment would be needed every four years. The estimated amount of sand needed for the Phased Approach/Rodanthe Nourishment Alternative is 2.3 million cubic yards (1.8 million cubic meters) for the first cycle of nourishment, and 1.5 million cubic yards (1.1 million cubic meters) every four years throughout the life of the project (through 2060).

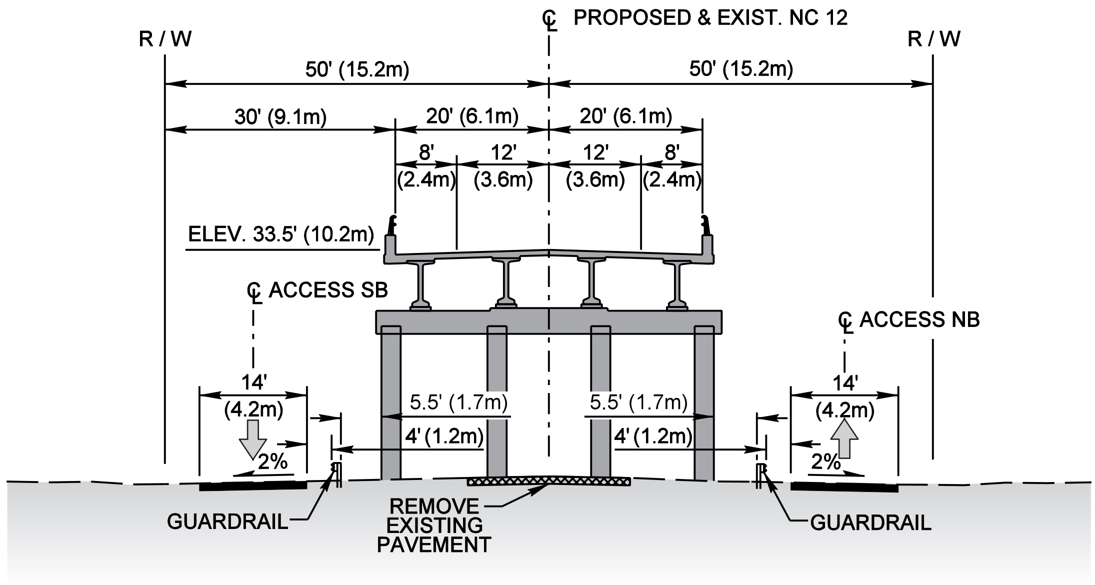
Design Features of Both Phased Approach Alternatives

The NC 12 maintenance bridges for the Phased Approach alternatives (including the Preferred Alternative) would have the same typical section as the bridges with the All Bridge Alternative, including two 12-foot (3.6-meter) lanes with 8-foot (2.4-meter) shoulders on each side, for a 40-foot (12-meter) roadway width (Figure 2-24). A design speed of 60 miles per hour (96.6 kilometers per hour) was used on the mainline NC 12 bridges.

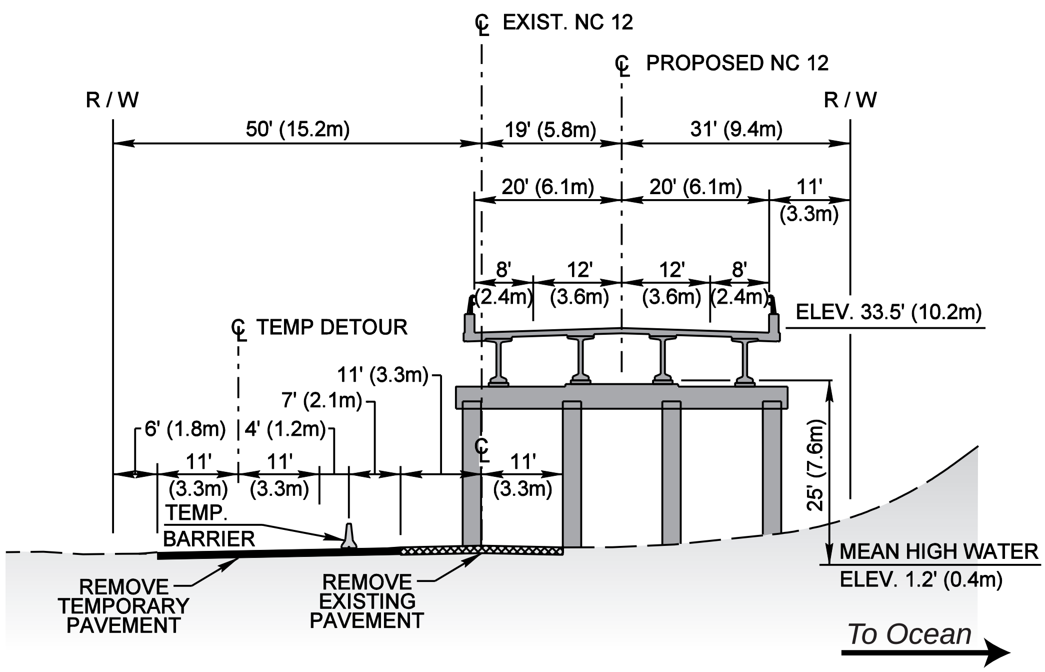
Based on a recommendation related to structure clearance heights from the August 2006 Constructability Workshop (see Section 2.7), these bridges would have a minimum 25-foot (7.6-meter) vertical clearance above mean high water. This height assumes the flat storm surge elevation plus the wave height plus some additional clearance. However, the Constructability Workshop recommendation also stated that this height may be re-evaluated based on a determination of the desired level-of-service of the structure during storm events, and should be refined during final design. Based on coastal data from the OBTF science panel, the NC 12 bridges between the northern end of Hatteras Island and the southern end of the Canal Zone Hot Spot were assumed to have a more substantial foundation than the remainder of the NC 12 bridges to the south in order to accommodate a potential breach that could be deeper than breaches that might occur elsewhere in the Refuge. At the northern end of Hatteras Island, a foundation that includes eight 54-inch (137.2-centimeter) cylinder piles was assumed. Elsewhere, eight 30-inch (76.2-centimeter) piles were assumed. A concrete girder ("I" shape) superstructure was assumed, but segmental box girders also could be used as proposed for the Oregon Inlet bridge. The span lengths were assumed to be 120 feet (37 meters) for the full height bridges and 100 feet (30 meters) for the permanent and temporary approach bridges (i.e., transitions from full height bridges to fill as the bridges come down to the existing grade). These are considered reasonable foundation and span assumptions for the purpose of analysis in this FEIS, but could change in project design.

Like the Pamlico Sound Bridge Corridor alternatives and the Parallel Bridge Corridor with All Bridge Alternative, which also include long bridges, proposed bridge cost estimates assume that turn-outs are built on the bridge where a disabled vehicle can be moved out of the way of traffic. The maximum desirable distance between these turn-outs was assumed to be 3 miles (4.8 kilometers) and the turn-outs would be 300 feet (91.4 meters) long. During final design, the NCDOT also would consider implementation of the following ITS devices to provide motorists with advance notification as to travel conditions on NC 12: Highway Advisory Radio, Roadway Weather Information Systems, Variable Message Signs, and Closed Circuit Television cameras, as well as fiber optic cabling to link the technologies and incident management patrols.

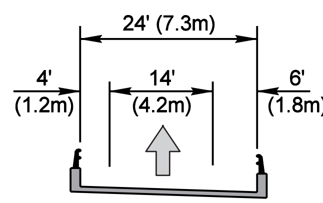
All five potential breach locations in the study area would eventually be bridged by the Phased Approach/Rodanthe Bridge Alternative (Preferred). The Phased Approach/Rodanthe Nourishment Alternative would only partially bridge the southernmost potential breach location,



TYPICAL SECTION IN RODANTHE



TYPICAL SECTION IN REFUGE



RAMP TYPICAL SECTION

R / W = Edge of NC 12 Easement or Right-of-Way
℄ = Centerline
SB = Southbound
NB = Northbound

PHASED APPROACH ALTERNATIVE TYPICAL SECTIONS

Figure 2-24

which is the one considered most likely to suffer a breach before 2060; however, this alternative assumes nourishment would forestall a breach in this area.

Because most of NC 12 ultimately would be on structure through the Refuge with the Phased Approach alternatives (including the Preferred Alternative), the existing dunes along the oceanside of NC 12 would not be re-built (i.e., they will be allowed to erode naturally). As with the other Parallel Bridge Corridor alternatives that do not involve dune construction and/or beach nourishment (i.e., the All Bridge Alternative and most of the Road North/Bridge South Alternative), not re-building the dunes would support Refuge and Seashore policies to let natural processes take their course.

The final design of the NC 12 maintenance bridges associated with the Phased Approach alternatives (including the Preferred Alternative) would account for wave energy, storm surge, scour, and corrosive environmental conditions in a manner similar to that described in Section 2.10.1.2 as applicable to the sound-side, Rodanthe area setting of this bridge.

Refuge Access

Four one-lane ramps would be built to provide vehicular access to and from the parking lot currently used to access the fishing catwalks on the existing Bonner Bridge, accommodating all directions of travel (see Figure 2-22). The ramps would have 12-foot (3.6-meter) lanes and a 6-foot (1.8-meter) shoulder. The Phased Approach alternatives (including the Preferred Alternative) would have a second point of access into the Refuge, within the 2.1-mile (3.4-kilometer) section of NC 12 in the southern half of the Refuge that would not be threatened by erosion prior to 2060.

Construction within the Existing Easement of Pea Island National Wildlife Refuge

The NCDOT's existing easement through the Pea Island National Wildlife Refuge is 100 feet (30.5 meters) wide and is centered on existing NC 12. The proposed structures and all construction activities, such as material/equipment deliveries, excavations, temporary shoring, pile driving, and erection of bridge girders, would remain inside the existing easement. All foundation elements, such as footings, piles, and drilled shafts, also would remain within the easement limits.

The design-build contractor would be required to submit a construction staging plan which would include plans, sections, and written descriptions to the NCDOT and the permitting agencies for review that shows the intended sequencing, erection schemes, and means of site access. This plan also would depict positions of traffic lanes, which would be maintained through the construction zones.

2.10.2.5 Construction Timing and Phasing of NC 12 Maintenance Components

With the exception of the Phased Approach alternatives (including the Preferred Alternative), it was assumed that construction of the NC 12 maintenance component of the Parallel Bridge Corridor would likely occur in parallel with the Oregon Inlet bridge. For the Phased Approach Alternatives (including the Preferred Alternative), it was assumed that the NC 12 maintenance components would be phased, with construction beginning after the completion of the Oregon Inlet bridge and timed as discussed below under "Phasing Timing and Minimizing Impacts of NC 12 Maintenance" and in commitment number 15 in the Project Commitments section of this FEIS. The following paragraphs describe the assumed phasing for the Phased Approach alternatives (including the Preferred Alternative) and opportunities for phasing the other NC 12 maintenance components of the Parallel Bridge Corridor alternatives.

Construction Phasing for the Phased Approach Alternatives

The Phased Approach alternatives (including the Preferred Alternative) are likely to be built in four phases based on the following criteria: the condition of Bonner Bridge, the location of forecast beach erosion, and potential breach locations (see Figure 2-21). The Oregon Inlet bridge replacement is the most urgent need and is Phase I. Phase II would bridge three locations where NC 12 is most threatened by shoreline erosion, as well as four of five potential breach locations. Phase III would bridge the fifth breach location and the next area threatened by shoreline erosion. Phase IV would bridge the final two areas where NC 12 would be threatened by shoreline erosion. The phasing schedule would change if the future shoreline evolves differently from that currently forecast based on the programs described in the next section. The phases are shown in Figure 2-21 and described below:

1. Phase I (2009 to 2015 TIP). The Phase I project would consist of the construction of a new Oregon Inlet bridge. The southern end of the Oregon Inlet bridge on Hatteras Island would not be brought down to grade, but would end at full height for future extension to the south (i.e., at an elevation of approximately 33.5 feet [10.2 meters] above mean sea level assumed for purposes of the impact assessment as shown in Figure 2-24). Access to the northern end of Hatteras Island is assumed to be provided by ramps from the bridge that would reach the ground near the entrance to the parking lot that currently serves the catwalks on Bonner Bridge. The beach nourishment component of the Phased Approach/Rodanthe Nourishment Alternative also could begin in Phase I, replacing storm-related NC 12 maintenance activities that would otherwise occur until Phase II is implemented. Nourishment would then be repeated at four-year intervals.

2. Phase II (Post 2015). The Phase II project would consist of constructing three separate bridges within the easement of existing NC 12 in locations where there is either a likelihood of a future breach in Hatteras Island or the distance from the edge of NC 12's pavement to the active shoreline is predicted to be less than or equal to the buffer width of 230 feet (70.1 meters) by 2015.

   The southernmost bridge in Phase II would begin in the Refuge near the northern end of the Rodanthe 'S' Curves Hot Spot (see Figure 2-21) and extend into Rodanthe. As described above, two possible design options were developed for the southern end of this Phase II bridge in Rodanthe and are shown on Figure 2-21. With both design options, access to properties adjacent to the NC 12 bridge in Rodanthe would be provided by one-lane, one-way frontage roads on both sides of the bridge (see Figure 2-23). The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would be approximately 2.3 miles (3.7 kilometers) long and would extend approximately 0.8 mile (1.3 kilometers) into Rodanthe to a point that is 230 feet (70.1 meters) south and west of where the projected 2060 high erosion shoreline crosses NC 12. A 1,200-foot (366-meter) long permanent approach roadway (i.e., a permanent transitional bridge structure and retaining wall section that brings the bridge back down to grade) would be added to both ends of this bridge. This alternative would extend a total distance of approximately 1.1 miles (1.8 kilometers) south of the Refuge boundary into Rodanthe.

   The Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative would be approximately 1.5 miles (2.4 kilometers) long, with the proposed NC 12 bridge ending just south of the Refuge boundary. The 1,200-foot (366-meter) long permanent roadway approach at the southern end of the bridge would extend approximately 0.3 mile (0.5 kilometer) into northern Rodanthe. A 1,200-foot (366-meter) long permanent approach roadway also would be added to the north end of the bridge in the Refuge. The beach nourishment component would begin in Phase I as noted above. This alternative would extend a total distance of approximately 0.3 mile (0.5 kilometer) south of the Refuge boundary into Rodanthe.

For both the Phased Approach alternatives (including the Preferred Alternative), the middle bridge in Phase II would be approximately 0.7 mile (1.1 kilometers) long. It would be adjacent to the southern half of the Refuge's North Pond, with the southern end being approximately at the northern end of the Sandbag Area Hot Spot. A 1,100-foot (335-meter) long temporary approach roadway (i.e., a temporary transitional bridge structure and retaining wall section that brings the bridge back down to grade) would be added to both ends of this bridge until the Phase IV bridges to the south and north are constructed.

The northernmost bridge in Phase II (for both the Phased Approach alternatives [including the Preferred Alternative]) would be approximately 2.6 miles (4.2 kilometers) long. It would tie into the southern end of the Oregon Inlet bridge constructed in Phase I, continue south through the Canal Zone Hot Spot (see Figure 2-21), and end near the northern end of North Pond. The second two access ramps for the north end of Hatteras Island also would be built as a part of this project. These ramps would combine with the ramps constructed in Phase I from the Oregon Inlet bridge to create a complete interchange for access to the northern end of Hatteras Island. The 1,100-foot (335-meter) long temporary approach roadway discussed above would be added to the southern end of this bridge until the Phase IV bridge to the south is constructed.

3. Phase III (Post 2020). The Phase III project would consist of constructing one bridge within the easement of existing NC 12 through a location where there is a likelihood of a future breach, as well as partially through an area where the distance from the edge of NC 12's pavement to the active shoreline is predicted to be less than or equal to the buffer width of 230 feet (70.1 meters) by 2020.

   The Phase III bridge would be approximately 1.9 miles (3.1 kilometers) long. It would start near the southern end of South Pond, within the southern portion of the Sandbag Area Hot Spot, and continue to the south past the southern end of the possible future breach in Hatteras Island that is in this area (see Figure 2-21). A 1,100-foot (335-meter) long temporary approach roadway would be added to the northern end of this bridge until the Phase IV bridge to the north is constructed. In addition, a 1,200-foot (366-meter) long permanent approach roadway would be added to the south end of the bridge.

4. Phase IV (Post 2030). The Phase IV project would consist of constructing two separate bridges within the easement of existing NC 12 in locations where the distance from the edge of NC 12's pavement to the active shoreline is predicted to be less than or equal to the buffer width of 230 feet (70.1 meters) by 2030 (see Figure 2-21).

   The southern Phase IV bridge would be approximately 1.6 miles (2.6 kilometers) long. It would be adjacent to New Field and South ponds (see Figure 3-1b) in an area through most of the Sandbag Area Hot Spot. This bridge would connect the middle Phase II bridge and the Phase III bridge. Because this bridge would connect to two previously constructed bridges, the temporary approach roadways previously built at the ends of the bridges would be removed while traffic is maintained on a temporary ramp placed to the west of the Phase II and III bridges.

The northern Phase IV bridge would be approximately 1.0 mile (1.6 kilometers) long. It would be adjacent to the northern half of North Pond (see Figure 3-1b) and would connect the two northern Phase II bridges. Once again, because this bridge would connect to two previously constructed bridges, the temporary approach roadways previously built at the ends of the two Phase II bridges would be removed while traffic is maintained on a temporary ramp placed to the west of the Phase II bridges.

With the completion of Phase IV, the resultant bridges would be over four to five miles in length. Therefore, a widened bridge section was included on both Phase IV bridges where a disabled vehicle can be moved out of the way of traffic. The maximum desirable distance between these turn-outs was assumed to be 3 miles (4.8 kilometers). In order to keep the turn-outs on the eastern side of the NC 12 bridges within the existing easement, a slight shift in the alignment of the bridges at the turn-outs would be required.

The construction duration for each of Phases II to IV is estimated to last approximately three years from letting. Phase I is estimated to last 3.5 years.

Phasing Timing and Minimizing Impacts of NC 12 Maintenance

NCDOT recognizes that shoreline erosion could occur at a more rapid or less rapid rate than assumed in the above phasing assumptions. A Hatteras Island breach could occur in the project area prior to the implementation of bridges to cross the project area's potential breach locations. It also is recognized that high levels of NC 12 storm-related maintenance are occurring at the three hot spots in the Refuge and that minimizing future storm-related maintenance along NC 12 is highly desirable. Finally, the Refuge has concluded that if the Phased Approach/Rodanthe Bridge Alternative (Preferred) is selected for implementation in a Record of Decision, any future storm-related maintenance outside the NC 12 easement will likely not be found compatible with the Refuge under the requirements of National Wildlife Refuge System Improvement Act of 1997.

The technical report *Bonner Bridge Replacement – Parallel Bridge Corridor with NC 12 Maintenance – Shoreline Change and Stabilization Analysis* (Overton and Fisher, June 2005) documents the results of the shoreline change and stabilization analysis that was conducted for the project area. For planning purposes, NCDOT considered the 2060 high erosion shoreline (described in Section 3.6.1.1) to be a reasonable assumption for current planning purposes. However, with recently published research on global climate change and its effects, additional analysis was conducted to identify, if any, gaps in methodology exist between the shoreline change and stabilization analysis when compared to recent and relevant research on climate change. Following a review of the additional analysis, it was determined that global climate change impacts have been reasonably accounted for in the existing shoreline change study. It was further concluded that too many unknowns exist to reasonably predict storm frequency and severity impacts to the project area.

With these factors in mind, after the issuance of the Record of Decision for this project, NCDOT will confine future NC 12 maintenance to the existing NC 12 easement. Further, it is NCDOT's intent to place a high priority on the implementation of Phase II. This intent recognizes the need to build Phase II, particularly in the ‘S’ Curves, Sandbag Area, and Canal Zone hot spots, as soon as it is practicable. The impact assessment presented in Section 4.6.8.6 of this FEIS assumes that construction of Phase II would begin upon the completion of Phase I.

In addition, the completion of Phases II and III would address possible, but less certain and less predictable, changes in sound-side erosion at Oregon Inlet (Section 3.6.3.2) and potential island breaching (Section 3.6.3.4) by providing deeper and larger bridge foundations at the portion of Phase II near Oregon Inlet and by bridging the five potential breach locations in the project area. NCDOT also recognizes that decisions related to the implementation of Phases III and IV and the specific locations of Phases III and IV will likely evolve with actual geomorphological change relative to the NC 12 easement, whether from changes in the characteristics of expected beach erosion, the possible changes of sound-side erosion at Oregon Inlet, accelerated sea level rise (Section 3.6.3.3), or island breaching. The need to confine NC 12 maintenance work to the existing easement in the Phase III and IV areas, as well as in the 2.1-mile (3.4-kilometer) section of NC 12 in the southern half of the Refuge also must be taken into account in planning for Phases III and IV. Limiting the growth of NC 12 storm-related maintenance in the Phase III and IV areas to the extent practicable given the availability of transportation funding and the efficient use of those funds also is considered desirable. "Availability of funds" recognizes that future funding analyses indicate that funding availability will continue to limit how much can be built at one time and the need for phasing. "Efficient" recognizes that it is desirable from the perspective of cost to build the project in a few longer phases rather than numerous short phases.

NCDOT recognizes that any decision to proceed with the implementation of project phases need to occur before higher levels of NC 12 storm-related maintenance manifest themselves (defined in Section 4.6.8.6) because the process of planning, assessment, and construction of Phases III and IV could take approximately five years for each phase.

NCDOT intends to: 1) implement an island monitoring program in the project area on Hatteras Island and 2) to conduct breach response-related data gathering. The descriptions below provide a conceptual framework for these two commitments. NCDOT would develop and finalize the details of these two commitments within the context of Phase I implementation following the release of a Record of Decision.

The particulars of the <u>monitoring program</u> on Hatteras Island in the project area would be developed in consultation with representatives of the Refuge. This program would include the development of decision-making criteria for translating monitoring findings into a decision to move forward with Phases III and IV. Components of a monitoring program could include:

- Gather data (at appropriate time frames) related to:
  - Changing geomorphological characteristics (e.g., the width and elevation of the island, dune height, shoreline position, and nearshore bathymetry);
  - Relative distance from NC 12 to critical geomorphological features (e.g., shoreline, dune, estuarine shoreline); and
  - Storm events and associated NC 12 maintenance activities.

  Efforts would be made to merge these data with that of other geologic and biological datasets from other ongoing studies by others.

- On an annual (or post-storm) basis, identify from these data geomorphological trends relevant to a decision to move forward with Phases III and IV or refine their location.

- Consider in its evaluation of geomorphological trends known warning signs. These warning signs will serve as indicators of areas deserving of extra scrutiny during the annual consideration of monitoring program findings and what they mean in terms of the timing and location of Phase III and IV implementation. Based on past experience, warning signs could include:

– A distance between the shoreline and the road of less than 650 feet (198 meters) (650 feet is based on measurements of the landward extent of washover fans that developed during Hurricane Isabel and should generally allow natural shoreline processes to occur without notable effects on NC 12 operations);

– Areas with weak dunes (e.g., low dunes that lack vegetation) that potentially require higher levels of storm-related NC 12 maintenance activity, proximity of the dune to NC 12, and the rate dunes may be advancing towards NC 12 (this recognizes that the frequency of dune maintenance is highest when a dune is less than 25 feet [7.6 meters] from the road);

– Increases in erosion rates over past trends; and

– Increases in NC 12 storm-related maintenance frequency or activity over previous years.

- Determine the shoreline and dune conditions under which the need for storm-related maintenance tends to escalate.

- Present annual monitoring findings and NCDOT conclusions on their relation to Phase III and IV planning, programming, and implementation to the Refuge for discussion. The conclusions may be refined based on Refuge input.

NCDOT recognizes there are several areas in the project area that are more susceptible to a breach because of the underlying geology and geomorphological characteristics of the barrier island and that the FEIS (Section 3.6.3.4) indicates that the southern part of the Refuge is the location most likely to suffer a breach prior to 2060. Further, a storm event of the nature required to create a breach in the southern part of the Refuge would probably occur once between now and 2060. The southern part of the Refuge is the location of a prior inlet, the island is very narrow with relatively small dunes, and there is a relic channel across the estuarine marsh. This potential breach location would be bridged in Phase II. But recognizing the possibility that a breach could occur in this location prior to the completion of Phase II, and that four other locations exist in the project area that are geologically susceptible to a breach (three are bridged in Phase II and one in Phase III), NCDOT would conduct a breach response-related data gathering program focusing on the southern end of the Refuge. Such a program could include: exploring further where sand of acceptable characteristics and volumes exists for use in closing a breach; options available for bridging a breach, their past use, their merits, and the situations for which they would be applicable; and other information that would facilitate timely (in order to reduce economic loss), environmentally sensitive, and cost-effective decision-making should a breach occur.

Opportunities for Phasing the Road North/Bridge South and All Bridge Alternatives

The discussion and assessment of the Road North/Bridge South and All Bridge alternatives presented in this FEIS assume that the entire project is built in a single construction program. As indicated in Section 2.10.2.1, the Nourishment Alternative is assumed to occur at four-year intervals and dune restoration at 12-year intervals. It would be possible, however, to phase construction of the Road North/Bridge South and All Bridge alternatives in a manner similar to the Phased Approach alternatives (including the Preferred Alternative). The assumed use of new easement or right-of-way for much of the length of these two alternatives does affect phasing opportunities. The endpoints of Phases I and II described below would need to make connections into the existing

NC 12 easement. These alternatives as defined in this FEIS do not cross the existing NC 12 easement at phasing endpoints. Phasing opportunities could be created as follows:

1. Phase I (2009 to 2015 TIP). The Oregon Inlet bridge could be built as a first phase of either the Road North/Bridge South, or All Bridge, alternatives if three conditions are met:

    a. The new bridge ties into the existing NC 12 easement in a manner similar to the Nourishment Alternative; and

    b. The alignment of the Phase II bridge or road south of the Oregon Inlet bridge is adjusted to connect to the changed southern bridge terminus.

2. Phase II (Post 2015). Phase II would consist of:

    a. The bridge in the Rodanthe area;

    b. A section of bridge or road approximately 0.7 mile (1.1 kilometers) long adjacent to the southern half of the Refuge's North Pond; and

    c. A section of road or bridge extending approximately 2.6 miles (4.2 kilometers) south of the southern terminus of the Oregon Inlet bridge.

    In order to accomplish the latter two components of Phase II (items "b" and "c"), two temporary roads would have to be built to connect the phase's endpoints into the existing NC 12 easement, one at the northern end of the section described under item "b" and one at the southern end of the section described under Phase II item "c." The northern end of the Phase II item "b" section, as currently assumed in this document, would be approximately 530 feet (161.5 meters) from the existing NC 12 easement with the Road North/Bridge South Alternative and approximately 570 feet (173.7 meters) from the existing NC 12 easement with the All Bridge Alternative. The southern end of the Phase II item "c" section, as currently assumed in this document, would be approximately 300 feet (91.4 meters) from the existing NC 12 easement with the Road North/Bridge South Alternative and approximately 370 feet (112.8 meters) from the existing NC 12 easement with the All Bridge Alternative. Finally, an adjustment would need to be made in the alignment of the All Bridge alternative at the southern end of the section described under Phase II item "b" above so it would connect into the existing NC 12 easement.

3. Phase III (Post 2020). This phase would involve building a road or bridge south of the Phase II section listed under Phase II item "b" above, with the southern starting point of the road being approximately 1.3 miles (2.1 kilometers) south of the Refuge's ponds and the southern starting point of the bridge being approximately 1.7 miles (2.7 kilometers) south of the Refuge's ponds. The starting points are defined for these alternatives in Sections 2.10.2.2 and 2.10.2.3, respectively.

4. Phase IV (Post 2030). This phase would complete the remaining two sections of the Road North/Bridge South and the All Bridge alternatives in the area of the Refuge's ponds.

2.10.2.6 Temporary Traffic Maintenance Roads with Phased Approach Alternatives

Temporary traffic maintenance roads would be needed to maintain traffic during construction of the Phased Approach alternatives (including the Preferred Alternative). These roads are assumed to have two 11-foot (3.4-meter) lanes with a 6-foot (1.8-meter) unpaved shoulder on the sound side of the road. A barrier would likely separate travelers on the temporary roads from bridge construction. There would be an approximately 3-foot (0.9-meter) clearance between the travel lanes and the barrier. It was assumed that the new bridges within the Refuge would be built on the east side of the NC 12 easement, and the temporary roads would be on the west side of the NC 12 easement, away from the existing dunes. In Rodanthe, the new bridge would be in the center of the right-of-way, and construction access would be provided on the new one-way frontage roads (see Figure 2-23 and Figure 2-24). During construction of the Phase IV bridges, Phase II and III bridge approaches at four locations would be replaced adjacent to the bridge temporarily in order to maintain traffic while the Phase II and III bridges are extended in Phase IV. Two lanes of traffic are expected to be maintained in all locations throughout bridge construction.

2.10.2.7 Other Construction Assumptions

When working either over water where SAV is present or over wetlands, bridges associated with the Road North/Bridge South and All Bridge alternatives would be span-by-span using top-down construction. Most of the Refuge area over which the bridges would pass with these two alternatives is classified as wetland. Given the closeness of the Rodanthe area bridge associated with these two alternatives to the west side of Hatteras Island, it is expected that SAV is present along most, if not all, of the bridge length over water. The Phased Approach bridges would not be built in areas of SAV and would affect only wetlands within the NC 12 easement.

Once a project in the Parallel Bridge Corridor is complete, replaced sections of NC 12 would be removed within the Refuge.

2.11 Demolition and Removal of Bridges and Pavement

2.11.1 Demolition and Removal of Bonner Bridge

Upon completion of the proposed project, Bonner Bridge and its approach fills would be demolished and removed. Separate contracts would be issued for construction of the proposed bridge and demolition and removal of Bonner Bridge with the Pamlico Sound Bridge. With an Oregon Inlet bridge, demolition could be within the same contract as construction.

The NCDOT Standard Specifications, Section 402 – Removal of Existing Structures states that, "*Upon removal, all material are the property of the Contractor unless otherwise indicated on the plans or in the special provisions*." The contractor then becomes responsible for the safe and environmentally-responsible disposal of the materials. The NCDOT Standard Specifications, Section 802 – Disposal of Waste and Debris, outlines the state and federal requirements the contractor must comply with. In accordance with the NDCOT Standard Specifications, the contractor is required to submit a demolition plan for approval to insure that a safe method of bridge demolition will be undertaken. In addition, for bridges over water, the NCDOT requires that sawing and/or non-shattering methods be used such that debris will not fall into the water.

Demolition in the navigation zone in the Oregon Inlet would be coordinated with and comply with USACE and US Coast Guard regulations as related to working in, working over, and working adjacent to navigable waters. Specific timing and scheduling requirements outlined by the USACE, US Coast Guard, and any other affected regulatory agency would be followed.

Demolition of Bonner Bridge would require dismantling and removing the superstructure and substructure. All substructure components would be removed to at least 25 feet (7.6 meters) below the mean low water elevation or possibly deeper as requested by the USACE in a letter dated January 16, 2001 (see Appendix A). The superstructure concrete deck would be broken into smaller pieces by sawing, jack hammering, etc. Deck pieces and superstructure girders would be loaded onto barges for towing to a disposal site. The footings and substructure also would be loaded onto barges for towing to a disposal site. The use of explosives during demolition is not anticipated. If explosives are needed to remove piles, the NCDOT would coordinate with the appropriate environmental resource and regulatory agencies to develop a blasting program that would minimize adverse effects to the natural environment.

The potential to recycle the construction materials from the demolished Bonner Bridge could be possible. Concrete, reinforced or un-reinforced, can be crushed and re-used as roadway sub-base material and aggregate for new concrete construction projects. Typically, the steel reinforcement is extracted from the concrete debris by means of a high-powered magnet. The reinforcing steel can then be sold as scrap steel to steel manufacturing companies to be re-formed into new steel products. Structural steel girders are recycled in a similar manner. Metal items such as bearing plates and railing also would be recycled. Currently, concrete and structural steel recycling facilities are both located in North Carolina and could be used as a potential location for delivery of construction materials for recycling. Other items, such as neoprene bearing pads, would be removed to a disposal site. If applicable, hazardous material procedures required by the NCDENR would be followed. There is no asbestos in Bonner Bridge.

Currently anticipated access options available include a combination of a dredged canal and either a haul road or a work bridge. A temporary haul road could be justified if it could be demonstrated that such access would not result in permanent impacts to marsh communities, these communities do not have an underlying organic subsoil, or if the cost of constructing and dismantling a temporary work bridge were so high that it would not be practicable to employ that methodology. A work bridge is feasible for demolition. As part of the demolition plan, the contractor would identify limits and dimensions of proposed haul roads, work bridges, and/or work barges required for bridge demolition work. Wetland and SAV areas would be identified in the demolition plan. Temporary work bridges could be required to span over the SAV and wetland areas, or a "top down" or overhead work method could be considered to protect SAV and wetland areas.

The majority of the materials removed, including cast-in-place and precast concrete elements, could be used in the construction of artificial reefs. If the old bridge is to be used as part of an offshore reef, it might need to be dismantled in large pieces; this would require the use of much larger equipment. The NCDOT would work with environmental resource and regulatory agencies prior to demolition to determine the most practicable construction access methodology for the demolition of Bonner Bridge. Impacts for demolition access would be determined and mitigated in concert with permitting agencies.

The DMF has suggested that concrete and steel bridge materials be placed on an artificial reef (or reefs). In subsequent conversations, the DMF (personal communication, October 21, 2003, Jim Francesconi, DMF) indicated that the bridge material should:

- Be free of oil, grease, or any petroleum-based residue, including asphalt and plastic products (unless encased in concrete), as well as lead (except lead-based paint);

- Have enough profile so that it would stay above the sea floor (generally greater than 3 feet [0.9 meters]). Small material can become buried during storms and would then not provide fish habitat; and

- Be concentrated in small areas on the reef site. A good way of deploying large amounts of concrete rubble is to use a hopper barge that opens and dumps the material in a pile. The material needs to be deployed properly to be effective.

Deployment of acceptable debris is done under an existing permit held by the DMF. The NCDENR Division of Coastal Management, DMF, and NMFS (as it relates to protected species) would be involved in disposal planning, and DMF staff would need to be on-site during disposal. Currently, there are four reef sites in the Oregon Inlet area. If enough material is available, a new reef site could be selected and a new reef created. If offshore disposal were not viable, the cost for removal of Bonner Bridge would be higher than what is described in Section 2.12. After demolition and removal is complete, approaches to Bonner Bridge and related fill would be removed and the sites restored to a condition similar to that of adjoining areas.

2.11.2 Removal of NC 12 Pavement

In addition to the demolition and removal of Bonner Bridge, existing and temporary NC 12 pavement replaced by the alternatives would be removed and disposed of in accordance with the latest version of the NCDOT's *Standard Specifications for Roads and Structures* (NCDOT, July 2006, or as current at the time of construction). The Standard Specifications indicate that salvageable materials, if approved by NCDOT, could be used in other parts of the construction as, for example, fill or sub-base. Depending on the construction sequencing and construction techniques chosen by the Design-Build Contractor, it is possible that some portion(s) of the pavement to be removed could be utilized in other areas of the project or potentially stockpiled for later use.

2.11.3 Future Demolition of Replacement Bridges

Future demolition of replacement bridges at the end of their design life would be in accordance with state and federal requirements for bridge demolition and removal at the time of removal. It is estimated that approximately 31,000 cubic yards of material per mile of bridge would be generated when the time comes to remove these bridges. The large majority of this material would be reinforced concrete. It is anticipated that most of the material would be recycled. No disposal difficulties would be expected with any of the alternatives, including those with a lengthy bridge component (Pamlico Sound Bridge Corridor and Parallel Bridge Corridor with All Bridge or with Phased Approach [including the Preferred Alternative]).

2.12 Costs and Funding

2.12.1 Project Costs

Table 2-9 and Table 2-10 show the total estimated costs through 2060 for the seven replacement bridge corridor alternatives under consideration. Construction, right-of-way, Bonner Bridge demolition, NC 12 pavement removal, and operation and maintenance costs are shown. Total costs for three different timeframes are shown.

Table 2-9. Highway Cost to 2060 (Low)

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge*	Phased Approach/ Rodanthe Nourishment
Highway Cost (2006 dollars)							
Replacement Bridge Construction Cost	$933,500,000	$929,100,000	$260,000,000	$260,000,000	$260,000,000	$294,000,000	$294,000,000
NC 12 Maintenance Construction Cost							
• New Road	$0	$0	$0	$35,000,000	$14,600,000	$0	$0
• New Bridge	$0	$0	$0	$151,000,000	$547,800,000	$514,900,000	$479,030,000
• Nourishment to 2060 (only 2015 with Phased Approach/Rodanthe Bridge[1])	$0	$0	$317,550,000	$0	$0	$23,694,000	$107,416,000
• Dunes to 2060	$0	$0	$8,267,000	$1,556,000	$0	$533,000	$3,378,000
Right-of-Way	$6,890,000	$5,245,000	$750,000	$1,725,000	$1,650,000	$73,575,000	$15,500,000
Bonner Bridge Demolition	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000
Wetland Mitigation (except SAV)	$512,000	$329,000	$468,000	$14,130,000	$1,860,000	$468,000	$468,000
NC 12 Pavement Removal	$4,255,000	$4,255,000	$90,000	$3,600,000	$3,600,000	Included in construction cost	Included in construction cost
Road and Bridge Operation and Maintenance Costs to 2060	$356,407,000	$356,137,000	$80,710,000	$131,197,000	$274,173,000	$260,289,000	$245,306,000
TOTAL Highway Cost to 2060	**$1,305,564,000**	**$1,299,066,000**	**$671,835,000**	**$602,208,000**	**$1,107,683,000**	**$1,171,459,000**	**$1,149,098,000**
Discounted Highway Cost (to 2060)	$987,028,000	$981,173,000	$394,977,000	$477,841,000	$858,295,000	$772,575,000	$712,909,000
Discount Rate =	5%						
Highway Cost by Expenditure Timeframe							
2009 to 2020	$1,001,472,000	$995,224,000	$342,542,000	$493,615,000	$876,418,000	$809,821,000	$721,916,000
2021 to 2040	$113,693,000	$113,568,000	$151,595,000	$43,650,000	$91,313,000	$223,528,000	$257,993,000
2041 to 2060	$190,399,000	$190,274,000	$177,698,000	$64,943,000	$139,952,000	$138,111,000	$169,189,000
TOTAL Highway Cost to 2060	$1,305,564,000	$1,299,066,000	$671,835,000	$602,208,000	$1,107,683,000	$1,171,460,000	$1,149,098,000

[1] The cost for nourishment included in the Phased Approach/Rodanthe Bridge Alternative (Preferred) is representative of continued emergency maintenance activities in that area until Phase II is implemented.
*Preferred Alternative

Table 2-10. Highway Cost to 2060 (High)

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge*	Phased Approach/ Rodanthe Nourishment
Highway Cost (2006 dollars)							
Replacement Bridge Construction Cost	$1,425,500,000	$1,418,100,000	$309,000,000	$309,000,000	$309,000,000	$347,000,000	$347,000,000
NC 12 Maintenance Construction Cost							
• New Road	$0	$0	$0	$35,000,000	$14,600,000	$0	$0
• New Bridge	$0	$0	$0	$240,000,000	$826,400,000	$774,900,000	$719,030,000
• Nourishment to 2060 (only 2015 with Phased Approach/Rodanthe Bridge[1])	$0	$0	$567,065,000	$0	$0	$36,348,000	$189,668,000
• Dunes to 2060	$0	$0	$8,267,000	$1,556,000	$0	$533,000	$3,378,000
Right-of-Way	$6,890,000	$5,245,000	$750,000	$1,725,000	$1,650,000	$73,575,000	$15,500,000
Bonner Bridge Demolition	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000
Wetland Mitigation (except SAV)	$512,000	$329,000	$468,000	$14,130,000	$1,860,000	$468,000	$468,000
NC 12 Pavement Removal	$4,255,000	$4,255,000	$90,000	$3,600,000	$3,600,000	Included in construction cost	Included in construction cost
Road and Bridge Operation and Maintenance Costs to 2060	$356,407,000	$356,137,000	$80,710,000	$131,197,000	$274,173,000	$260,289,000	$245,306,000
TOTAL Highway Cost to 2060	**$1,797,564,000**	**$1,788,066,000**	**$970,350,000**	**$740,208,000**	**$1,435,283,000**	**$1,497,113,000**	**$1,524,350,000**
Discounted Highway Cost (to 2060)	$1,444,988,000	$1,436,340,000	$523,757,000	$606,293,000	$1,163,229,000	$999,357,000	$945,339,000
Discount Rate =	5%						
Highway Cost by Expenditure Timeframe							
2009 to 2020	$1,493,472,000	$1,484,224,000	$428,559,000	$631,615,000	$1,204,018,000	$1,066,475,000	$964,897,000
2021 to 2040	$113,693,000	$113,568,000	$247,369,000	$43,650,000	$91,313,000	$292,528,000	$358,628,000
2041 to 2060	$190,399,000	$190,274,000	$294,421,000	$64,943,000	$139,952,000	$138,111,000	$200,825,000
TOTAL Highway Cost to 2060	$1,797,564,000	$1,788,066,000	$970,349,000	$740,208,000	$1,435,283,000	$1,497,114,000	$1,524,350,000

[1] The cost for nourishment included in the Phased Approach/Rodanthe Bridge Alternative (Preferred) is representative of continued emergency maintenance activities in that area until Phase II is implemented.

*Preferred Alternative

2.12.1.1 Cost Range

Both low (Table 2-9) and high (Table 2-10) costs are shown. The low and the high reflect the potential range of costs as they are known at this time. The range for the bridge costs takes into account the following items that are unknown or for which only partial knowledge exists during the planning process:

- Geotechnical conditions;
- Site access, staging, and transport of materials constraints within and surrounding the project limits, particularly constraints requested by third parties that are unknown at this time;
- Permit conditions, including construction techniques that may be required or not be allowed by permits;
- Material availability, particularly for large orders to be filled on a demanding schedule;
- Material costs, noting that currently some suppliers are not providing cost estimates to contractors because of large product demand, especially if large orders must be filled on a demanding schedule;
- Final structural design criteria, especially as it relates to geotechnical and wave impact effects and that new wave action guidelines for design are currently being developed nationally;
- Variations in design approach that best suit individual contractors (e.g., one contractor may opt for long spans and fewer piers lending itself to segmental construction, while another contractor may have resources that would be better suited by a more traditional design approach; this is particularly true with the planned design-build procurement method);
- Effects of the upcoming implementation of the LRFD bridge code in North Carolina;
- The results of chloride modeling of a specific site, which would affect the content of the concrete used in project bridges;
- Risk assumptions in contractor estimates, including weather;
- Utility company needs as they affect schedule and cost;
- Final dredging needs; and
- The potential rate of erosion of sand nourishment sand.

2.12.1.2 Changes in Bridge Cost Assumptions since the SDEIS

The bridge costs (per square foot/per square meter) used for the 2006 cost estimates presented in Table 2-9 and Table 2-10 for the Oregon Inlet bridge (with the Parallel Bridge Corridor alternatives) and the Pamlico Sound Bridge Corridor bridge, reflect material unit costs solicited from three national bridge contractors, all of whom participated in the August 2006 Constructability Workshop (see Section 2.7). Costs developed by NCDOT were independently verified by FHWA and Finley Engineering (a private engineering firm). In Table 2-9 and Table 2-10, the low estimate for the Pamlico Sound Bridge Corridor bridge assumes conventional (concrete girder ["I" shape] superstructure) construction and the high estimate assumes segmental (box girder superstructure) construction. The Oregon Inlet bridge estimates assume segmental construction only.

Bridge costs (per square foot/per square meter) for the Pamlico Sound Bridge Corridor bridge using conventional construction methods are consistent with data from the construction of the 2.8-mile (4.5-kilometer) long bridge on the US 17 Washington (North Carolina) Bypass over the Tar River (TIP Project No. R-2510). The bridge on the Washington Bypass is a design-build project that is currently under construction with an expected completion date of November 2010. Bridge costs for the Pamlico Sound Bridge Corridor bridge using conventional construction methods, the Oregon Inlet bridge, and the bridges for the NC 12 maintenance component of the Phased Approach alternatives (including the Preferred Alternative), were independently estimated by an engineering firm specializing in cost estimation of large bridge projects. These independent cost estimates support the 2006 estimates presented in Table 2-9 and Table 2-10.

The estimated 2005 cost to construct the Oregon Inlet bridge in Table 2-9 of the SDEIS was $191 million. The current (2006) cost estimate ranges from a low of $260 million (Table 2-9) to a high of $347 million (Table 2-10). The current estimate is higher than the SDEIS estimate because the SDEIS estimate was based on a conventional contract delivery method (the bridge is designed by NCDOT and a contractor is selected to build that design). The 2006 estimate utilizes a design-build contract delivery method (a contractor is selected to both design and build the project), as required by state legislation. This change resulted first in cost additions of five percent to complete the design of the project and 10 percent to reflect contractor risk. Second, this change resulted in 14.9 percent (5 percent per year) being added to cover inflation between 2005 and the midpoint of construction of the project based on a design-build contract start date of 2006. Adding an inflation factor in this way is the design-build cost estimate equivalent of assuming current year (2006) dollars when estimating the cost of a conventional contract delivery project. Similar design-build factors are used for the NC 12 maintenance components of the Parallel Bridge Corridor alternatives.

The estimated cost to construct the Pamlico Sound Bridge Corridor bridge presented in the SDEIS was $414.2 to $416.8 million depending upon the Rodanthe terminus option. The cost estimate range of $929.1 million to $1.4 billion presented in Table 2-9 and Table 2-10 is broader and reflects more than just a difference in terminus options. First, the range reflects the factors discussed in Section 2.12.1.1, as well as differences in superstructure type. Second, the costs include the design-build-related 5 percent design and the 10 percent risk increases, as well as an inflation factor of 18.7 percent (5 percent per year). The higher inflation factor than the Oregon Inlet bridge reflects the longer construction period assumed for constructing a Pamlico Sound Bridge Corridor project. Finally, the remainder of the difference reflects the elimination of assumptions made in 2005 related to economies of scale that now appear to be invalid. Initially, NCDOT and FHWA had determined that the cost of construction would be $55 per square foot ($5.1 per square meter), if erecting the bridge from barges, or $60 per square foot ($5.6 per square meter), if erecting the bridge from a work bridge. The 2006 cost estimate places the price at $130 to $140 per square foot ($12.1 to $13.0 per square meter) for conventional construction and $210 to $220 per square foot ($19.5 to $20.4 per square meter) for segmental construction.

2.12.1.3 Cost Comparison

The following observations can be made about the costs in Table 2-9 and Table 2-10:

- In terms of simply replacing Bonner Bridge with a new bridge, the shorter bridge over Oregon Inlet used with the Parallel Bridge Corridor would be the least costly ($260.0 to $347.0 million versus $929.1 million to $1.4 billion with the Pamlico Sound Bridge Corridor bridge). However, the cost of the shorter Oregon Inlet bridge does not account for maintaining traffic from the bridge through Rodanthe; the NC 12 maintenance component must be included to truly compare the cost of the alternatives over the long-term.

- When the cost of NC 12 maintenance through the Refuge is added to the cost of a new Oregon Inlet bridge in the Parallel Bridge Corridor, as well as other highway-related costs until 2060, the Road North/Bridge South Alternative would be the least expensive ($602.2 to $740.2 million). The Nourishment Alternative is the second least expensive at $671.8 to $970.4 million. The remaining alternatives, which involve longer bridges, would range in cost from $1.1 to $1.8 billion.

- Right-of-way in Rodanthe would be most expensive ($15.5 to $73.6 million) with the Phased Approach alternatives (including the Preferred Alternative).

- Operation, inspection, and maintenance costs are greater for bridges than for roads. Inspection costs per square foot are expected to be higher when bridges are closer to the ocean and lower when bridges are over land.

- When costs through 2060 are discounted at a 5 percent discount rate, the Parallel Bridge Corridor with Nourishment Alternative becomes the least expensive. The Phased Approach alternatives (including the Preferred Alternative) become the least expensive alternatives involving bridges. The concept of discounting was explained in Section 2.6.3.3 under "Cost." As explained in that section, when the cost streams for the various alternatives are discounted, the costs of alternatives with higher up-front expenditures (e.g., un-phased alternatives) drop the least and the costs of alternatives with expenditures spread-out through 2060 (e.g., Nourishment and the Phased Approach alternatives [including the Preferred Alternative]) drop the most. With the latter, the costs are occurring closer to the time in which the benefits to the traveling public actually occur. Alternatives with lower discounted costs can be viewed as providing a better return on the investment of federal and state resources.

- The Parallel Bridge Corridor with Nourishment or Road North/Bridge South would involve the lowest near-term expenditures. The Road North/Bridge South Alternative could potentially offer even lower near-term expenditures if it was phased (see Section 2.10.2.5 under "Opportunities for Phasing the Road North/Bridge South and All Bridge Alternatives").

The nourishment costs shown in Table 2-9 and Table 2-10 for the Nourishment Alternative include a forecast low and forecast high rate of erosion of the material placed on the beach and the associated need to periodically replace newly eroded material. The cost through 2060, assuming the most likely erosion rate considered would be $429.4 million, in contrast with the low of $317.5 million and the high of $567.1 million shown in Table 2-9 and Table 2-10, respectively. In the case of nourishment associated with the Phased Approach alternatives (including the Preferred Alternative), the high cost also is considered the likely cost.

There is also the risk of a storm-created breach of Hatteras Island within the Refuge between now and 2060. A storm-created breach of Hatteras Island in the Refuge would separate almost all of Hatteras Island and its associated communities, tourism businesses, and the Cape Hatteras National Seashore from Bodie Island and the mainland. The cost of closing such a breach is discussed in Section 4.6.6, but is not included in the tables because although the potential for a breach exists, the occurrence of a breach (unlike shoreline erosion that can be predicted) is not a certainty (see Section 3.6.3.4). In addition, there would be the associated economic loss, challenges for maintaining community services, and disruptions to daily living until the breach is closed. These economic costs of a breach are discussed in Section 4.1.5.4.

2.12.1.4 Potential Cost Sharing Opportunity with the Nourishment Alternative

The potential exists for reducing the cost of the nourishment component of the Nourishment Alternative shown in Table 2-9 and Table 2-10 by up to $20.0 million through 2060 if sand from the US Army Corps of Engineers' (USACE) ocean bar maintenance were used for nourishment and a cost sharing arrangement could be developed between the NCDOT and the USACE. The USACE is expected to continue to spend approximately $1,362,000 per year for contract hopper dredges to maintain the Oregon Inlet ocean bar channel. The USACE also has spent since 1989 an average of $1.53 million on pipeline dredges to maintain the channel in the vicinity of the navigation span of Bonner Bridge. The new Oregon Inlet bridge, which would have an approximately 3,300 to 5,000-foot-wide (1,006 to 1,524-meter-wide) navigation zone with a series of spans, could reduce navigation span maintenance requirements, reducing the USACE's dredging costs.

If arrangements could be made between the NCDOT and the USACE to cost-share the channel maintenance activities, the level of funding that the USACE may be willing to contribute could equal the expected costs for future contract hopper dredging, $1.362 million per year. This approach acknowledges that the replacement bridge would eliminate or greatly reduce USACE dredging cost under the Oregon Inlet bridge and the nourishment program could use sand down to the 14-foot (4.3-meter) authorized Oregon Inlet channel depth, which is not currently achieved (as described in Section 2.10.2.1).

The cost included in Table 2-9 and Table 2-10 for nourishment in the northern part of the Refuge (at the ponds and north of the ponds) is $182.7 to $320.4 million of the $317.5 to $567.1 million shown. If material was used for nourishment from the USACE's ocean bar dredging program, mobilization costs for nourishment would be higher than assumed in the cost in Table 2-9 and Table 2-10 because the sand would become available annually and the costs in Table 2-9 and Table 2-10 assume mobilization for nourishment every four years. Increased mobilization costs would increase the cost of nourishment in the northern part of the Refuge by $49.5 million. The total USACE contribution through 2060 would be $69.5 million based on the annual contribution noted in the previous paragraph. Thus, such a partnership between the USACE and the NCDOT would reduce the cost of the Nourishment Alternative by up to $20.0 million through 2060.

2.12.2 Bonner Bridge Demolition and Removal Costs

Demolition and removal of Bonner Bridge would cost approximately $4 million (2006 dollars). This cost can vary greatly depending on accessibility and the location of an acceptable site for disposal of those items that cannot be recycled or disposed of economically.

2.12.3 Other Public Costs

The highway costs shown do not include other non-highway costs, such as the potential public cost of providing alternative access to the Refuge with the Pamlico Sound Bridge Corridor. A sample of these public costs is provided in Table 2-11 and Table 2-12. Again, a low (Table 2-11) and a high (Table 2-12) cost table is presented. The non-highway and alternate access cost estimates are identical in the two tables. Both tables are included so that the combination of these costs with the range of highway costs presented in Table 2-9 and Table 2-10 can be shown.

Table 2-11. Non-Highway Public Cost and Total Highway Cost (Low) to 2060

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge*	Phased Approach/ Rodanthe Nourishment
TOTAL Highway Cost to 2060	$1,305,564,000	$1,299,066,000	$671,835,000	$602,208,000	$1,107,683,000	$1,171,459,000	$1,149,098,000
Non-Highway and Potential Non-Highway Costs							
Utilities	$53,863,000	$53,863,000	$12,054,000	$14,960,000	$17,365,000	$17,433,000	$17,365,000
Terminal Groin Removal	$12,000,000	$12,000,000	$0	$0	$0	$0	$0
(Former) Oregon Inlet US Coast Guard Station Relocation (excludes prep cost)	$50,000	$50,000	$0	$0	$0	$0	$0
Visitors Center Relocation	$20,000	$20,000	$0	$20,000	$20,000	$20,000	$20,000
TOTAL Non-Highway and Potential Non-Highway Costs to 2060	$65,933,000	$65,933,000	$12,054,000	$14,980,000	$17,385,000	$17,453,000	$17,385,000
Refuge Alternate Access Costs							
Tram Service (full length)	$17,385,000	$17,385,000					
Tram Service (with partial road access)	$10,692,000	$10,692,000					
(for both trams serving 620 passengers per day for 4 months with 20 minute headways, 310 per day for 4 months, and 155 per day for 4 months)							
Passenger Ferry (TOTAL)	$518,364,000	$518,364,000					
• Capital	$1,112,000	$1,112,000					
• Dredging	$149,332,000	$149,332,000					
• Operation (365 days/year; 7 round trips, 90 persons per trip, $33.33 per person at capacity round trip)	$367,920,000	$367,920,000					
Partial Road Access to Refuge (capital/O&M)							
• Via Nourishment	$141,771,000	$141,771,000					
• Via Bridge	$167,038,000	$167,038,000					
• Via Road then Bridge	$178,293,000	$178,293,000					
Total Highway Costs+							
With Non-Highway Costs	$1,371,497,000	$1,364,999,000	$683,889,000	$617,188,000	$1,125,068,000	$1,188,912,000	$1,166,483,000
With Non-Highway+Tram	$1,388,882,000	$1,382,384,000					
With Non-Highway+Tram+Ferry	$1,907,246,000	$1,900,748,000					
With Non-Highway+Tram+Nourish	$1,523,960,000	$1,517,462,000					
With Non-Highway+Tram+Bridge	$1,549,227,000	$1,542,729,000					
With Non-Highway+Tram+Road then Bridge	$1,560,482,000	$1,553,984,000					

*Preferred Alternative

Table 2-12. Non-Highway Public Cost and Total Highway Cost (High) to 2060

	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge*	Phased Approach/ Rodanthe Nourishment
TOTAL Highway Cost to 2060	$1,797,564,000	$1,788,066,000	$970,350,000	$740,208,000	$1,435,283,000	$1,497,113,000	$1,524,350,000
Non-Highway and Potential Non-Highway Costs							
Utilities	$53,863,000	$53,863,000	$12,054,000	$14,960,000	$17,365,000	$17,433,000	$17,365,000
Terminal Groin Removal	$12,000,000	$12,000,000	$0	$0	$0	$0	$0
(Former) Oregon Inlet US Coast Guard Station Relocation (excludes prep cost)	$50,000	$50,000	$0	$0	$0	$0	$0
Visitors Center Relocation	$20,000	$20,000	$0	$20,000	$20,000	$20,000	$20,000
TOTAL Non-Highway and Potential Non-Highway Costs to 2060	$65,933,000	$65,933,000	$12,054,000	$14,980,000	$17,385,000	$17,453,000	$17,385,000
Refuge Alternate Access Costs							
Tram Service (full length)	$17,385,000	$17,385,000					
Tram Service (with partial road access)	$10,692,000	$10,692,000					
(for both trams serving 620 passengers per day for 4 months with 20 minute headways, 310 per day for 4 months, and 155 per day for 4 months)							
Passenger Ferry (TOTAL)	$518,364,000	$518,364,000					
• Capital	$1,112,000	$1,112,000					
• Dredging	$149,332,000	$149,332,000					
• Operation (365 days/year; 7 round trips, 90 persons per trip, $33.33 per person at capacity round trip)	$367,920,000	$367,920,000					
Partial Road Access to Refuge (capital/O&M)							
• Via Nourishment	$253,588,000	$253,588,000					
• Via Bridge	$189,076,000	$189,076,000					
• Via Road then Bridge	$200,331,000	$200,331,000					
Total Highway Costs+							
With Non-Highway Costs	$1,863,497,000	$1,853,999,000	$982,404,000	$755,188,000	$1,452,668,000	$1,514,566,000	$1,541,735,000
With Non-Highway+Tram	$1,880,882,000	$1,871,384,000					
With Non-Highway+Tram+Ferry	$2,399,246,000	$2,389,748,000					
With Non-Highway+Tram+Nourish	$2,127,777,000	$2,118,279,000					
With Non-Highway+Tram+Bridge	$2,063,265,000	$2,053,767,000					
With Non-Highway+Tram+Road then Bridge	$2,074,520,000	$2,065,022,000					

*Preferred Alternative

All or part of the non-highway costs may be borne by the FHWA and NCDOT, including some utility costs, cost of removing the terminal groin, and the cost of relocating the (former) Oregon Inlet US Coast Guard Station (if required as a part of mitigating the loss of access associated with the Pamlico Sound Bridge Corridor alternatives). The following can be observed about these costs:

- Utility relocation costs would be greatest with the Pamlico Sound Bridge Corridor because the costs of placing electrical lines over water are more expensive than over land. The utility costs for the Parallel Bridge Corridor alternatives assume that utilities are relocated onto the new Oregon Inlet bridge and elsewhere utilities are relocated as needed, on land, and within the Refuge.

- Terminal groin removal is shown for the Pamlico Sound Bridge Corridor because the groin would not be needed with this alternative. Others may choose to obtain a new permit to retain the groin if the Pamlico Sound Bridge Corridor is chosen for implementation.

- Retention of the groin with the Parallel Bridge Corridor alternatives would allow the (former) Oregon Inlet US Coast Guard Station to remain in place.

- The USFWS will need to relocate its Visitor Center as the shoreline erodes with all alternatives except the Nourishment Alternative, which would maintain the existing shoreline as needed to protect NC 12.

The Refuge costs recognize that with the Pamlico Sound Bridge Corridor, the NCDOT would no longer need to maintain NC 12 in the Refuge to retain access to Hatteras Island south of the Refuge and that Refuge representatives have indicated that they would prefer a type of access that did not involve regular storm-related maintenance. The options listed are possibilities suggested in the past by Refuge officials and reflected in the Refuge's *Comprehensive Conservation Plan* (USFWS, 2006), alternatives 4 and 5. In addition to the options presented here, the Refuge could designate a sand route for private vehicles at presumably a nominal cost in contrast with the options presented in Table 2-11 and Table 2-12. Also, these options do not consider costs if a storm-caused breach were to occur at the southern end of the Refuge. If this were to occur, a ferry service would need to be implemented to get visitors, and perhaps their vehicles, to and from the Refuge.

The following can be observed about the costs of alternate Refuge access:

- Operating a ferry to the north end of Hatteras Island from Bodie Island would be a high cost strategy at $500 million through 2060. This cost includes the actual ferry operations costs as well as regular maintenance dredging.

- A tram service would be the least costly strategy based on the assumptions used to develop the cost (trams serving 620 passengers per day for 4 months with 20 minute headways, 310 per day for 4 months, and 155 per day for 4 months or an annual capacity of 132,000). The Refuge has an estimated 400,000 to 500,000 annual visitors.

- Partial road access also would be a high cost strategy at $179 to $254 million through 2060.

The combination of additional potential non-highway and Refuge access costs would increase Pamlico Sound Bridge Corridor costs (the most expensive alternative even when considering only highway costs) from $1.3 to $1.8 billion to as high as $1.9 to $2.4 billion.

2.12.4 Capital Funding

The funds to build one of the replacement bridge corridor alternatives are expected to come from two sources:

1. The funds allocated in NCDOT's approved 2009 to 2015 TIP for construction of the proposed project; and

2. In the case of the two Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) and the Parallel Bridge Corridor with Nourishment Alternative, spreading the cost over multiple federal and state funding cycles.

Many states use innovative techniques to finance large projects or transportation improvement programs. They all involve the issuance of revenue bonds against one or more long-term sources of revenue. Revenues used to pay the principle and interest associated with the bonds can come from future FHWA Federal-Aid funds, state transportation revenues (e.g., motor fuel taxes), local taxes, local fees, and tolls. The US Department of Transportation also can loan monies that are in addition to the federal transportation funds normally apportioned to the state. In this case, repayment must come from non-federal sources. In North Carolina, the opportunities for such financing that is available to NCDOT Division 1, where the project is located, would not be adequate to fund the proposed project.

The State of North Carolina Highway Trust Fund Act of 1989 (GS 136-175 to 136-184) created the North Carolina Highway Trust Fund. This Act states that the Highway Trust Fund shall be used for the following purposes:

1. For the planning, design, and construction of the North Carolina Intrastate System specifically described in GS 136-178;

2. For the planning, design and construction of the Urban Loops described in GS 136-179;

3. For a supplement to secondary road construction as described in GS 136-180; and

4. For a supplement to the NCDOT's TIP.

The Act also identified the sources of funding for the Highway Trust Fund (GS 136-177) and established a distribution formula (GS 136-184) by which the transportation funds would be distributed to seven "Distribution Regions" of the state, each region consisting of two NCDOT Highway Divisions. The purpose of this distribution formula, also known as the "Equity Formula," was to spread transportation funds throughout the state. Under the Equity Formula, all state and federal funds allocated for construction of projects under the NCDOT's TIP in each Distribution Region shall be determined by "multiplying the total amount of the funds available for that seven-year period for the construction of these projects by a factor based: 25 percent on the miles to complete the Intrastate System within the Distribution Region as compared to the miles of the entire Intrastate System; 50 percent on the population of the Distribution Region compared to the total population of the State; and 25 percent on an equal share based on the number of Distribution Regions (one-seventh)."

Based on the Equity Formula, NCDOT Division 1 received approximately $548 million in funding from NCDOT's 2007 to 2013 TIP (current at the time this analysis was conducted). Therefore, Division 1 does not currently have sufficient funding available in the seven-year period to *completely* build the Pamlico Sound Bridge Corridor or any of the Parallel Bridge

Corridor alternatives (see Table 2-9 and Table 2-10). Furthermore, State law prohibits exceeding the funds allocated by the Equity Formula in one TIP period. Applying the Equity Formula to projected future transportation funds indicates that Division 1 would not exceed $1 billion in cumulative funding until 2021. Therefore, Division 1 would only have sufficient funding to completely build the Nourishment Alternative and the Road North/Bridge South Alternative (and then only in phases) through at least 2021.

The NCDOT considered several innovative financing techniques to fund the Bonner Bridge replacement, including the State Infrastructure Bank, toll roads, and GARVEE Bonds. The State Infrastructure Bank is a low interest loan program that NCDOT administers primarily to municipalities. The program has $1.5 million and currently $1.2 million is loaned, leaving $200,000 available mainly for cities and counties. NCDOT has not utilized the State Infrastructure Bank for one of its own projects.

Another innovative financing technique considered was toll roads. However, State law requires that a free route be available as an alternative to a toll road. Currently NC 12 to Bodie Island is the only free route connecting Hatteras Island to the mainland. The North Carolina Turnpike Authority (NCTA) is not considering the Bonner Bridge replacement as a potential toll project.

The final innovative financing technique considered was GARVEE Bonds, which are transportation bonds issued by the state against future federal funding. NCDOT had sought legislation that would have allowed for GARVEE Bonds to construct this project and other very costly projects; however, the statute that was approved by the state legislature dictated that the bond money be distributed according to the Equity Formula. Therefore, of the initial $950 million bond offering, only $76 million is allocated to Division 1, and this entire amount is currently allocated to the Bonner Bridge project. Approximately $55 million will go towards the replacement bridge, and the balance will be used to repair Bonner Bridge to facilitate its continued use until the replacement bridge is built.

As stated above, NCDOT Division 1 is projected to receive $548 million in equity funds from federal and state sources over the next seven years. Since the GARVEE Bonds funds of $55 million are from a bond, the State will be repaying the debt service over the next 12 years, which reduces the actual purchasing power, so there is only a $27 million net gain in funding that can actually go towards the proposed project from the GARVEE Bonds. Therefore, a total of $575 million can be used on projects in Division 1 over the next seven years.

Based on the initial $950 million bond offering from the GARVEE Bonds and the Division's $548 million apportionment from the 2007 to 2013 State TIP, each of the replacement bridge corridor alternatives could have been cost-feasible to build if the Equity Formula had not been applied. However, because the Equity Formula would apply, NCDOT does not have a means in which the State could generate enough funds for Division 1 to be able to *completely* build the Pamlico Sound Bridge Corridor or any of the Parallel Bridge Corridor alternatives in one seven-year State TIP period. However, the Parallel Bridge Corridor alternatives could be phased (i.e., the costs spread-out over time). For example, the replacement bridge construction costs for the Parallel Bridge Corridor alternatives (i.e., the Oregon Inlet bridge components) in both tables ($260.0 to $347.0 million) are less than the $575 million that is currently available. For the Phased Approach alternatives (including the Preferred Alternative), the construction of the new Oregon Inlet bridge corresponds to Phase I (see Section 2.10.2.5). The four phases of the Phased Approach alternatives (including the Preferred Alternative) were developed primarily to address future forecast coastal conditions, but the issue of funding availability was also a consideration in the decision to phase these alternatives.

2.12.5 Short-Term NC 12 Maintenance Costs Expected Prior to Implementation of the Phased Approach Alternatives

From August 1999 to October 2007, NCDOT spent approximately $5.5 million on major actions to restore NC 12 after storm events. Of that amount, approximately $3.9 million was spent within the Refuge, predominantly at the three hot spots. The greatest expenditures within the Refuge occurred in 1999 (approximately $1.7 million) in association with Hurricanes Dennis, Bonnie, and Floyd, and in 2003 (approximately $1.2 million) in association with Hurricane Isabel. From 2004 to 2007, major restoration costs totaled approximately $1.1 million over the four years. No substantial costs occurred between 2000 and 2002. Lesser levels of NC 12 weather-related maintenance occur on a regular basis for which specific costs are not available. They include in recent years road scraping 1 to 2 times per month and minor dune maintenance 2 to 3 times per year (see Table 4-15). These activities are concentrated in the three hot spots: ‘S’ Curves, Sandbag Area, and Canal Zone.

The extent of expenditures for NC 12 weather-related maintenance in any given year is highly dependent on whether major storms occur. As indicated in Section 4.6.8.6, as the shoreline evolves between now and the completion of Phase II, maintenance needs in the hot spots are expected to increase, and the cost of new storm events are expected to rise as the potential increases for larger areas to be affected by storms (see Table 4-15 and Table 4-16).

Once Phase II is complete, it is expected that NC 12 weather-related maintenance (and its associated cost) would drop substantially, since all three hot spots would be bridged (see Table 4-15 and Table 4-16). Costs would again rise as more maintenance is required with shoreline change prior to the completion of Phases III and IV. As indicated in Section 2.10.2.5, NCDOT intends to implement a monitoring program in the Phase III and IV areas, as well as in the 2.1-mile (3.4-kilometer) section of NC 12 in the southern half of the Refuge that is not expected to be threatened by erosion prior to 2060, so as to time the implementation of Phases III and IV (to the extent practicable given the availability of transportation funding and the efficient use of those funds) such that the need for future NC 12 maintenance in those areas is reduced. Thus, high levels of NCDOT weather-related maintenance costs are not expected to return after Phase II is complete; however, accelerated sea level rise and increased storm activity (magnitude and frequency) could change these expectations. A monitoring program described in Section 2.10.2.5 would help minimize the effect of such change.

2.13 Environmental Protection during Construction and Demolition

Best Management Practices (BMPs) to control erosion, sedimentation, and stormwater runoff would be used during construction and Bonner Bridge demolition. BMPs are discussed in Section 4.13.7.

The use of explosives during construction and Bonner Bridge demolition is not anticipated. If explosives are needed to remove Bonner Bridge's piles, the NCDOT would coordinate with the appropriate environmental resource and regulatory agencies to develop a blasting program that would minimize adverse effects to the natural environment.

Environmental protection-related specifications contained in the NCDOT's *Standard Specifications for Roads and Structures* (July 2006 or latest revision) would be incorporated into construction contracts. The types of environmental specifications that would be included in construction contracts are:

- Observance of and compliance with all federal, state, and local laws, ordinances, regulations, orders, and decrees that affect the conduct of the construction work.

- Traffic maintenance within the limits of the project, including existing roadways that cross or intersect the project. During peak season in the summer, two lanes would be maintained. The construction work would be conducted in a safe manner that creates a minimum amount of inconvenience to traffic. Continuous and safe access would be provided to adjoining activities, and operations would be conducted such that the inconvenience to property owners and users is limited.

- Implement measures to minimize the dust generated by construction, when the control of dust is necessary for the protection and comfort of residents, motorists, and campers. Construction contractors would take measures necessary to minimize air pollution. Dust control is not considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of surrounding properties.

- Development and implementation of a soil erosion schedule. It would describe the time relationship between phases of the work that must be coordinated to reduce erosion, construction practices, and temporary control measures that would be used to minimize erosion. Contractors must take whatever measures are necessary to minimize soil erosion and siltation.

- Incorporation of all permanent erosion control work into the project at the earliest practicable time and coordination of temporary measures to ensure economical, effective, and continuous erosion control.

- Seeding and mulching on all earth areas disturbed by construction on a section-by-section basis, immediately upon completion of each section.

- Proper disposal of waste and debris outside the project right-of-way. A plan for the disposal of waste materials also would be developed. Disposal in areas under the jurisdiction of the USACE regulatory jurisdiction would not be allowed unless the contractor obtains the required permit and coordinates with other pertinent agencies. When public waste and disposal areas are not used, waste would be disposed of in areas compatible with such disposal, covered with earth, and shaped into contours that are comparable to, and blend in, with the existing topography. The covered waste areas would be seeded and mulched. Erosion would be controlled. Any burning of debris would be in accordance with applicable local, state, and federal laws and ordinances.

- Exercise every reasonable precaution to prevent pollution of water bodies, including proper storage of any fuel or hazardous materials and following required emergency response procedures in the event of a hazardous waste or oil spill.

Excavated, dredge, and fill material generated by the proposed bridge construction generally would be disposed of using one or more of the techniques that have been used regularly in the Oregon Inlet area in past years: open water disposal, diked as well as undiked disposal areas, and beach nourishment. These techniques and possible disposal locations associated with these techniques are described in Section 4.13.5. The appropriate location for disposal would be determined based on the character of the materials dredged, the availability of disposal sites, and coastal conditions near the time of construction. All of this information would be sought during USACE permit preparation.

2.14 Permits and Approvals

Various regulatory agencies were contacted to identify specific permit requirements, to solicit input into the assessment of potential environmental impacts, and to begin the permit coordination process. Permits would be needed from:

- The US Coast Guard (Norfolk District Bridge Section);
- The USACE (Wilmington Field Office);
- The USFWS;
- The NCDENR's Division of Coastal Management;
- The NCDENR's Division of Water Quality; and
- The NPS, Cape Hatteras National Seashore, Manteo.

These permits, as well as permitting issues as they pertain to the seven replacement bridge corridor alternatives, are described below. Coordination with permitting agencies was initiated at an agency scoping meeting on June 19, 1991, and at a joint permitting agency meeting on July 11, 1991. Another coordination meeting with the NPS and the USFWS was held August 29, 1995. A November 13, 2002, meeting with the NPS and the USFWS discussed permitting issues related to the Refuge and the Seashore.

Permitting-related issues also were discussed at the February 12, 2003 and July 23, 2003, NEPA/Section 404 Merger Team meetings. These meetings were attended by state and federal environmental resource and regulatory agencies. Permitting issues were discussed at January 7 and April 5, 2005 meetings with several regulatory agency representatives that were a part of developing the Parallel Bridge Corridor with NC 12 Maintenance alternatives, as well as at a May 24, 2005 briefing of the NEPA/Section 404 Merger Team. Coordination with permitting agencies would continue throughout the proposed project design and the permit application process, as well as during project construction. This coordination will help ensure the development of an environmentally sensitive design reflecting any changes in project area conditions that might occur following completion of the EIS process.

US Coast Guard Permit

A bridge permit for either the Oregon Inlet or Pamlico Sound bridge would be required from the US Coast Guard. Under the authority of Section 9 of the Rivers and Harbors Act of 1899 and the General Bridge Act of 1946 (as well as other legislation), the Coast Guard is responsible for approving the locations and plans for bridges and causeways over navigable waterways.

US Army Corps of Engineers Permit

The USACE Sections 404 and 10 permits and the NCDENR, Division of Coastal Management CAMA permit can be obtained through a joint permit application process (general permit 291). For this project, however, separate Section 404 and Section 10 permits must be obtained. Under Section 404 of the Clean Water Act, the USACE is responsible for issuing permits for discharges of dredged or fill material in the waters of the United States, including fill placed in connection with bridge and road construction and disposal of construction debris. The wetlands that would be filled by the five replacement bridge corridor alternatives and mitigation options are discussed in Section 4.7.4.

Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 regulates ocean dumping of dredged material. If this disposal methodology is used, this permit would be obtained. The Secretary of the Army can issue a permit after it has been determined that the dumping would not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities.

US Fish and Wildlife Service Permits and Compatibility Determination

Depending on the Parallel Bridge Corridor Alternative selected, the permits required from the USFWS would include:

- Right-of-Way Permit (when leaving the current easement);
- Special Use Permit (for temporary impacts because of construction, temporary detours, and beach nourishment); and
- A new permit for the retention of the terminal groin and revetment because the permit granted for the construction of the terminal groin states that the groin's intended use is only to protect the Bonner Bridge.

With the Phased Approach/Rodanthe Bridge Alternative (Preferred), only the new groin permit would be required because the project would be confined to the current easement.

With the exception of the Phased Approach/Rodanthe Bridge Alternative (Preferred), the alternatives in the Parallel Bridge Corridor could occur only if the USFWS concluded that the alternative is compatible with the April 1938 Executive Order 7864, which reserved the Refuge to advance the purposes of the Migratory Bird Conservation Act, and the National Wildlife Refuge System Improvement Act of 1997. Without such a compatibility determination, the USFWS could not issue a permit for the construction of a project on new alignment within the Refuge or a long-term beach nourishment program.

Also, with the Pamlico Sound Bridge Corridor, a new Special Use Permit for the retention of the terminal groin and revetment would be required if it is to remain in place. Without a new permit, the NCDOT would be obligated under the terms of the existing permit to remove the terminal groin and revetment two years after the construction of a replacement bridge at the request of the USFWS. The terminal groin and revetment would not be needed to protect a replacement bridge in the Pamlico Sound Bridge Corridor.

Coastal Area Management Act Permit

A CAMA permit would be required since all alternatives would involve construction along the oceanfront and in an area of environmental concern (AEC). The Pamlico Sound Bridge Corridor would affect coastal wetlands. The extent of impact on coastal wetlands is discussed in Section 4.7.4.

NCDENR, Division of Water Quality Certification

A 401 Water Quality Certification (as mandated under Section 401 of the Clean Water Act) would be required from the NCDENR Division of Water Quality. The 401 certification process is coordinated with the 404 and CAMA processes.

National Park Service Special Use Permit

An NPS special use permit would be obtained to use NPS lands at a bridge terminus on Bodie Island. In the Refuge area, the NPS would be involved in any permitting decisions related to the Refuge for the area outside the mean low tide level (the Refuge's ocean-side boundary) because the NPS property extends 150 feet (45.7 meters) beyond the shoreline. The permit would be issued by the Seashore Superintendent. The Superintendent must conclude that the bridge would not impair park resources.

2.15 Preferred Alternative

On August 27, 2007, representatives of NCDOT, FHWA, USACE, and NCDENR identified the Phased Approach/Rodanthe Bridge Alternative (Preferred) as the Least Environmentally Damaging Practicable Alternative (LEDPA) for replacing the Bonner Bridge under the project's NEPA/Section 404 merger process (see Appendix D for the signed agreement). The LEDPA has been adopted as the Preferred Alternative by NCDOT and FHWA. As described in Section 2.10, the Phased Approach/Rodanthe Bridge Alternative (Preferred) proposes replacing the Bonner Bridge with a parallel bridge and maintaining existing NC 12 through the Refuge by building bridges as needed in the existing NC 12 easement. Agency representatives based their decision on each alternatives' ability to meet the project's purpose and need, environmental consequences, opportunities available to mitigate impacts, cost, public and agency comment on the findings of the SDEIS and SSDEIS, and other findings presented in this FEIS. Agency representatives concurred that the Pamlico Sound Bridge Corridor is not a practicable alternative because of the high cost estimates and the impracticality of phasing this alternative, and therefore is not the LEDPA.

Specifically, the agencies concurred that:

- The Pamlico Sound Bridge Corridor is not practicable based on cost estimates and thus is not the LEDPA;

- Phase I of the project should be to construct the replacement bridge within the Parallel Bridge Corridor as soon as possible, every effort should be made to place the new bridge terminus within the existing easement, and Phase I should be advanced through the merger process;

- Phase I of the Phased Approach/Rodanthe Bridge Alternative (Preferred) alone would not meet the purpose and need of the project;

- Phases II to IV present substantial challenges to obtaining permit approvals; and

- At the time of permit application of Phases II to IV (see Section 2.14 for a discussion of needed permits), reasonable, practicable, and feasible alternatives will be considered and evaluated in pursuit of the LEDPA/Preferred Alternative.

Although agency representatives selected the Phased Approach/Rodanthe Bridge Alternative as the Preferred Alternative, they recognized that the project area is complex and the shoreline is constantly changing. They noted that the ability to predict the effect of future storms on the project area is extremely difficult to quantify, and they agreed that the various alternatives may need to be reassessed in the future as the shoreline and other landscape changes.

The concurrence form is presented in Appendix D. A description of the NEPA/Section 404 Merger Team meetings associated with the selection of the Preferred Alternative is presented in Section 8.10.

In addition to the reasons listed in the concurrence form, the Phased Approach/Rodanthe Bridge Alternative (Preferred) also:

- Could be phased and built as funding became available;
- Would meet the project's purpose and need;
- Would ultimately allow natural shoreline processes to occur between Oregon Inlet and Rodanthe, with the exception of the continued presence of the terminal groin;
- Would ultimately end regular storm-related NC 12 maintenance in the Pea Island National Wildlife Refuge, including substantially decreasing such maintenance after the complete of Phase II;
- Would bridge potential island breach locations; and
- Would provide continued road access to the Refuge.

Chapter 3

Affected Environment

3.0 Affected Environment

This chapter describes the existing conditions and characteristics in the project area that could be affected by the Bonner Bridge replacement. The characteristics described are those relevant to the assessment of impacts presented in Chapter 4. As appropriate to the assessment of impacts, the information presented under each topic focuses on the project area, the community of Rodanthe, the Cape Hatteras National Seashore, the Pea Island National Wildlife Refuge, Oregon Inlet, Pamlico Sound, and Dare County in general. The following topics are addressed:

3.1 Community

3.1.1 Regional Setting

The project area is in Dare County in eastern North Carolina. The project area encompasses northern Hatteras Island, the southern end of Bodie Island, and regions of the Pamlico Sound (see Figure 1-1). NC 12 is the only major road traversing the region. It runs north-south through the entire project area. Dare County's population was 29,967 in 2000, increasing 32 percent between 1990 and 2000. The area's economy is highly dependent on tourism-related activities, and the peak visitor numbers for Dare County have undergone a steady increase over the last 23 years. For 2002, it was estimated to be as high as 232,000 during the day and 126,000 at night during peak summer periods (*Outer Banks Economic and Demographic Package*, Outer Banks Chamber of Commerce, 2003).

The most developed area of the barrier islands in Dare County is the northern portion of Bodie Island, which includes the communities of Nags Head, Whalebone, Kill Devil Hills, and Kitty Hawk. With the development of much of Bodie Island, there has been a recent movement of construction and development to Hatteras Island in the small communities of Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, and Hatteras Village. NC 12 and Bonner Bridge connect Bodie Island, Hatteras Island and, via a ferry, Ocracoke Island. Much of the southern portion of Bodie Island, as well as most of Hatteras Island, are within the Cape Hatteras National Seashore. The northern end of Hatteras Island includes the Pea Island National Wildlife Refuge.

3.1.2 Land Use

The project area encompasses the southern tip of Bodie Island at the northern terminus of Bonner Bridge and the northern portion of Hatteras Island as far south as the community of Rodanthe. Land use in the project area is shown in Figure 3-1a through Figure 3-1c.

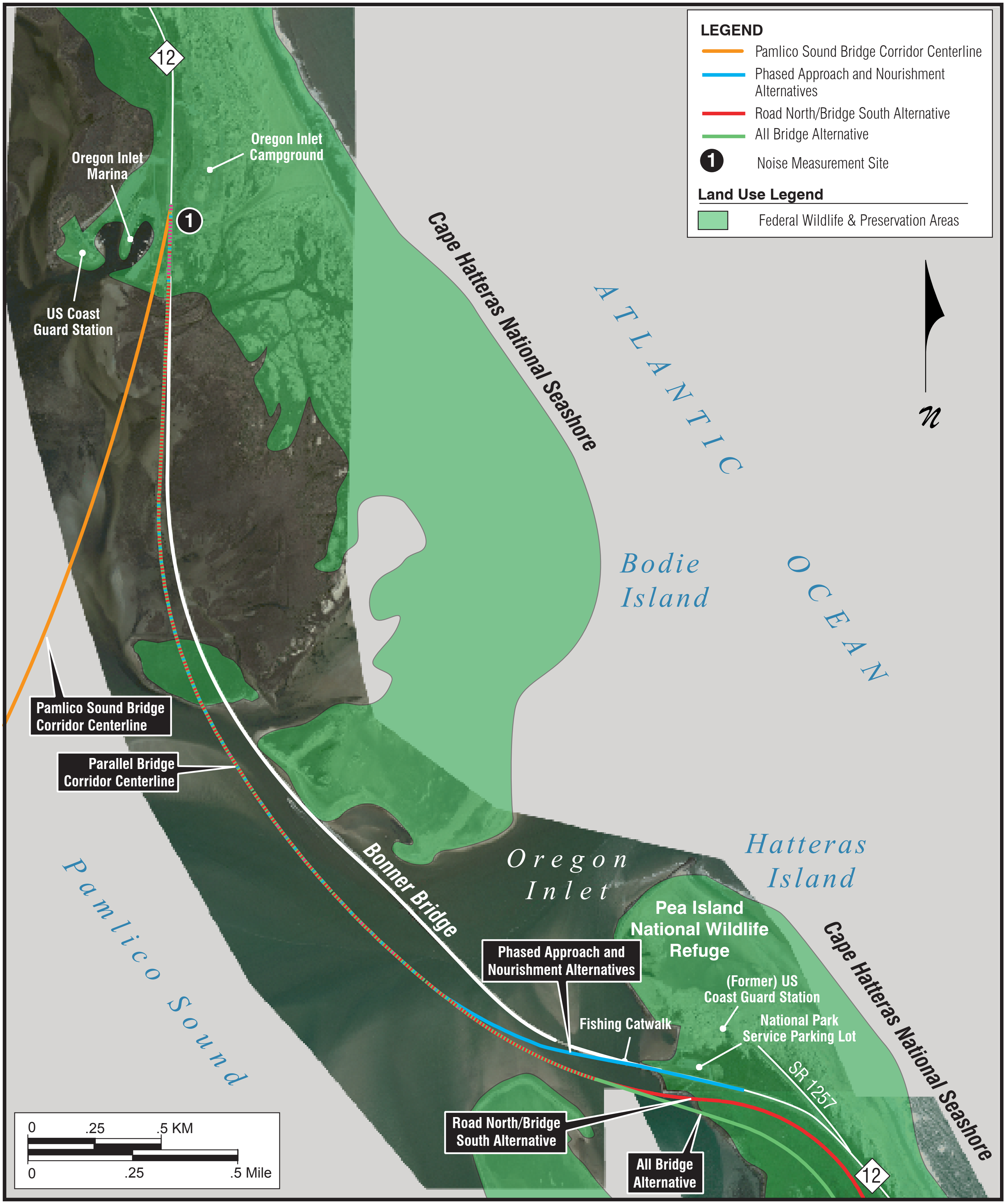
Bodie Island forms the northern shoulder of the Oregon Inlet and is a part of the Cape Hatteras National Seashore (Seashore), which is administered by the National Park Service (NPS). The southern end of Bodie Island, including the Oregon Inlet campground and the Oregon Inlet Marina and Fishing Center, is used for recreation. The active Oregon Inlet US Coast Guard Station is also in this area.

South of Bonner Bridge are Hatteras Island and the Pea Island National Wildlife Refuge (Refuge). The Refuge lies within the boundaries of the Seashore and is administered by the US Fish and Wildlife Service (USFWS). Refuge facilities include wildlife trails, a Visitor Center, a boat ramp, and headquarters buildings. There are catwalks used by fishermen on the south end of Bonner Bridge. A NPS parking lot is also near the south end of the bridge. The USFWS is responsible for wildlife management within the Refuge, and the NPS is responsible for Seashore visitors and visitor facilities. The Refuge consists primarily of barrier island beach, dunes, and coastal wetlands. A (former) US Coast Guard Station building also is at the northern end of Hatteras Island. The Station is listed on the National Register of Historic Places (NRHP).

The community of Rodanthe is at the southern end of the project area. Development has occurred such that there is no clear distinction between Rodanthe and the adjoining communities of Waves and Salvo. Commercial development in Rodanthe exists along NC 12 and consists mostly of small service stations that also serve as general stores, realty agencies, restaurants, and businesses for recreational activities. An automobile junkyard, which is part of an automobile parts business, is located west of NC 12 in Rodanthe. Junked cars were removed from a part of it in 2003 and 2004. Residential development focuses on the oceanfront on the east and Pamlico Sound on the west and primarily consists of large multiple-story, multiple-bedroom rental vacation home neighborhoods; however, there are also scattered neighborhoods of smaller, often one-story, permanent homes. A desalinization plant run by Dare County opened in 1996 in Rodanthe and has eliminated the communities' general dependence on private wells for potable water. The Chicamacomico Life Saving Station, a museum listed on the NRHP, is in Rodanthe on the east side of NC 12. The Rodanthe-Waves-Salvo Community Center is on the west side of NC 12.

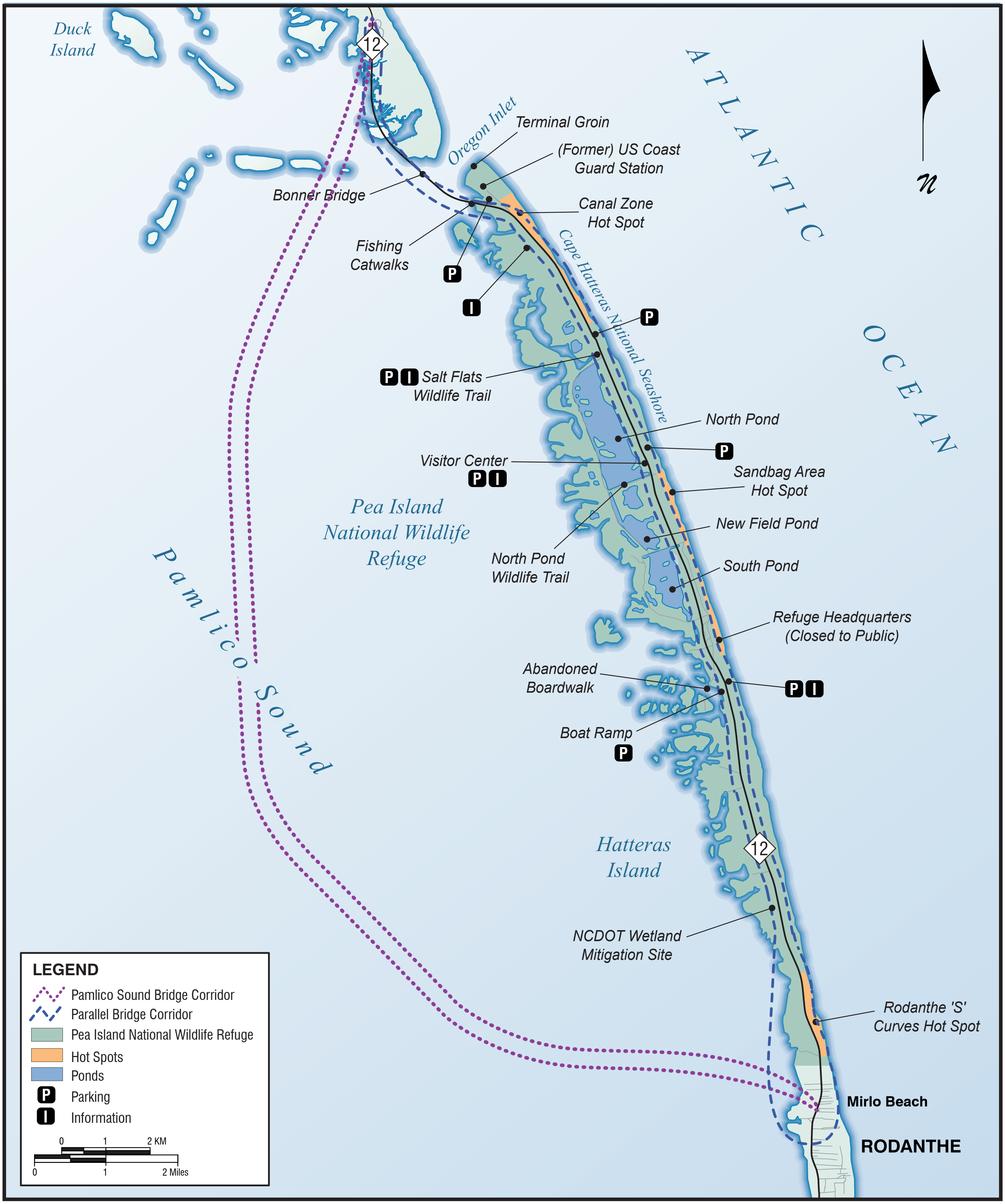
Six other communities are on Hatteras Island south of the project area:

- Waves;
- Salvo;
- Avon;
- Buxton;
- Frisco; and
- Hatteras Village.



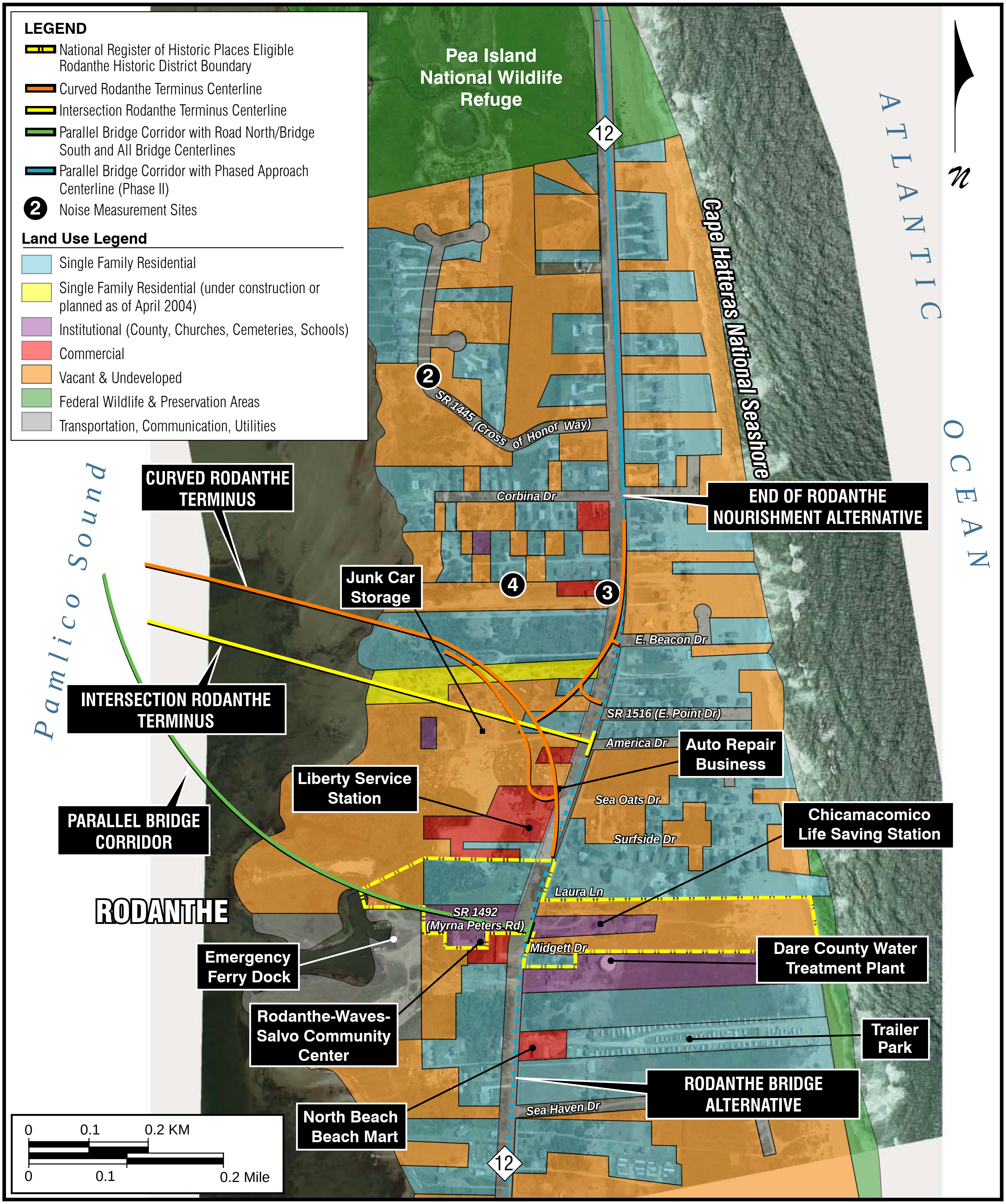
LAND USE OREGON INLET AREA

Figure 3-1a



LAND USE
PEA ISLAND NATIONAL WILDLIFE REFUGE

Figure 3-1b



LAND USE RODANTHE AREA

Figure 3-1c

3.1.3 Land Use Planning

This section describes area plans. The area that would be affected directly by construction of a bridge is within the jurisdiction of the Coastal Area Management Act (CAMA), Dare County's land use plan, the NPS's plan for the Seashore, and the USFWS's Refuge management plan. No new Seashore, Refuge, or US Coast Guard facilities are planned in the project area.

3.1.3.1 Coastal Area Management Act

The Coastal Zone Management Act (CZMA) was passed by Congress in 1972. This legislation relies on voluntary measures and incentives to encourage federal, state, and local partnerships for coastal protection. This program does not require that states develop a coastal protection program, but it provides two specific incentives to encourage participation. First, it provides financial assistance to establish coastal management programs. Second, it assures states that federal actions in the coastal areas of participating states will be consistent with enforceable policies. Essentially, the Act vests considerable authority in the states to implement coastal management programs. In order for federal actions to occur that are not consistent with state policies, the President must determine that the actions are paramount to the interest of the United States.

As a result of the federal Coastal Zone Management Act, the State of North Carolina passed the CAMA in 1974. The CAMA established the North Carolina Coastal Resources Commission (NCCRC). NCCRC is responsible for adopting CAMA's implementing rules. In September 1978, the National Oceanic and Atmospheric Administration (NOAA) approved the North Carolina Coastal Management Program (NCCMP), which is administered by the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Coastal Management (DCM). DCM works to protect, conserve, and manage North Carolina's coastal resources though an integrated program of planning, permitting, education, and research. DCM administers CAMA, the Dredge and Fill Law, and the federal CZMA in the coastal zone, using rules and policies of the NCCRC.

CAMA requires each of the 20 coastal counties in North Carolina to have a local land use plan that meets guidelines established by the NCCRC. Municipalities within coastal counties may establish land use plans independent from their respective counties. The act provides financial assistance to support coastal communities in developing their land use plans. Once a land use plan is certified by NCCRC, DCM uses the plan when making CAMA permit decisions. Proposed development must be consistent with the local land use plan, or DCM will not permit a planned development to be implemented.

In addition to certifying local land use plans, CAMA regulations also require NCCRC to identify certain areas of environmental concern (AECs) and adopt rules and policies for coastal development within those areas. AECs are broadly defined as: the estuarine system, the ocean hazard system, public water supplies, and natural and cultural resources. These are environmentally fragile and important land and water areas that are judged to be of greater-than-local significance. AECs encompass less than 3 percent of the land in the 20 coastal counties covered by CAMA. NCCRC, in cooperation with local governments in the 20-county coastal area, has developed a program of permit review and coordination within these AECs. The intent of the regulatory program is to ensure the compatibility of development with the continued productivity and value of certain critical land and water areas. Such areas—including those under State and federal jurisdiction—are subject to special management controls and development permitting procedures. In addition, a proposed development must comply with the policies and land classifications of the local land use plans and with the local zoning ordinances, subdivision regulations, and other local development regulations to receive a permit to build in CAMA areas.

If an application for a CAMA permit is denied, or if the applicant finds the conditions on a permit unacceptable, the applicant may appeal the permit decision or petition NCCRC for a variance to undertake a project that is prohibited by CAMA or NCCRC's development standards. Applying for a variance means that the applicant recognizes the legal restrictions as valid, but requests an exception to the restrictions because of hardships resulting from unusual conditions. A permit decision must have been received before a variance can be sought. In order to apply for a variance, the applicant must file a petition for a variance with the NCDENR-DCM Director and the State Attorney General's Office on a standard form, which must be accompanied by additional information on the nature of the project and the reasons for requesting a variance. In order to be granted a variance, the applicant must show that:

- Strict application of NCCRC's development standards would result in unnecessary hardships;
- These hardships result from conditions peculiar to the property, such as its location, size or topography;
- The hardships did not result from actions taken by the petitioner; and
- The requested variance is consistent with the spirit, purpose and intent of NCCRC's development standards; will secure public safety and welfare; and will preserve substantial justice.

Dare County has substantial amounts of environmentally fragile areas, and many of these lands have been designated as AECs. The Seashore and the Refuge are protected by an AEC designation. Thus, the entire project area, with the exception of portions of Rodanthe is protected as an AEC. AECs within the project area include all estuarine waters, public trust waters, lands within 75 feet (22.9 meters) of the mean high-water line of those waters, coastal wetlands, inlet hazard areas, and ocean hazard areas.

3.1.3.2 Dare County Land Use Plan

Since the ratification of the CAMA in 1974, Dare County has been required to have a land use plan. The *Dare County Land Use Plan, 2003 Update* (Dare County, 2003) was completed and certified by the NCCRC in July 2003. The previous update was completed in 1994. The *Dare County Land Use Plan* is an evolving document that was first completed in 1976. The review process for the 2003 update included a land use plan survey, which was conducted in 2001 and is summarized in the *2001 Dare County Land Use Plan Update Issue Questionnaire Report of Findings* (Dare County, 2001). The *Dare County Land Use Plan, 2003 Update* provides a set of guidelines to manage growth and development in unincorporated Dare County over the next five years. The land use plan recognizes the priority of the transportation needs in Dare County. Accordingly, it contains specific policies for protecting NC 12 and for working in coordination with the North Carolina Department of Transportation (NCDOT) for a replacement of Bonner Bridge.

One of the goals stated in the *Dare County Land Use Plan, 2003 Update* is to develop facilities for pedestrians and bicyclists that connect its population nodes, providing for travel by means other than the automobile. The land use plan supports the development of bikeways, walkways, and greenways.

Another goal of the plan is to maintain the "coastal village" atmosphere of the County. The plan indicates that new development, particularly national retail franchises and "chains," should maintain the look and feel of the surrounding community. The plan predicts that future development will shift from new development toward redevelopment of land. It supports the re-use of historic residential structures for business or commercial purposes. The plan also predicts that the limited amount of commercial enterprises in the County will move toward serving the needs of year-round residents rather than seasonal visitors.

One of the major changes in the 2003 plan is the relaxation of wetland mitigation requirements. Because of the strict language in the 1994 plan, some public projects in Dare County—such as the new Virginia Dare Bridge—experienced permit review problems. The policy in the 2003 plan is intended to provide more flexibility so as not to preclude projects that would benefit Dare County and its citizens. The 2003 plan also supports beach nourishment to maintain the shoreline.

3.1.3.3 National Park Service Plan

The NPS's *Management Policies* (NPS, 2001) is the basic Service-wide policy document of the NPS. Adherence to these policies is mandatory unless specifically waived or modified by the Secretary of the Interior, the Assistant Secretary of the Interior, or the Director of the NPS. The policies provide guidelines for interpreting the National Park Service Organic Act (16 USC 1) and the 1978 amendment to the National Park System General Authorities Act of 1970 (16 USC 1a-1). These acts prohibit the impairment of park resources and values. *Impairment* in this context refers to an impact that, according to the NPS manager, would harm park resources or values. The resources and values affected, direct and indirect effects, cumulative effects, and the severity, duration and timing of the impact contribute to whether an impact meets this definition. The policies further state that "an impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot reasonably be further mitigated, of an action necessary to preserve or restore the integrity of park resources or values."

The *General Management Plan and Amended Environmental Assessment for Cape Hatteras National Seashore* (NPS, 1984) and the *Draft Revised Statement for Management* (NPS, 1991) serve as the NPS plans for the Seashore. Completion of a new General Management Plan is scheduled for 2010 or 2011. The current two management documents provide for the preservation of the cultural resources and the flora, fauna, and natural physiographic conditions, while allowing appropriate recreational use and public access to the oceanside and soundside shores. Included in these plans are provisions for controlling off-road vehicles, providing for accessible oceanside and soundside sites, allowing natural seashore dynamics to occur, controlling exotic vegetation, preparing natural and cultural resource studies, and cooperating with state and local governments to achieve mutual planning objectives.

In 1973, the NPS—realizing the problems that the managed dune system caused the estuaries—announced a change of desire with respect to management of the Seashore. The NPS no longer attempts to stabilize the Outer Banks artificially but where possible allows natural processes to take their course. In its 1991 *Draft Revised Statement for Management*, the NPS affirmed a desire to manage the Seashore in ways "that support the natural processes of barrier island dynamics..." (NPS, 1991). The NPS's desire was affirmed in part by the USFWS's special use permit issued in 1989 for construction of the terminal groin at the north end of Hatteras Island. The permit states that if, as a result of a required shoreline monitoring program, the "NCDOT determines that the terminal groin and revetment are causing adverse shoreline erosion or migration by interrupting or otherwise affecting natural or normal sand migration, NCDOT will either remove the structures or perform additional beach nourishment." This Final Environmental Impact Statement (FEIS) for replacing Bonner Bridge was prepared with the understanding that this long-term desire has not changed despite recent threats of ocean overwash and shoreline erosion to NC 12 within the Seashore and the NCDOT's ongoing efforts to protect and maintain NC 12.

No new Seashore facilities are planned in the project area. The Seashore's plans focus on restoration and maintenance of existing facilities. The plans also support the construction of bicycle lanes along NC 12.

The *Cape Hatteras National Seashore Long-Range Interpretive Plan* (September, 2007) provides a vision for the future of interpretation at the Seashore. The plan "confirms the foundations of the park: its purpose, significance, interpretive themes, visitor profiles, visitor experience goals, issues and influences, and existing conditions," as well as "recommends actions to be taken over the next five to seven years to improve the park's personal services program and interpretive media, and provides an achievable implementation strategy." The program includes goals related to improving personal services and visitor facilities. None of the visitor facilities referenced for improvement are in the project area.

Planning efforts ongoing in 2008 include an off-road vehicle negotiated rulemaking and management plan, a predator control program for protected species management, and a plan to relocate the Coast Guard Station and Life Saving Station on Bodie Island. Off-road vehicle management, as it relates to protected species, is currently (2008) managed under a Consent Decree (i.e., a judicial ruling that sanctions a voluntary agreement between parties in dispute) that was approved by a US District Court judge on April 30, 2008. The Consent Decree is a compromise solution between the NPS, Dare County, and other groups that wanted beach access preserved for recreational use and environmental groups that wanted beach access banned in order to preserve and protect wildlife. The Consent Decree ends the lawsuit brought by two environmental groups against the NPS in October 2007. The lawsuit challenged the failure of the NPS to have an adequate management plan in place to protect birds, sea turtles, and other natural resources from the impacts of beach driving. The Consent Decree specifies that a final long-term off-road vehicle (ORV) management plan be implemented by the NPS no later than April 1, 2011. Until the final ORV management plan is adopted, the Consent Decree requires the NPS to: take immediate actions to address declining populations of nesting shorebirds and water birds on the Seashore; provide enhanced protection to the threatened piping plover; and provide additional protections to the three species of endangered or threatened sea turtles that nest on the Seashore. It also calls for public education on beach driving and the protection of the region's natural resources while providing opportunities for ORV and pedestrian access.

3.1.3.4 Pea Island National Wildlife Refuge Comprehensive Conservation Plan

The USFWS prepared a *Comprehensive Conservation Plan* (USFWS, 2006) to guide the management of the Refuge. The plan, which was published in September 2006, outlines programs and corresponding resource needs for the proceeding 15 years, as mandated by the National Wildlife Refuge System Improvement Act of 1997. The purpose of the plan is to identify the role that the Refuge will play in support of the mission of the National Wildlife Refuge System and to provide long-term guidance to the Refuge's management programs and activities. The goals of the plan are to:

- Provide a clear statement of direction for the future management of the Refuge;

- Provide Refuge neighbors, visitors, and local, state, and federal government officials with an understanding of the USFWS's management actions on and around the Refuge;

- Ensure that the USFWS's management actions, including land protection and recreational and educational programs, are consistent with the mandates of the National Wildlife Refuge System Improvement Act of 1997;

- Ensure that the management of the Refuge is consistent with federal and state laws; and

- Provide a basis for the development of budget requests for the Refuge's operational, maintenance, and capital improvement needs.

There are several objectives for each of the five plan goals that relate to management of fish and wildlife populations, management of habitat, public use, resource protection, and Refuge administration.

Five alternatives were developed and analyzed in the plan, with public input, to meet Refuge goals and objectives. The five alternatives are:

1. Alternative 1—proposed to maintain the status quo;

2. Alternative 2—proposed moderate program increases;

3. Alternative 3—proposed optimum program increases;

4. Alternative 4—assumed that vehicular access to the Refuge on a paved road would be eliminated from the north but would be maintained from the south as far north as the Refuge's Visitor Center; and

5. Alternative 5—assumed that access to the Refuge on a paved road would be totally eliminated.

The planning team selected Alternative 2 as its preferred alternative. It advances the Refuge program considerably, and was viewed as more realistic than Alternative 3 in terms of expected staffing levels to conduct proposed programs. Alternative 2 assumes a bridge over Oregon Inlet and a maintained road in the Refuge pending NCDOT's decisions on the replacement of Bonner Bridge and the long-term maintenance of NC 12.

The general goals of the plan's preferred alternative are:

> "*FISH AND WILDLIFE POPULATIONS*: Protect, maintain, and enhance healthy and viable populations of indigenous migratory birds, wildlife, fish, and plants including federal and state threatened and endangered species.
>
> *HABITAT*: Restore, maintain, and enhance the health and biodiversity of barrier island upland and wetland habitats to ensure optimum ecological productivity.
>
> *PUBLIC USE*: Provide the public with safe, quality wildlife-dependent recreational and educational opportunities that focus on barrier island wildlife and habitats of the refuge.

Continue to participate in local efforts to sustain economic health through nature-based tourism.

RESOURCE PROTECTION: Protect refuge resources by limiting the adverse impacts of human activities and development.

ADMINISTRATION: Acquire and manage adequate funding, human resources, facilities, equipment, and infrastructure to accomplish all refuge goals."

Specific goals, objectives, and strategies are included in the plan for each of the above general goals. They reflect the Refuge's commitment to achieving: the mandates of the National Wildlife Refuge System Improvement Act of 1997; the mission of the National Wildlife Refuge System; the North American Waterfowl Management Plan; and the purpose and vision for the Refuge. Depending upon the availability of funds and staff, the Refuge intends to accomplish their goals, objectives, and strategies during the next 15 years (2021).

General management directions under the Refuge's preferred alternative include:

- Protecting, maintaining, restoring, and enhancing Refuge lands for resident wildlife, waterfowl, migratory nongame birds, and threatened and endangered species.

- Initiation of extensive wildlife and plant census and inventory activities to develop the baseline biological information needed to implement management programs on the Refuge.

- Direction of management actions towards achieving the Refuge's primary purposes: (1) preserving nesting and migratory habitat for neotropical migratory songbirds; and (2) helping to meet the habitat conservation goals of the North American Waterfowl Management Plan, as well as managing the Refuge to contribute to other national, regional, and state goals for protecting and restoring populations of wildlife.

- Implementing active habitat management through forest management and moist-soil unit management designed to provide a historically diverse complex of habitats that meets the foraging, resting, and breeding requirements for a variety of species.

- Continuing to seek acquisition of all in-holdings from willing sellers within the present acquisition boundary.

- Developing and implementing a habitat management plan designed to maintain the present spatially and specifically diverse mosaic of habitats with little negative effect to wildlife objectives.

- Providing opportunities for quality wildlife-dependent recreation activities, including maintaining the interior and exterior access roads to provide all-weather vehicular access to a broad segment of the public.

- Permitting of hiking to support wildlife-dependent recreation to the extent that these opportunities do not substantially interfere with or detract from the achievement of wildlife conservation.

- Providing wildlife observation sites and platforms; interpretive trails, boardwalks, and kiosks; and restrooms at specific sites to allow for fully accessible environmental education and interpretation programs.

- Providing for quality fishing and hunting programs, consistent with sound biological principles with sufficient focus on migratory bird needs for resting, loafing, feeding, and courting requirements, including permitting fishing along the banks of streams and ditches and from boats.

- Continue implementing an environmental education plan, incorporating an aggressive and proactive promotion of both on- and off-site programs.

Although Alternative 2 was selected as the Refuge's preferred alternative, the Refuge evaluated Alternatives 4 and 5 in the event that the NCDOT would build the Bonner Bridge replacement in the Pamlico Sound Bridge Corridor. The plan notes that the NCDOT is considering Bonner Bridge's replacement, but has not yet made a decision. The plan also notes that the "status quo" alternative in the plan should not be interpreted in any way as a statement that the USFWS prefers Bonner Bridge or NC 12 remain where they are located currently. The alternatives merely reflect planning strategies with the road and bridge located in their current positions. The plan states that if paved road access to the Refuge is altered or eliminated as a result of NCDOT's replacement of Bonner Bridge, the plan may require revision to reflect new methods of access.

3.1.4 Zoning

Dare County is responsible for zoning in the communities of Hatteras Island and other unincorporated areas of the County. The primary focus of the current zoning code is on building heights and setbacks, etc., with no specific use restriction in any particular location. The County has plans to create use-specific zoning maps for areas not zoned or minimally zoned. Currently, Rodanthe is zoned S-1; this permits all uses, including multifamily residential. The rest of the project area is not within the jurisdiction of Dare County and therefore is not zoned.

The *Dare County Land Use Plan* has a land classification system that includes six of the seven different land classifications identified in CAMA guidelines, as well as two sub-classes. Rodanthe is classified as *Limited Transition*. Limited Transition indicates that an area is suitable for lower-density development because of its geographic remoteness. Land in the project area not within Rodanthe is classified as *Conservation*. The Conservation classification is intended to provide for the effective long-term management and protection of significant, limited, or irreplaceable areas. This classification includes, but is not limited to, all CAMA AECs.

3.1.5 Coastal Barrier Resources System

The Coastal Barrier Resources Act (CBRA) withdraws federal assistance for infrastructure in areas deemed "undeveloped" in 1982. Coastal Barrier Resources System (CBRS) Unit L03 is on Hatteras Island. It is divided into two parts, one near Avon and one near Buxton. The federal government no longer can provide financial assistance for new infrastructure in CBRS areas. Specifically, the act prohibits federal expenditures for buildings, airports, roads, bridges, causeways, piers, jetties, seawalls, water supply systems, and utility lines within the CBRS.

3.1.6 Population Characteristics

Population figures for Dare County and the communities on Hatteras Island are shown in Table 3-1. Population growth in Dare County has occurred at a faster rate than the State of North Carolina's growth. According to the State Data Center, the 2010 population projection for Dare County is 36,681, which represents growth of 22.4 percent from 2000 to 2010. This projected growth rate remains slightly higher than the projected statewide growth of 17.9 percent (based on a 2010 population projection for North Carolina of 9,491,372).

Table 3-1. Permanent Population

Permanent Population	Hatteras Island	Dare County	North Carolina
1990	3,814	22,746	6,628,637
2000	4,001	29,967	8,049,313
Percentage Change	4.9%	31.7%	21.4%

Source: US Census of Population, 1990 and 2000.

Dare County has a large nighttime seasonal population that can be as high as 126,000, 4.2 times the permanent population. The daytime seasonal population can be as high as 232,000 (*Outer Banks Economic and Demographic Package*, Outer Banks Chamber of Commerce, 2003). Although the seasonal influx is highest during the summer months (June to August), more visitors are arriving as early as Easter weekend and as late as Thanksgiving weekend. Representatives of the Dare County Planning Department postulate that the growth of permanent residents and peak visitation levels in Dare County and on Hatteras Island will continue into the future.

As shown in Table 3-2, the age distribution across population cohorts generally is consistent between Hatteras Island, Dare County, and the State of North Carolina. The median age for Hatteras Island is higher than the county and state as a whole, as is the percent of persons aged 65 or above.

Table 3-2. Age Distribution

Age in Years	2000		
	Hatteras Island	Dare County	North Carolina
0 to 18	18.2%	22.4%	25.8%
19 to 64	65.3%	63.8%	62.2%
65 or above	16.6%	13.8%	12.0%
Median Age	42.9	40.4	35.3

Source: US Census of Population, 2000.

Income, poverty, and minority characteristics of the project area compared with Dare County as a whole and the State of North Carolina are discussed in Section 3.2.

3.1.7 Economics

3.1.7.1 Permanent Housing Values

The 2000 US Census found that the median permanent home value on Hatteras Island was $139,180, compared with $137,200 in Dare County as a whole and $108,300 in the State of North Carolina. The median rent paid by the permanent population was $619 per month on Hatteras Island, $638 per month in Dare County, and $548 per month in the State. These statistics indicate that the cost of housing for the permanent residents of Hatteras Island is greater than that for the state as a whole. The housing costs on Hatteras Island and in Dare County are comparable.

3.1.7.2 Labor Force

Dare County's economy has been, and continues to be, heavily dependent on travel-related industries. The largest industries in 2000 were retail trade, 23.3 percent of earnings; services, 20.2 percent; and construction, 11.5 percent. In 1990, the largest industries were services, 22.7 percent of earnings; retail trade, 22.4 percent; and construction, 17.2 percent. The fastest growing sector was finance, insurance, and real estate; it increased at an average annual rate of 14.5 percent between 1990 and 2000.

The growing dependence of Dare County on travel-related industries is further exemplified by the increasing percentage of the labor force involved in employment related to that sector. Table 3-3 highlights the county's four primary labor force distributions as compared to the state's and the nation's in 1980, 1990, and 2000. Dare County's employment is not as diversified as those of the state and the nation. It is highly dependent on jobs in these four categories, which comprised more than 75 percent of the total work force in the year 2000.

Table 3-3. Labor Force Distribution

	Dare County			North Carolina			United States		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Construction	8%	13%	11%	5%	6%	7%	5%	5%	6%
Retail Trade	27%	29%	28%	14%	16%	16%	16%	16%	16%
Financial/Insurance/ Real Estate	12%	11%	14%	6%	6%	6%	8%	8%	8%
Services	21%	23%	24%	16%	21%	27%	22%	28%	32%
TOTAL	**68%**	**76%**	**77%**	**41%**	**49%**	**56%**	**51%**	**57%**	**62%**

Source: Bureau of Economic Analysis, April 2003.

3.1.7.3 Demand for Unimproved Land

Growth in the travel-related industries has been driven by growth in the number of summer visitors, summer and vacation cottage construction, commercial growth, and new permanent residents. Commercial growth has included increases in the number of restaurants, retail stores, rental home properties, motels, and hotels. Table 3-4 uses land sales data from the Dare County Tax Department to highlight the growth in demand for (unimproved) land from 1996 to 2002.

Table 3-4. Land Sales in Dare County

	1996	1997	1998	1999	2000	2001	2002
Number of Land Parcels Sold Annually	6,175	5,333	7,163	6,028	6,442	6,514	7,478
Value of Land Sold (in 1996 thousands of dollars)	$240,617	$242,426	$416,102	$427,040	$542,345	$653,007	$1,031,535
Percent Change in Sales	N/A	0.8%	71.6%	2.6%	27.0%	20.4%	58.0%

Source: Dare County Tax Department

3.1.7.4 Dare County Economic Indicators

Table 3-5 summarizes five key current economic indicators for Dare County, including building permit values, land transfer tax, gross retail sales, gross occupancy receipts, and food/beverage sales. As shown in Table 3-5, most of these series indicate rapid current growth. In addition, there is a high degree of seasonal variation in most of these figures reflecting the area's dependence on tourism.

Table 3-5. Dare County Economic Indicators

	2003 (Total)	2004 (Total)	2003-2004 Percent Change	February 2004	August 2004
Building Permit Values	$295,600,000	$342,200,000	15.5%	$26,700,000	$18,500,000
Land Transfer Tax	$10,400,000	$14,500,000	39.4%	$700,000	$1,200,000
Gross Retail Sales	$1,258,000,000	$1,390,600,000	10.5%	$55,100,000	$238,000,000
Gross Occupancy Receipts	$256,700,000	$259,600,000	1.1%	$1,400,000	$68,600,000
Food/Beverage Sales	$153,600,000	$166,000,000	8.1%	$5,500,000	$25,900,000

Source: Outer Banks Chamber of Commerce

3.1.7.5 Dare County Tax Structure

After a property revaluation in 2005, Dare County's base real estate tax rate is 0.25 per $100 of assessed value, with additional charges for fire, sanitation, and community services. Prior to the revaluation, the rate was 0.54 per $100. Dare County's effective property tax rate (the rate of tax as a percentage of market value) is $0.36. Incorporated towns also have their own additional tax rates, as do unincorporated areas.

Other state and local taxes within Dare County include:

- 1 percent Land Transfer Tax;
- 2 percent Retail Food Sales Tax;

- 5 percent Occupancy Tax, comprised of:
  - 3 percent Room Occupancy Tax
  - 1 percent Room Occupancy and Tourism Development Tax
  - 1 percent Room Occupancy and Tourism Development Tax for Beach Nourishment;
- 1 percent Prepared Food and Beverage Tax; and
- 7 percent North Carolina State Sales Tax.

There are specific apportionment formulas for the distribution of the Occupancy Tax**.**

3.1.7.6 Hatteras Island Economy

Little formal data are available for just the Hatteras Island economy. In general, Hatteras Island is dominated by the Refuge, beach and recreational related activities, small businesses along NC 12, tourist cottages and motels, and large homes built as summer or seasonal vacation homes. There are about 64 businesses in the communities of Rodanthe, Waves, and Salvo, ranging from gas stations/convenience stores to campgrounds and realty agencies. Most of these businesses are primarily only open during the tourist months, from April to October.

According to information obtained from the Outer Banks Chamber of Commerce, about 26 percent of the housing value for Dare County is on Hatteras Island, with 29 percent of the occupancy receipts (from rental cottages and motels) also collected on Hatteras Island. In addition, it is estimated that approximately 25 percent of the total economic activity of Dare County is derived from Hatteras Island. (Personal communication, June 20, 2005, John Bone, Outer Banks Chamber of Commerce, Kill Devil Hills, NC.)

3.1.8 Community Services

3.1.8.1 Emergency Medical Service

Dare County provides emergency medical services (EMS) for Hatteras Island. The main offices are in Kill Devil Hills, with additional EMS stations in Nags Head, Southern Shores, Manteo, and Mann's Harbor. There also are EMS stations, each with two ambulances and crews, on Hatteras Island in Rodanthe and in the Buxton/Frisco area. Dare County maintains a helicopter in Manteo for transporting unstable cardiac and obstetric patients. Hatteras Island has doctor's offices in Avon and Hatteras Village that also serve as emergency clinics. Depending on the emergency and its location, ambulance destinations may be the two island emergency clinics or the Outer Banks Hospital in Kitty Hawk, which opened in March 2002. Before the new hospital opened, emergencies also were routed to hospitals in Elizabeth City, North Carolina; Norfolk, Virginia; and Chesapeake, Virginia.

3.1.8.2 Police Department

Hatteras Island is under the jurisdiction of the Dare County Sheriff's Department. The Dare County Sheriff's Department has approximately 57 deputies. The main office is in Manteo along with the county courthouse, magistrate office, and jail. In addition to the satellite offices in Kill Devil Hills and Nags Head, there also is a satellite in Hatteras Village at the southern end of Hatteras Island.

The Sheriff's Department assists the NPS officers who work along the beaches and in the national parks of Dare County. Other law enforcement officials in Dare County are officers of the North Carolina Highway Patrol, who focus their activities primarily along the roads in the unincorporated portions of the County.

3.1.8.3 Fire Service

Dare County is divided into 15 fire districts, including four serving municipalities and the Hatteras Island Rescue Squad. The districts on Hatteras Island include Rodanthe/Waves/Salvo, Chicamacomico, Frisco, Buxton, Avon, and Hatteras. All of the fire districts have signed mutual aid agreements with neighboring fire departments. Stations on Hatteras Island have between four and six officers and an average of 20 volunteer firefighters.

3.1.8.4 Schools

Public schools in Dare County are consolidated. Six separate school facilities serve the county. Cape Hatteras Elementary (grades K–5) and Cape Hatteras Secondary (grades 6–12) serve all of Hatteras Island. In 2002, Cape Hatteras Elementary had 312 students and a preferred capacity of 346 students, while Cape Hatteras Secondary had 358 students and a preferred capacity of 346 students. The total student population on Hatteras Island is expected to increase from 670 students to 710 by 2012. No school buses cross Bonner Bridge on a regularly scheduled daily route. Children do not have to leave Hatteras Island to attend school, although many extracurricular activities, particularly sports competitions, involve off-island travel.

3.1.8.5 Rodanthe-Waves-Salvo Community Center

The Rodanthe-Waves-Salvo (RWS) Community Center is on the south side of Myrna Peters Road (SR 1492) in Rodanthe, just east of the emergency ferry dock (see Figure 3-1c). The RWS Community Center is financed by property taxes collected from property owners in the Rodanthe, Waves, and Salvo communities. Dare County appoints a Board of Directors to oversee operations of the facility. Use of the facility is free to property owners in Rodanthe, Waves, and Salvo, and it is also rented to users from outside these communities (the rental fee pays for the cost of cleaning the facility). The facility is primarily used for events like church and civic association meetings, birthday parties, historical association meetings, and fundraisers. There is also a small outside basketball court that is maintained by Dare County. The Community Center's Assistant Director maintains a calendar of meetings scheduled for the facility. (Personal communication, July 13, 2005, Susan Gray, Assistant Director RWS Community Center, Rodanthe, NC.)

3.1.8.6 Water

Water consumers in Dare County receive water from the Town of Kill Devil Hills, the Town of Nags Head, the Dare County Regional Water System, or from private wells. The Cape Hatteras Water Association, established in 1965 as private and non-profit, previously supplied water for the southern communities of Hatteras Island. However, restrictive legislation hindered the association's ability to obtain sufficient freshwater supplies. The association was acquired in 1997 by the Dare County Regional Water System. The combined public water supply storage capacity for the county currently exceeds 24 million gallons (90.9 million liters).

The water supply in Rodanthe is provided by the Dare County, Rodanthe, Waves, and Salvo Reverse Osmosis Drinking Water Plant. Completed in 1996, the plant feeds approximately 22 miles (32.5 kilometers) of distribution pipe. Prior to the completion of the plant, the majority of residents obtained their water from individual, unreliable, and untested private wells. Upon completion of the plant, a majority of the residents elected to receive their water supply from the public facility.

At the southern tip of Bodie Island, the water supply is provided by the Town of Nags Head. A water main exists near the northern termini of the replacement bridge corridor alternatives at the Oregon Inlet Marina and Fishing Center. The water main crosses NC 12 north of Oregon Inlet and provides service to the nearby Seashore campground.

3.1.8.7 Sewer Service

In Dare County, the treatment and disposal of sewage is handled by one of three methods:

1. A municipal sewage treatment plant in Manteo;

2. Septic tanks; or

3. Package sewage treatment plants.

For the unincorporated parts of Dare County (including Hatteras Island), conventional septic tanks comprise the most common method of sewage disposal.

3.1.8.8 Solid Waste Disposal

Solid waste collection from both residential and commercial properties in Dare County is handled by local governments. Dare County contracts with Kitty Hawk and Southern Shores for solid waste pick-up in these two towns. The County also provides services to the unincorporated areas, including Hatteras Island and Ocracoke Island. Dare County owns and operates transfer stations in Buxton and Manteo. In 1994, the County entered a regional solid-waste authority; all solid waste from Dare County now is transported to a regional landfill in Bertie County, North Carolina.

3.1.8.9 Power and Telephone

Bonner Bridge carries electricity and telephone cables to Hatteras Island. These cables are the sole source of service on the island. In addition to the electrical cables servicing facilities on Hatteras Island, low-voltage submarine cables service the residents of Ocracoke Island.

Sprint Communications is responsible for all telecommunication service near the project area. Facilities previously operated by Carolina Telephone and United Telephone were acquired by Sprint and are utilized as part of the active network. Both copper and fiber optic lines are buried along the shoulders of NC 12 south of Bonner Bridge. The fiber optic lines are attached to the east side of Bonner Bridge and are buried along the east side of NC 12 north of the bridge. The copper lines terminate south of Bonner Bridge.

North Carolina Power supplies electricity to the north side of Bonner Bridge, and Cape Hatteras Electric Membership Corporation supplies the south side. The portion of the existing transmission line attached to Bonner Bridge, the portion north of Oregon Inlet, and the portion between Oregon Inlet and Buxton were upgraded in 1995. They are the property of the Cape Hatteras Electric Membership Corporation. The lines attached to Bonner Bridge were upgraded to three ducts, and hung from the east side of the structure. The old lines on the west side of the structure were abandoned. Also in 1995, approximately 1,800 feet (548.6 meters) of transmission line on Bodie Island just north of Bonner Bridge were placed underground on a new 15-foot (4.6-meter) right-of-way on the east side of NC 12. The east side of the highway was chosen to minimize interference with construction of the then-proposed replacement bridge.

A new riser/breaker station was constructed to accommodate this underground transmission line. This station serves as the location of the transfer of the Electric Membership's lines to those of North Carolina Power. This station is on the west side of NC 12, north of the marina and west of the campground. The existing riser station on the north end of Hatteras Island was rebuilt. The riser station is on the west side of NC 12, as are the above ground lines through the Refuge. (Personal communication, May 29, 2003, Jim Kinghorn, Cape Hatteras Electric Membership Corporation, Buxton, NC.)

3.1.8.10 Cable Service

Charter Communications is the primary provider of cable service technology to the Dare County coastal community. Currently, their access to Hatteras Island is limited, as Bonner Bridge cannot accommodate the additional service lines. The communication company has deemed it impractical to provide lines to the island through other means. Thus, microwave transmission and a satellite farm in Waves are used to service the communities of Hatteras Island. Currently service is provided to approximately 3,000 customers. (Personal communication, May 29, 2003, George Weaver, Charter Communications, Nags Head, NC.)

3.1.8.11 Emergency Ferry Dock

A NCDOT emergency ferry dock is in Rodanthe. Its purpose is to move people and goods between the mainland at Stumpy Point and Hatteras Island should Bonner Bridge be unavailable for use. The channel (Chicamacomico) serving the dock on Hatteras Island extends west-northwest from the dock just south of the Pamlico Sound Bridge Corridor (see Figure 2-11).

3.1.9 Oregon Inlet Users

3.1.9.1 Commercial

Commercial use of Oregon Inlet is best estimated by the NCDENR's Division of Marine Fisheries' (DMF) trip ticket program. This program, established in 1994, allows the DMF to determine how many trips are made in a specific fishery. The number of commercial boat landings (i.e., when a commercial boat loaded with fish reaches the shore or a structure attached to the shore) between fiscal years (FY) 2000 and 2003 ranged from 518 to 534 per year. In FY 1999, there were only 375 commercial boat landings, a lesser amount because of the fall hurricanes of 1999. The number of commercial vessel trips (commercial vessel leaving the dock and returning) at Oregon Inlet between FY 2000 and FY 2003 ranged between 6,769 and 7,876 per year. Only 4,482 trips were taken in 1999. These figures represent vessels licensed in North Carolina as well as transient vessels whose home ports are in other states. They also include full- and part-time commercial fishermen. Fish and shellfish harvests are described in Section 3.7.6.2.

3.1.9.2 Recreational

The recreational fleet using Oregon Inlet represents more annual trips than the commercial fleet. Vessels categorized as recreational include charter fishing boats, head-boats, and private recreational crafts that either are moored in the area or brought in from other locations.

The number of recreational vessels using Oregon Inlet varies from year to year and is difficult to determine. The 1984 US Army Corps of Engineers (USACE) economic analysis (USACE, 1984), however, did identify the local recreational fleet and attempted to determine the size of the fleet brought to the area through a recreational boating questionnaire. The data collected through that study were supplemented by the 1985 "Ship-Watch" program conducted by the USACE and by 1990 inquiries at local marinas. The 1990 study estimated that the recreational fleet utilizing Oregon Inlet is in excess of 2,200 vessels, representing approximately 34,000 vessel one-way trips per year through Oregon Inlet. More recent data are not available.

The amount of total vessel utilization of Oregon Inlet is expected to remain generally stable with only a slight annual increase as a direct result of continued growth in recreational vessel usage.

The USACE maintains a channel that passes under Bonner Bridge, a channel to the Oregon Inlet Marina and Fishing Center, and other channels for Pamlico Sound users. For the charter fishing boats and other recreational boats operating out of the fishing center, however, a natural channel known as Bridge to Old House Channel (or known more commonly as “the crack”) offers a more direct route between the fishing center and Bonner Bridge’s navigation spans (see Figure 2-11).

3.1.9.3 Vessel Size

The typical size of vessels using Oregon Inlet in the future is not expected to exceed that of the largest fishing boats or recreational vessels using Oregon Inlet today. The best available data on vessel size were provided by the US Coast Guard Station at Oregon Inlet. (Personal communication, September 24, 2003, Boatswain Mate 1 Shane Heagy, US Coast Guard.) The largest commercial or recreational vessel currently utilizing Oregon Inlet is an occasional 100-foot (30.5-meter) motor yacht. The largest commercial vessels in use in the Oregon Inlet are 80- to 85-foot (24.4- to 25.9-meter) steel haul trawlers. These vessels utilize Oregon Inlet daily over four months in the wintertime. According to US Coast Guard personnel, utilization of Oregon Inlet by vessels in excess of this size is rare because of the unpredictable channel locations and the shifting shoals. Such vessels generally are confined to dredge and construction barges.

3.1.10 Underground Storage Tanks and Hazardous Waste

A geo-environmental impact evaluation was conducted within Pamlico Sound Bridge Corridor project area in June 2003. A second impact evaluation was conducted of the project area, including the Refuge, in July 2005. A third impact evaluation was conducted in Rodanthe within the corridor for the Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) in October 2007. The main purpose of these investigations was to identify properties within the project area that might contain hazardous materials and result in future environmental liability if acquired. These hazards may include, but are not limited to underground storage tanks (UST), hazardous waste sites, regulated landfills, and unregulated dumpsites. Field reconnaissance surveys were conducted in the project area in association with all three impact evaluations. In addition, file searches of appropriate environmental agencies were conducted to identify any known problem sites.

Based on searches of a geographic information systems database and the field reconnaissance surveys, no potential Resource Conservation and Recovery Act (RCRA) or Comprehensive Environmental Response and Liability Act (CERCLA) sites were identified within the project area.

On Hatteras Island at Rodanthe, there are two gas stations/convenience stores with active USTs within the project area. The North Beach Mart and Campground is on the east side of NC 12 approximately 300 feet (91.4 meters) north of Sea Haven Drive (see Figure 3-1c). The front of the canopied pump island is 47 feet (14.3 meters) from the centerline of NC 12. The October 2007 impact evaluation indicated that there are four USTs in use at this site. The current UST area is north of the store and pump island, and set back 58 feet (17.7 meters) from NC 12. The file search for this property indicated that six USTs were removed in 1992; however, the October 2007 impact evaluation stated that no monitoring wells were noted on the property, and there is no other evidence of USTs or UST removal.

The Liberty service station is the second gas station/convenience store with active USTs in Rodanthe. The Liberty service station is on the west side of NC 12 approximately 230 feet (70.1 meters) south of Sea Oats Drive (see Figure 3-1c). The front of the canopied pump islands is 45 feet (13.7 meters) from the centerline of NC 12, which is within the existing 100-foot (30.5-meter) right-of-way on this section of NC 12. The October 2007 impact evaluation indicated that there are four USTs in use at the site. The current UST area is south of the pump islands and set back 75 feet (22.9 meters) from NC 12. The file search for this property indicated that five USTs were removed in 1988 and four more tanks were removed in 1994; however, the October 2007 impact evaluation stated that no monitoring wells were noted on the property and there is no other evidence of USTs or UST removal.

A garage/auto repair business and automobile junkyard is also in the project area on Hatteras Island (see Figure 3-1c). The business is just north of the Liberty service station and behind a group of small strip shops along NC 12. According to the property owner, all USTs were removed. There is one above ground storage tank (AST) used to store waste oil on the property. The junkyard contains old automobiles, automobile parts, and boats, although junked cars were removed from a part of the area between 2003 and 2004. Minor staining of the ground has occurred from fluids leaking from the junked vehicles and parts. According to the property owner, in the past there were various other repair shops on the property, and other areas of the larger property were also used as a junkyard.

On Bodie Island, the Oregon Inlet Marina and Fishing Center has four ASTs currently in use. The ASTs are approximately 380 feet (115.8 meters) from the centerline of NC 12. According to the NCDENR's Division of Water Quality (DWQ), Groundwater Planning Unit, there was a groundwater incident reported at the Marina in 1990 (Incident No. 6046). Several monitoring wells were noted at the site, and it appears that the site is currently under remediation. None of the current tanks are within the area directly affected by the two proposed corridors.

A Preliminary Site Assessment (PSA) was conducted for the Liberty service station/convenience store, the automotive repair facility, and the automobile junkyard for the Pamlico Sound Bridge Corridor (Catlin Engineers and Scientists, December 2003). The PSA included soil and groundwater sampling. The testing of the soil samples did not reveal the presence of any compound in concentrations above the lowest corresponding Maximum Soil Concentration allowed by the NCDENR. Minor soil contamination from Diesel Range Organics (diesel fuel and associated compounds) was found within the area directly affected by the two Rodanthe Terminus Options for the Pamlico Sound Bridge Corridor defined in Section 2.9.4. The contaminated soil samples were taken from two borings in the northern part of the junkyard. However, at 11 and 12 parts per million (ppm), the contamination is below the regulatory limit for surface releases of 40 ppm. Groundwater contamination was not detected in excess of the laboratory reporting (detection) limits.

3.1.11 Farmland

The US Soil Conservation Service (now the US Natural Resources Conservation Service [NRCS]), in a June 19, 1990, letter (see Appendix A), determined that there are no important farmland soils in the project area. The NRCS re-confirmed this determination on May 20, 2003. (Personal communication, Mike Hinton, NRCS.)

3.2 Environmental Justice

3.2.1 Executive Order 12898

Executive Order 12898, issued in February 1994, requires federal agencies to identify and address any disproportionate health or environmental impacts of their programs, policies, and activities on minority or low-income communities. It also calls for the meaningful involvement of these populations in project planning.

Minority is defined as Black, American Indian or Alaskan Native, Hispanic, or Asian-American populations. *Low-income* is defined as a household income at or below the US Department of Health and Human Services poverty guidelines (Federal Highway Administration [FHWA], December 1998). A minority population or a low-income population is any readily identifiable group of minority or low-income persons who live in geographic proximity, and (if circumstances warrant) geographically dispersed/transient persons who would be similarly affected by a proposed FHWA program, policy, or activity.

3.2.2 Concentrations of Minority and Low-Income Populations

Block group data from the 2000 US Census were used to help identify concentrations of minority and low-income populations in the project area. Table 3-6 shows racial and poverty characteristics in the project area (Rodanthe/Waves/Salvo block group), Hatteras Island, Dare County, and the State of North Carolina. Minority and low-income households make up a smaller proportion of the population on Hatteras Island than in Dare County and the State of North Carolina. In the Rodanthe/Waves/Salvo area, minority and low-income households make up a larger part of the population than Hatteras Island as a whole and, in the case of low-income households, a larger part of the population than Dare County as a whole. During field surveys in the project area and interviews with county officials, it was concluded that low-income households most likely are concentrated in several mobile home and trailer parks in the Rodanthe/Waves/Salvo area. One such area is east of NC 12 in the project area and is shown in Figure 3-1c. No particular minority neighborhoods were identified.

3.3 Visual Characteristics

The project area can be divided into three landscape units or geographic sections for analysis of both existing visual character and potential visual impacts resulting from the proposed project. These geographic sections are the Rodanthe area, the Pea Island National Wildlife Refuge area, and the Oregon Inlet area. The three units are described below. For each unit, existing visual character, visual quality, visually sensitive resources, and viewers are described.

Table 3-6. Racial and Poverty Characteristics (Percent of Population), 2000

	Rodanthe/ Waves/ Salvo		Hatteras Island		Dare County		North Carolina	
Racial Characteristics								
Total Population	1,600		4,001		29,967		8,049,313	
White	1,545	96.5%	3,918	97.8%	28,393	94.7%	5,804,656	72.1%
Black	3	0.2%	7	0.2%	797	2.7%	1,737,545	21.6%
Other Racial Minorities	52	3.3%	76	2.0%	777	2.6%	507,112	6.3%
Hispanic	14	0.9%	31	0.7%	666	2.2%	378,963	4.7%
Total Minority[1]	62	3.9%	100	2.5%	1,939	6.5%	2,402,158	29.8%
Percent Below the Poverty Level								
	185	11.1%	296	7.5%	2,381	8.0%	958,667	12.3%

[1] Total minority is the sum of all persons other than white-non Hispanic.
Source: US Census of Population, 2000.

3.3.1 Rodanthe

3.3.1.1 Visual Character

The project area includes a northern area of Rodanthe (see photograph 1 in Figure 3-2). This area is characterized by rural coastal development that is a mixture of housing types and styles and small business commercial development. Residential development includes older one- and two-story single-family residences, trailers, and newer multi-story large beach homes.

Commercial developments are typical in appearance of the type and size found in small coastal towns. Businesses include the Liberty service station, an auto repair shop with a used car storage area, and a gift shop. An auto junkyard is between the businesses along NC 12 and Pamlico Sound. NC 12 provides the main access to the community, with east-west side streets providing access to residences on both ocean and sound sides. Homes and businesses typically have maintained grass yards. Closer to the sound, vegetation progresses generally from shrub thicket to low marsh grasses. The terrain is generally flat. Panoramic views of Pamlico Sound can be seen from the shoreline. The view is of the open water with no land visible when looking straight out into Pamlico Sound (see photograph 2 in Figure 3-2).

3.3.1.2 Visual Quality

The view of Pamlico Sound conveys visual excellence. Although other views in this portion of the project area generally are aesthetically pleasing, the components of those parts of the existing landscape do not combine to create striking characteristics. There are no officially designated scenic areas to be protected in this area.

PHOTO 1: Liberty Service Station (formerly Texaco) on NC 12 in Rodanthe

PHOTO 2: Pamlico Sound viewed from Rodanthe

PHOTO 3: Bonner Bridge viewed from Hatteras Island near the Terminal Groin

VISUAL CHARACTERISTICS

Figure 3-2

3.3.1.3 Visually Sensitive Resources

The Chicamacomico Life Saving Station in Rodanthe is on the NRHP. This resource has views of NC 12 and the other land uses along both NC 12 and the sound from its upper stories. Visually sensitive resources are the homes in the area, particularly those that line Pamlico Sound.

3.3.1.4 Viewers

Viewers of Pamlico Sound in this part of the project area are persons in private homes lining the sound, as well as those with views from upper stories further away from the sound. Viewers also include boaters and sailboarders that recreate in this area of Pamlico Sound. Pamlico Sound generally is not visible from NC 12 because of buildings or vegetation that impair views.

3.3.2 Pea Island National Wildlife Refuge

3.3.2.1 Visual Character

Views in the Refuge have a generally consistent character, which is mostly of natural features with expansive wetlands to the west towards Pamlico Sound and of vegetated dunes to the east towards the Atlantic Ocean. Man-made features include Bonner Bridge, three freshwater ponds, the dunes between NC 12 and the ocean, and visitor and Refuge facilities. One enters the Refuge from the south via NC 12.

Because of the flat terrain to the west of the ocean-side dunes throughout the Refuge, multi-story houses in Rodanthe (in particular within the Mirlo Beach subdivision immediately adjacent to the southern Refuge boundary) are visible from a long distance away to southbound motorists on NC 12 within the Refuge.

In the southern part of the Refuge, the land is generally flat on the west side of NC 12, with small brush and some views of the backwater creeks that wind between the smaller islands between Pamlico Sound and Hatteras Island. Pamlico Sound is seldom visible from NC 12 in the Refuge. The Atlantic Ocean also is not visible in most places from NC 12 because of dunes.

Continuing north, a boat launch is located west of NC 12 (see Figure 3-1b). Here an abandoned wooden bridge over the creek is visible. There is a paved parking lot at the boat launch. The next feature is a paved parking lot with an information kiosk on the east side of NC 12. Just south of South Pond and east of NC 12 is the Refuge's headquarters, which includes four buildings.

In the midst of the Refuge are the three freshwater ponds (South Pond, New Field Pond, and North Pond) that are immediately west of NC 12 for approximately 4 miles (6.4 kilometers). North Pond has wildlife viewing/hiking trails at both its southern and northern ends. The Refuge Visitor Center is at the southern end of North Pond. The southern trail (North Pond Wildlife Trail) is popular with birders and includes raised observation platforms with spotting scopes. The other two ponds are closed to public entry, but are visible from NC 12 in places.

Most of the area east of NC 12 is covered with vegetation. There are, however, three locations within the Refuge (the Rodanthe 'S' Curves, the Sandbag Area, and the Canal Zone hot spots described in Section 1.1.3) where portions of the dunes were reconstructed, so they are not completely covered with vegetation. In these locations, the only features between NC 12 and the ocean are the dunes and the sandy beach. In addition, the view from NC 12 changes within the hot spot areas, particularly the Canal Zone hot spot, because the dunes are much closer to NC 12.

The northern Refuge exit is via Oregon Inlet and Bonner Bridge. The character of the Refuge in this area is described below in Section 3.3.3.

3.3.2.2 Visual Quality

The components of the existing landscape within the Refuge combine to create striking characteristics that convey visual excellence. The northern end of Hatteras Island between Oregon Inlet and Rodanthe is designated as a National Wildlife Refuge with its associated land use and user activities. NC 12 is also designated as a Scenic Byway by the NCDOT through the entire Refuge. As stated previously, the undeveloped and protected character of the area makes it rare along the eastern US seaboard in terms of views and a setting for recreational activities.

3.3.2.3 Visually Sensitive Resources

The entire Refuge is a visually sensitive resource from the perspectives of its natural character, its uniqueness as an undeveloped barrier island, the objectives of its viewers (see Section 3.3.2.4), and the designation of NC 12 through the Refuge as a Scenic Byway by the NCDOT. The Refuge was found to be eligible for the NRHP under Criterion A of the National Historic Preservation Act of 1966, as amended, in the areas of conservation and social history (see Section 3.4.1.1). A letter dated September 17, 2003 from the North Carolina SHPO that affirms this finding is contained in Appendix A.

3.3.2.4 Viewers

Viewers include visitors stopping and participating in recreational activities within the Refuge, as well as the users of NC 12 noted in Section 3.3.3.4. The major recreational activities within the Refuge are birding, fishing (from both the catwalks and surf fishing), surfing, boating, and beach usage activities such as sunbathing and walking. Birders, in particular, frequently view NC 12 while conducting their activities. For example, the most popular locations for birding are the trails around North Pond, and NC 12 is visible from many locations on these trails. Birders also use many of the other parking lots and information kiosks along NC 12, or just pull to the side of the road when they see birds. Thus, NC 12 is generally visible while they are conducting their activities. Individuals participating in activities on the beach generally do not have views of NC 12, but only of the dunes that lie between NC 12 and the Atlantic Ocean. The longest distance views in the Refuge are generally from the top of these dunes.

3.3.3 Oregon Inlet

3.3.3.1 Visual Character

In general, the northern end of Hatteras Island and southern end of Bodie Island have a low vertical profile with slightly rolling terrain and scattered vegetation. Sandy beaches are along the oceanfront and inlet side of the islands. Salt marsh and mudflats are on the soundside of the islands. The middle portions of the islands in the vicinity of Oregon Inlet are vegetated sparsely with dune grasses, yaupon, and myrtle. Other than the marsh on the soundside of the islands and the general undeveloped character of the islands, there are no unique physical features related to landform or vegetation. Manmade vertical elements are present on both the Hatteras Island and Bodie Island sides of Oregon Inlet (see photograph 3 in Figure 3-2).

On the Hatteras Island side of Oregon Inlet, a public-use parking lot is on the east side of NC 12. The terminal groin and the top of the (former) US Coast Guard Station also are visible. On Bodie Island, there is a campground on the east side of NC 12. The US Coast Guard Station, a large radio tower, and Oregon Inlet Marina are on the west side of NC 12. Other manmade features associated with the marina include a parking lot, a pier, and a stone revetment. The Bonner Bridge structure is a prominent visual feature on both sides of Oregon Inlet. The manmade features contrast with the natural characteristics of the island. Salt marsh and mudflats are on the soundside of the islands with emergent wetland vegetation such as needlerush and smooth cordgrass found there. The terrain generally is flat with some dunes bordering the beach area. Low shrubs and grasses are more prevalent further inland.

3.3.3.2 Visual Quality

The components of the existing landscape around Oregon Inlet combine to create striking characteristics that convey visual excellence. NC 12 is designated as a Scenic Byway by the NCDOT between the community of Ocracoke on Ocracoke Island and Whalebone Junction on Bodie Island. The most significant aspect of the area is its designation as a National Seashore and, on Hatteras Island, a National Wildlife Refuge with its associated land use and user activities. The undeveloped and protected character of the area makes it rare along the eastern US seaboard in terms of a setting for recreation activities such as surf fishing, bird watching, and shell collecting.

3.3.3.3 Visually Sensitive Resources

The (former) US Coast Guard Station on Hatteras Island is on the NRHP. Visually sensitive resources are the marina and the campground on the Bodie Island side of Oregon Inlet.

3.3.3.4 Viewers

Groups with a view from the road are primarily the highway users crossing Bonner Bridge, including residents of Hatteras Island and other residents of Dare County who travel the road to work and for local or regional trips. Another large group of users with a view from the road is comprised of tourists traveling to recreational opportunities in the area. Existing (2002) annual average daily traffic for NC 12 in this area is 5,400 vehicles per day (vpd), which rises to 10,900 vpd on the average summer weekend day. Groups that view NC 12 and Bonner Bridge are boaters, campers, people fishing along Oregon Inlet beaches and from the catwalks on Bonner Bridge, and US Coast Guard Station and Oregon Inlet Marina users.

3.4 Cultural Resources

Section 106 of the National Historic Preservation Act of 1966 as amended (16 USC 470f) affords consideration of those properties that are listed or eligible for listing on the NRHP.

In addition, Section 4(f) of the Department of Transportation Act of 1966, as amended (49 USC 303), states that the US Department of Transportation may not approve the use of land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site, unless a determination is made that the project will have a de minimis impact or unless a determination is made that:

- There is no feasible and prudent alternative to the use of land from the property; and

- The action includes all possible planning to minimize harm to the property resulting from such use.

In accordance with the requirements of Section 4(f), Section 106, and the National Environmental Policy Act (NEPA), surveys were conducted to identify the cultural resources in the project area.

3.4.1 Architectural and Landscape Resources

A survey was conducted in order to identify historic architectural and other historic resources within the area of potential effects (APE). The APE included the area surrounding the northern terminus of Bonner Bridge and Hatteras Island from Oregon Inlet to Rodanthe. The findings of the surveys are contained in the following reports:

- *Historic Structures Survey and Evaluation Report - Bonner Bridge* (Architectural Conservation Associates, September 1990);
- *Phase II Architectural Survey Report of Pea Island National Wildlife Refuge* (Mattson, Alexander and Associates, Inc., July 2003);
- *Phase II Historic Architectural Survey Report, Herbert C. Bonner Bridge Replacement Project* (Mattson, Alexander and Associates, Inc., August 2003); and
- *Addendum to Phase II Historic Architectural Survey Report, Herbert C. Bonner Bridge Replacement Project* (URS Corporation, April 2006).

The methodology for the survey consisted of background research into the historical and architectural development of the area and a field survey of the APE. All structures 50 years of age and older were photographed, mapped, surveyed, and evaluated for NRHP-eligibility.

Four resources or resource areas within the APE were identified as either listed on or eligible for inclusion in the NRHP:

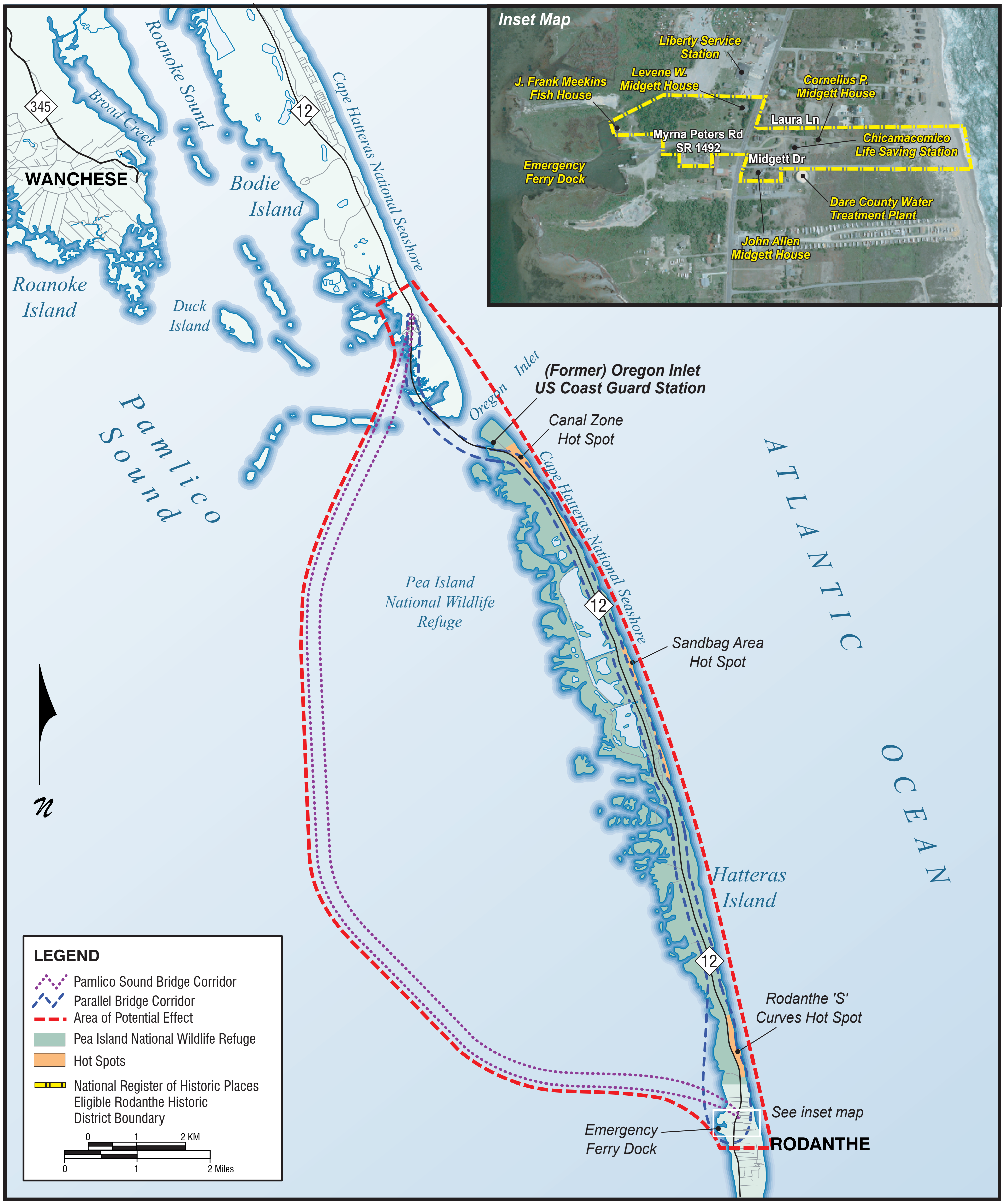
1. Pea Island National Wildlife Refuge (determined eligible);
2. The (former) Oregon Inlet US Coast Guard Station building (NRHP listed) at the northern end of Hatteras Island;
3. Rodanthe Historic District (determined eligible) at the southern end of the project area; and
4. The Chicamacomico Life Saving Station (NRHP listed), which stands within the Rodanthe Historic District.

The four historic resources also are Section 4(f) resources. (See the introduction to Chapter 5 for a definition of Section 4(f) resources.)

These resources and the project's APE are shown in Figure 3-3. The APE also encompasses a part of Pamlico Sound because the potential exists for the bridge replacement project to affect shipwreck sites (see Section 3.4.2.2.) The following sections describe the four historic resources.

3.4.1.1 Pea Island National Wildlife Refuge

The federal government established the Pea Island National Wildlife Refuge in 1938 within the Cape Hatteras National Seashore. A survey was conducted to evaluate the historical significance of the Refuge. The Refuge was found to be eligible for the NRHP. It is eligible under Criterion A of the National Historic Preservation Act of 1966, as amended, in the areas of conservation and social history. The Refuge is an outstanding example of the national wildlife refuges that arose during the early twentieth century.



HISTORIC RESOURCES

Figure 3-3

With its manmade dikes and dunes, the Refuge also illustrates the efforts of the Civilian Conservation Corps (CCC) on the Outer Banks to protect and revitalize natural resources. The US Congress established the CCC in 1933 during the Great Depression to employ young men in the conservation and development of natural resources. A letter dated September 17, 2003 from the North Carolina State Historic Preservation Officer (SHPO) that affirms the above finding is contained in Appendix A.

3.4.1.2 (Former) Oregon Inlet US Coast Guard Station

The (former) Oregon Inlet US Coast Guard Station at the northern end of Hatteras Island is listed in the NRHP. In the nineteenth century, the US Life Saving Service established life saving stations every 6 to 8 miles (10 to 13 kilometers) along the Outer Banks. Small settlements for the life saving crews and their families grew up around the stations. The Oregon Inlet Station—as it was constructed in 1898—was similar, but not identical, to other stations built along the Outer Banks during that period.

The US Coast Guard no longer uses the structure and does not plan to return to it. The State of North Carolina owns the building and the surrounding 10 acres (4.0 hectares), and the North Carolina Aquarium Society oversees its operations and maintenance.

3.4.1.3 Chicamacomico Life Saving Station and Rodanthe Historic District

In 2003, a Phase II Historic Architectural Survey was conducted in the southern portion of the Bonner Bridge study area. In this report, eight resources (six contributing and two non-contributing) were identified as being at least 50 years of age near the Rodanthe terminus. Among those properties were five houses dating from ca.1900 to ca.1950 and the Chicamacomico Life Saving Station, which was listed in the NRHP in 1976. The cluster of houses and outbuildings that surround the life saving station are eligible for the NRHP as the Rodanthe Historic District. The district is defined by the tax parcels on which the houses and the life saving station are situated.

An Addendum to the Phase II Historic Architectural Survey was completed in April 2006, after it was determined that one of the recommended contributing resources had been moved since the completion of the initial report. In this addendum, NCDOT recommended altering the boundaries of the district by truncating the southern boundary and extending the western boundary. The revised Rodanthe Historic District encompasses approximately 17.1 acres (6.9 hectares) in Dare County. The following six buildings and associated resources were included in the district: the Levene W. (or Levine) Midgett House; the J. Frank Meekins Fish House; the (former) Rodanthe School (non-contributing); the Chicamacomico Life Saving Station; the Cornelius P. Midgett (or Payne) House, on its new site minus its boathouse and cemetery; and the John Allen Midgett House. The components of the district generally line the east and west sides of NC 12, in the Myrna Peters Road and Midgett Drive area. The revised Rodanthe Historic District is shown in Figure 3-3.

The Rodanthe Historic District is eligible for the NRHP under Criterion A for social history. The district of well-preserved dwellings, for the fishermen and merchants of Rodanthe, and fish house clustered around the Chicamacomico Life Saving Station is a rare survivor in Dare County. The metamorphosis of Dare County from an area of small, largely isolated, fishing villages to a tourist destination of international renown has almost completely eliminated any vestige of life on the Outer Banks before the late twentieth century. The string of early twentieth century houses, the life saving station at Rodanthe, and the fish house on Rodanthe harbor, are rare illustrations of life in the pre-tourism age of the mid-twentieth to late-twentieth century. The Rodanthe Historic District is also eligible under Criterion C for architecture.

The Chicamacomico Life Saving Station is illustrative of a property type unique to the Outer Banks. Listed in the NRHP, Chicamacomico is the most complete of any of the life saving stations built along the North Carolina barrier islands. In addition to its original 1874 board-and-batten station and 1911 shingle-style facility, Chicamacomico contains a detached, frame kitchen, cisterns, a flag tower, and several frame boathouses, all of which are well-preserved. Surrounding the life saving station are several houses, including the Cornelius P. Midgett House which was recently moved to the Chicamacomico Life Saving Station site, that illustrate both the persistence of traditional domestic forms in Dare County and the introduction of nationally popular designs during the early twentieth century. The station is operated as a museum. It is open from mid-April through November, though the operational months may be extended in the near future (personal communication, December 12, 2006, Linda Molloy). The number of annual visitors is approximately 10,000. According to Linda Malloy, Site Operations Manager, there was a slight drop in visitation from 2004 to 2006. Future plans for the station include: restoration of the 1874 station house; construction of a museum building to house the growing collections; continued research; expansion of the programming, living history displays, and physical facilities; and creation of two separate historic districts on site.

At the north end of the district, across NC 12 from the station, is the Levene W. Midgett House. This home was built for a member of a locally prominent family and the last keeper of the station. The Levene W. Midgett House has changed little since the 1950's or earlier. In addition to the house, the associated boathouse and storage shed also contribute to the district. A third outbuilding, modern or thoroughly reworked and raised on piers, does not contribute to the district.

The Cornelius P. Midgett House stood, largely unaltered until the past year or two, on a long road-to-sea lot south of its current location. It is now within the Chicamacomico Life Saving Station complex. The house was moved in its entirety but continues to retain its architectural integrity.

The appearance of the John Allen Midgett House has changed little since the 1950's or earlier. Immediately to the house's south rises the modern and noncontributing county desalinization facility, which provides an appropriate southern boundary for the district.

Although the siding on the original building of the J. Frank Meekins Fish House has suffered through the years, and a less than 50-year-old addition was added on one side, it retains sufficient integrity and significance to be a contributing resource within the district. Because of its significance as a rare, small-scale fish house, it is considered to be a particularly important component of the district. It appears to still be used as a staging area for fishing, although not as a commercial fish house.

All of the homes and the J. Frank Meekins Fish House are privately owned. The Chicamacomico Life Saving Station is owned by the Chicamacomico Historical Association.

The principal access for most of these resources is NC 12. The J. Frank Meekins Fish House is reached from Myrna Peters Road, which intersects with NC 12. There are no sidewalks on either NC 12 or Myrna Peters Road. Other than those noted for the Chicamacomico Life Saving Station, no improvement plans are known.

A letter dated December 5, 2006 from the North Carolina SHPO that affirms the above NRHP-eligibility finding is in Appendix A.

3.4.2 Archaeological Resources

The North Carolina Office of State Archaeology site files contain no record of terrestrial or submerged cultural resources in the Bonner Bridge project area and the associated APE. The environment of the Outer Banks provides little of the stability necessary for good terrestrial archaeological preservation. As such, archaeological studies in the project area focused on the potential for shipwrecks in Oregon Inlet and Pamlico Sound.

3.4.2.1 Likelihood of Sites Related to Human Habitation

The North Carolina Outer Banks represent one of the most dynamic environments on the Atlantic seaboard. The current barrier island complex is a relatively recent feature and a variety of estimates confirm that it has been constantly migrating in a westerly direction. Inlets that bisect the Outer Banks also are extremely dynamic and remain in an almost constant state of flux. Archaeologists generally agree that the Outer Banks' environment has a profound impact on both human habitation (as noted above) and the project area's potential for well-preserved archaeological resources (Thompson and Gardner, 1979 and NCDOT, 1989).

The environment of the Outer Banks provides little of the stability necessary for good archaeological preservation. In a dynamic environment characterized by dramatic migration, the processes of erosion and accretion prove highly destructive. Fragile prehistoric and historic period terrestrial sites have little chance of survival. The migratory nature of the Outer Banks can preclude finding Archaic or earlier sites because of the extent of changes in the land forms. In more recent times, the migratory processes associated with Outer Banks inlets can be equally destructive.

In 1991, a background archaeological survey was conducted in the Bonner Bridge area. The results of this research are documented in *Historical and Cartographic Research to Identify and Assess the Potential for Cultural Resources in the Proposed Corridor for a Replacement Bridge on NC 12 Across Oregon Inlet, Dare County, North Carolina* (Watts, 1992). This technical memorandum was reviewed by the SHPO's staff, which concurred with its recommendation that significant archaeological properties are unlikely to be found in the Oregon Inlet area (see March 27, 1992 letter in Appendix A). The North Carolina Division of Archives and History archaeological site files contain no record of terrestrial cultural resources in the Bonner Bridge area.

In 2005, the NCDOT conducted background research to evaluate the potential for terrestrial archaeological resources in the Parallel Bridge Corridor through the Refuge. A review of the files at the North Carolina Office of State Archaeology and the results of past archaeological investigations within the Refuge led the NCDOT to conclude that the potential for significant archaeological properties in the Refuge was low. The SHPO concurred that no additional archaeological work is warranted because the potential for archaeological resources eligible for the NRHP in the Refuge is minimal (see June 21, 2005 letter in Appendix A).

3.4.2.2 Likelihood of Shipwreck Sites

Historical research indicates that the project area lies in a location with an active maritime history. The examination of secondary source material (e.g., Angley, 1985; Stick, 1952, 1958; Dames and Moore, 1979; Watts, 1992; Krivor, 2003) and the site files of the North Carolina Division of Archives and History, Underwater Archaeology Branch documented the loss of approximately 96 vessels in the general vicinity of Oregon Inlet and an additional 79 vessels within Pamlico Sound. The types of wrecked vessels include those involved in various pursuits such as trade, warfare, and fishing. The majority of the documented wrecked vessels are schooners. Other vessel types identified include barks, brigs, and steamers. While the wrecks chronologically span the entire period of historical activity along the North Carolina coast, from 1586 until 1982, documentation indicates that vessel traffic through Oregon Inlet was heaviest in the nineteenth century, with traffic during earlier periods slight in comparison (Dames and Moore, 1979; Angley, 1985; Watts, 1992; Krivor, 2003). However, reviews of the state site files within the North Carolina Office of State Archaeology, Department of Cultural Resources, identified no known archaeological sites within the project corridors; therefore, no known archaeological sites would be affected within the project area.

The project area is dynamic. Shipwreck research on the beach and in other North Carolina inlets has found, however, that both shipwreck vessel structure and an associated archaeological record warranting NRHP eligibility can survive in such an environment.

Historic maps identify four wrecks in proximity to the project area. Three of the wrecks plotted on an 1849 US Coast Guard Survey Map are likely well north of the project area because of the southerly migration of Oregon Inlet since its formation in 1846. The fourth wreck, plotted on National Oceanic and Atmospheric Administration Navigation Chart No. 12204 (1975), appears to be the remains of an iron-hulled barge that washed ashore in the early 1970s. This wreck site is in Pamlico Sound immediately west of Rodanthe (just north of the emergency ferry dock). It is a modern vessel and is not a significant submerged cultural resource. An early twentieth-century windmill also was identified during a review of historic cartographic maps; however, the windmill site is outside of the project area.

Dredging has occurred in the Oregon Inlet area. Channel dredging has occurred through the navigation zone of Bonner Bridge, in a corridor approximately 1,000 feet (304.8 meters) to the east of Bonner Bridge and in a corridor parallel to and west of Bonner Bridge. The dredging parallel to Bonner Bridge occurred during construction of the bridge. The inlet bottom was dredged where the water was less than 10 feet (3 meters) deep. This dredging occurred in an area approximately 150 feet (45.7 meters) wide and extending the full length of the bridge, except in the area of the current navigation span and several spans to the south. Dredging would have disturbed, damaged, or destroyed shipwreck resources unless scour associated with inlet movement re-deposited vessel remains at depths below the limits of dredging.

The potential for significant submerged cultural resources within Pamlico Sound Corridor area was assessed using criteria set forth by the Division of Archives and History, Underwater Archaeology Branch. The potential for wrecks within the vicinity of Oregon Inlet is moderate to high; the probability for historic vessel remains within the project area south of Oregon Inlet is moderate.

Surveys in the Parallel Bridge Corridor at Oregon Inlet

A magnetometer survey (Dames and Moore, 1979) of the Oregon Inlet navigation channel revealed several anomalies. However, no ground truthing of the Dames and Moore targets has been done. Background research revealed no known shipwrecks; however, NCDOT, FHWA, and representatives of the SHPO worked cooperatively to develop a scope of work for a remote sensing survey for underwater resources in the area that would likely be disturbed by the potential construction of an Oregon Inlet bridge in the Parallel Bridge Corridor. The survey was conducted in February 1993, excluding those areas that have been dredged in the past. The results of the remote sensing survey revealed 41 anomalies, of which three were considered high priority (two near the northern end of Bonner Bridge, and one near the southern end of Bonner Bridge), requiring investigations if not avoided. The SHPO concurred with this assessment (see May 23, 1993 letter in Appendix A). In October 1995, an underwater investigation was conducted. A brief magnetometer survey was conducted to confirm and refine each location. Visual inspections were conducted and the anomalies in the northern area were investigated using sub-bottom probes. This investigation revealed that the source objects for the anomalies of the two clusters at the north end of the bridge either lie more than 10 feet (3 meters) below bottom or were too small to be located within the patterns of sub-bottom probing. It is, therefore, reasonable to conclude that no substantial shipwreck remains exist within 10 feet (3 meters) of the bottom in this area. The anomaly cluster at the south end of the bridge consists of three anomalies. A pipeline discovered during the diving investigation has characteristics indicating modern origin and, apparently, is the source object for two of the three anomalies. The third anomaly, indicative of an isolated single-source object, has significantly reduced potential for representing a shipwreck. Based on the results of this investigation, it is concluded that no shipwrecks exist in this area. The SHPO concurred with this finding in a letter dated June 5, 1996 (see Appendix A).

Surveys in the Pamlico Sound Bridge Corridor

The North Carolina Office of State Archaeology concurred with the results of a historical background investigation conducted for the Pamlico Sound Bridge Corridor in a letter dated July 25, 2003 (see Appendix A). Based on the results of the background investigation, the NCDOT conducted remote sensing surveys and diver investigations of the Pamlico Sound Bridge Corridor to determine if significant shipwrecks lie within the corridor. None was found. In the portion of the project area immediately west of Bodie Island, anomalies identified by remote sensing (magnetic signatures of debris revealed by a magnetometer) were found buried in the sand. Probing with a 10-foot-long (3-meter-long) hydro probe did not identify the source of the anomalies. Remote sensing data, however, suggests that the anomalies are modern debris associated with Bonner Bridge construction (Krivor, 2004). A letter from the SHPO concurring with these results is included in Appendix A.

3.5 Parks and Recreation/Wildlife Refuges

There are two publicly owned recreation areas within the Bonner Bridge Replacement project area: the Cape Hatteras National Seashore and the Pea Island National Wildlife Refuge. Seashore and Refuge lands and the waters of the Atlantic Ocean and Pamlico Sound that border the Seashore, the Refuge, and Hatteras Island as a whole are used for a variety of recreational activities. Activities within the project area include:

- Surf fishing off Atlantic Ocean beaches within the Refuge and Seashore;
- Fishing from the catwalks on the south end of Bonner Bridge;
- Surfing in the Atlantic Ocean;
- Wind-boarding (windsurfing) and kite surfing in Pamlico Sound;
- Walking along the beach;
- Birding and hiking on wildlife trails;
- Cycling along NC 12; and
- Visiting the Refuge Visitor Center.

The importance to the tourist economy of the recreational activities within the Seashore and the Refuge and along the Atlantic Ocean beachfront and in Pamlico Sound was emphasized on numerous occasions at the project's Citizens Informational Workshops, at meetings with Dare County officials, and interviews conducted during the community data-gathering process.

Except in the bulk of Pamlico Sound and in the community of Rodanthe, the project area is wholly within the Seashore or both the Seashore and the Refuge. Per Section 4(f) of the Department of Transportation Act of 1966, lands from parks and wildlife refuges cannot be used for federally sponsored transportation projects unless a determination is made that the project will have a *de minimis* impact or unless a determination is made that:

- There is no feasible and prudent alternative to the use of land from the property; and

- The action includes all possible planning to minimize harm to the property resulting from such use.

All the detailed study alternatives (including the Preferred Alternative) would use land from the Seashore. Because the Preferred Alternative would use land from the Seashore, a Final Section 4(f) Evaluation for the proposed project is contained in Chapter 5. The Seashore and the Refuge are described in the following sections.

3.5.1 Cape Hatteras National Seashore

The Cape Hatteras National Seashore in Dare and Hyde counties stretches north to south across three islands (see Figure 5-1):

- Bodie Island, from Whalebone south except along ocean beach, where Seashore lands begin about 5 miles (8 kilometers) south of Whalebone;

- Hatteras Island, the entire island except for privately held lands at the communities of Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, and Hatteras; and

- Ocracoke Island, the entire island except for privately held lands at the community of Ocracoke.

These barrier islands have a wealth of sand dunes (natural and man-made), marshes, and woodlands. The creation of the Seashore was authorized by Congress in 1937; 21 years later the final parcels were acquired and the Seashore was dedicated. The Seashore has contributed to the area's increase in tourism. It was the first in a series of national seashores established to preserve significant segments of unspoiled barrier islands along the Atlantic and Gulf coasts for the benefit and enjoyment of the people. The Seashore covers 30,319 acres (12,275 hectares) and stretches along 72 miles (115 kilometers) of open, virtually unspoiled beach and scenic drive. The State of North Carolina donated approximately 10,000 acres of the Seashore's land.

The Seashore is a publicly owned park and recreation area that is owned by the federal government and administered by the NPS. At the south end of Bodie Island, the Seashore boundary follows the mean low water mark along the Atlantic Ocean side. On the Pamlico Sound side, the boundary follows the shoreline until it reaches Oregon Inlet. The Seashore boundary on Hatteras Island, between Oregon Inlet and Rodanthe, extends to the mean low water mark along the ocean-side and extends 150 feet (45.7 meters) from the shoreline into Pamlico

Sound on the west side. Figure 5-3 shows the Seashore boundary in the vicinity of Oregon Inlet. The boundary does not follow the shoreline in the Oregon Inlet area because it was based on the shoreline location in the 1950s. The NPS and the USFWS share management duties where the boundaries of the Seashore overlap with those of the Refuge at the northern end of Hatteras Island. Within the Refuge, the NPS is responsible for visitors and visitor facilities, while the USFWS is responsible for wildlife management.

Eight villages exist within the Seashore's authorized boundaries (seven on Hatteras Island), but are neither parklands nor a part of the Seashore. Only one village, Rodanthe, exists within the project area. The villages, the Seashore, and the Refuge are served by NC 12, a hard-surfaced, two-lane road approximately 50 miles (80 kilometers) in length bisecting the Seashore. By Act of Congress, the section of the Seashore encompassing the Refuge was to include a road. This road, which connects Rodanthe to Oregon Inlet, was completed in 1953 and was connected to Bodie Island to the north by Bonner Bridge in 1963. The NPS contributed funds ($500,000) to construct Bonner Bridge, which was considered a benefit to the Seashore at that time. The roadway, including the bridge, was officially designated as NC 12 in 1963; it is maintained by the NCDOT under agreements with the US Department of the Interior. NC 12 is the only road providing motor vehicle traffic through the Seashore. Vehicle access between Bodie Island and Hatteras Island is provided by Bonner Bridge across Oregon Inlet. The right-of-way or easement for NC 12 is 100 feet (30.5 meters) wide.

Access to Ocracoke Island is provided by the Hatteras Inlet ferry between Hatteras Island and Ocracoke Island, as well as by two NCDOT ferry routes operating between Ocracoke Island and the mainland. Ocracoke Island is outside the project area and thus not discussed in detail.

The Cape Hatteras National Seashore is a Section 4(f) resource, but the NC 12 right-of-way is not considered to be a Section 4(f) property. (See the introduction to Chapter 5 for a definition of Section 4(f) resources.)

3.5.1.1 Facilities

Seashore facilities administered by the NPS on Bodie Island are:

- Whalebone Junction Information Station;
- Bookstore;
- Coquina Beach Day Use Facility;
- Bodie Island Visitor Center and Nature Trail;
- Bodie Island Lighthouse;
- Oregon Inlet Campground*; and
- Oregon Inlet Marina and Fishing Center*.

Seashore facilities on Hatteras Island (including those within the Refuge) are:

- Refuge Visitor Center, wildlife trails, and boat ramp*;
- Rodanthe fishing pier;
- Little Kinnakeet US Life Saving Service Station;
- Avon fishing pier;
- Hatteras Island Visitor Center and Nature Trail;
- Cape Hatteras Lighthouse;
- Cape Point Campground and Day Use Facilities;
- Frisco Campground; and
- Frisco area fishing pier.

*Facilities marked with an asterisk (*) are in the project area.

The Atlantic Ocean beach south of Whalebone Junction is completely within the Seashore and is open for public use beginning about 5 miles (8 kilometers) south of Whalebone Junction (see Figure 5-1). The Oregon Inlet Marina and Fishing Center and the Oregon Inlet Campground are the only Seashore facilities located near the Parallel Bridge Corridor alternatives (including the Preferred Alternative), the Pamlico Sound Bridge Corridor alternatives, and the existing Bonner Bridge (see Figure 5-3). An unpaved beach access road intersects with NC 12 near the Marina and Fishing Center. Although not owned or maintained by the NPS, but rather the NCDOT, catwalks used by fishermen are attached to Bonner Bridge off Hatteras Island. There also are catwalks on the Bodie Island side, but they are now over land and are unusable for fishing. A parking lot and a path to the catwalks immediately south of Bonner Bridge are maintained by the NPS. The Refuge Visitor Center and its associated parking lot, the North Pond Wildlife Trail, and the boat ramp are all located near the Parallel Bridge Corridor alternatives (including the Preferred Alternative) (see Section 3.5.2).

3.5.1.2 Visitors

Statistics provided by the NPS in 2004 (see Table 3-7) indicated that visitors to the Seashore (irrespective of where they are staying) increased from 2,200,208 in 1990 to 3,077,940 in 2002—a 40 percent increase. Although the number of visits generally increased, the percentage of overnight stays decreased 41 percent between 1990 and 2002. Thus, not only was Hatteras Island use increasing, but an increasing proportion of residents and visitors to Dare County were taking day trips to Hatteras Island since most of the visitor facilities of the Seashore are on Hatteras Island. The 2002 monthly figures for recreational and non-recreational visitors to the Seashore in Table 3-8 illustrates the seasonal fluctuations of visitation levels and the greater summer season levels. Recreation visit statistics posted on the NPS web site show that the Cape Hatteras National Seashore (including Bodie, Hatteras, and Ocracoke islands) had 2,237,378 recreational visitors in 2007, indicating a decrease in visitors since 2002 (approaching 1990 levels). Overnight stays in 2007 were 96,934.

Table 3-7. Cape Hatteras National Seashore Annual Use

	Number of Visits				Overnight Stays	
	Recreation	Non-Recreation	Total	% Change from Previous Year	Total	% Change from Previous Year
1990	2,072,715	127,493	2,200,208	--	161,074	--
1997	2,515,057	130,367	2,645,424	--	111,367	--
1998	2,737,640	141,518	2,879,158	9%	103,676	-7%
1999	2,634,587	137,833	2,772,420	-4%	87,709	-15%
2000	2,647,383	136,743	2,784,126	0%	91,085	4%
2001	2,592,889	136,193	2,729,082	-2%	104,469	15%
2002	2,923,894	154,046	3,077,940	13%	95,297	-9%

Source: NPS, 2002.

Table 3-8. Cape Hatteras National Seashore Monthly Use (2002)

	Number of Visits			Overnight Stays		
	Recreation	Non-Recreation	Total	% of Annual Visitation	Total	% of Annual Visitation
January	60,738	2,369	63,107	2%	16	0%
February	53,194	2,027	55,221	2%	24	0%
March	140,302	4,133	144,435	5%	589	1%
April	183,766	7,317	191,083	6%	5,312	6%
May	226,414	15,550	241,964	8%	13,284	14%
June	410,366	23,387	433,753	14%	20,468	22%
July	410,966	23,400	434,366	14%	26,044	27%
August	574,159	33,900	608,059	20%	19,486	20%
September	466,686	27,569	494,255	16%	7,606	8%
October	182,665	7,247	189,912	6%	2,356	2%
November	140,145	4,228	144,373	5%	96	0%
December	74,493	2,919	77,412	2%	16	0%

Source: NPS, 2002.

3.5.1.3 Activities

Visitors to the Seashore enjoy a wide variety of recreational opportunities related to the unique natural, undeveloped, and protected character of the area. The NPS's Summer 2002 survey of Seashore visitors (University of Idaho, Summer 2002) provided the visitor participation statistics presented in Table 3-9 at its Outer Banks group of parks (the Seashore, the Wright Brothers National Memorial in Kill Devil Hills, the Fort Raleigh National Historic Site on Roanoke Island, and the Cape Lookout National Seashore), ranked according to activity popularity:

Table 3-9. Visitor Activities and Participation

Activity	Visitor Participation
Swimming/sunbathing	78%
Visiting historic sites	70%
Walking	65%
Enjoying solitude	56%
Photography	53%
Beach driving	36%
Picnicking	26%
Surf fishing	25%
Nature study	22%
Camping	21%
Surfing (wind/board/kite)	18%
Bicycling	17%
Canoeing/kayaking	13%
Charter boat fishing	9%
Attending ranger-led programs	9%
Boat fishing	7%
Other	11%

Note: The individual percents do not add up to 100 because visitors often participate in more than one activity.

Seashore lands in the project area are used for a variety of recreational activities, including:

- Camping at Oregon Inlet Campground on Bodie Island;
- Ocean fishing excursions from the Oregon Inlet Marina and Fishing Center;
- Surf fishing off Atlantic Ocean beaches;
- Fishing from the catwalks on the south end of Bonner Bridge;

- Surfing in the Atlantic Ocean;
- Wind-boarding (windsurfing) and kite surfing in Pamlico Sound;
- Walking along the beach;
- Birding and hiking on wildlife trails in the Refuge;
- Visiting the Refuge Visitor Center;
- Cycling along NC 12;
- Fishing from the Rodanthe fishing pier; and
- Driving the "Outer Banks Scenic Byway," which includes NC 12 from Whalebone Junction south through the Seashore.

3.5.1.4 Plans

The *General Management Plan and Amended Environmental Assessment for Cape Hatteras National Seashore* (NPS, 1984) and the *Draft Revised Statement for Management* (NPS, 1991) serve as the current NPS plans for the Seashore. These documents are described in Section 3.1.3.3. Completion of a new General Management Plan is scheduled for 2010 or 2011.

As discussed in Section 3.1.3.3, no new Seashore facilities are planned in the project area. The Seashore's plans focus on restoration and maintenance of existing facilities. The plans also support the construction of bicycle lanes along NC 12.

The *Cape Hatteras National Seashore Long-Range Interpretive Plan* (September, 2007) provides a vision for the future of interpretation at the Seashore. This document is described in Section 3.1.3.3. The plan includes goals related to improving personal services and visitor facilities, but none of the visitor facilities referenced for improvement are in the project area.

3.5.1.5 Natural Resources

The Seashore provides habitat for a wide variety of wildlife. Extensive marine and estuarine systems exist within the Seashore. The sand and mudflats on the south end of Bodie Island attract many shorebirds. In the portion of the Seashore through which the proposed project would pass, the most common plant community/habitat type is "Man-dominated." Seven types of wetland communities also are located within the Seashore portion of the project area. (See Section 3.7.4 and Figure 3-7 in Section 3.7.2.1 for a full description of habitats.) Eighteen protected species are documented in the project area and/or have suitable habitat within the project area (see Section 3.7.7).

3.5.2 Pea Island National Wildlife Refuge

The Pea Island National Wildlife Refuge (5,834 acres [2,361 hectares]) was established in Dare County on the northern end of Hatteras Island in 1938 by President Roosevelt through Executive Order 7864 (see Figure 3-1b). The Refuge was created in recognition of the importance of the area for wildlife. Executive Order 7864 reserved the area for migratory birds and other wildlife to advance the purposes of the Migratory Bird Conservation Act of 1929. The Refuge was named for the once-abundant dune peas in the area that attracted waterfowl and was developed by CCC projects in the 1930s. The boundaries of the Refuge generally overlap with the boundaries of the Seashore north of Rodanthe. The Refuge is managed by the USFWS; however, a Memorandum of Agreement is in place so that the parking lots and comfort station on Hatteras Island are managed by the NPS. The USFWS is responsible for the natural resources management within the Refuge. (Personal communication, September 15, 2003, Dennis Stewart, USFWS, Pea Island National Wildlife Refuge, Manteo, NC.) As a first priority, federal law and regulation require the Refuge manager to ensure that all uses of the Refuge are compatible with Executive Order 7864 and the National Wildlife Refuge System Improvement Act of 1997, and that any allowed use of the Refuge be compatible with the mission ("wildlife first") and purpose of the Refuge. The primary purpose of the Refuge is to be a refuge and breeding ground for migratory birds and other wildlife.

The Refuge is a Section 4(f) resource. In addition, it is a significant publicly owned recreation area and also a significant historic site eligible for inclusion in the NRHP.

The Refuge is owned by the federal government and administered by the USFWS. Executive Order 7864 also established a boundary for the Refuge, which extends to the mean high tide level on both sides of Hatteras Island. The northern boundary of the Refuge extends to Oregon Inlet and the southern boundary is immediately adjacent to private properties in Rodanthe (see Figure 3-1c). Proclamation Boundary Waters also were established in 1938 around the Refuge but are not a part of the Refuge. This is an area that extends into Pamlico Sound to protect migratory birds from hunters in areas adjacent to the Refuge. The Proclamation Boundary Waters cover approximately 25,700 acres (10,400 hectares) of Pamlico Sound. All of the Refuge overlaps with a portion of the Cape Hatteras National Seashore.

Like the Seashore, NC 12 provides the primary access to and through the Refuge. NC 12 runs the full length of the Refuge south to north, as decreed by Act of Congress. The length of NC 12 (south to north) within the Refuge between Rodanthe and Oregon Inlet is approximately 11.8 miles (19.0 kilometers). The width of the Refuge ranges from 0.25 mile (0.4 kilometer) to 1 mile (1.6 kilometers) from east to west. The area was historically used for market waterfowl hunting, commercial fishing, farming, and livestock operations (Pea Island National Wildlife Refuge web site, August 18, 2008).

Currently, a 23-person staff administers both Pea Island and Alligator River (in mainland Dare County) National Wildlife Refuges. Numerous volunteers devote approximately 25,000 hours each year to the Refuge (*Comprehensive Conservation Plan*, Pea Island National Wildlife Refuge, 2006).

Like the Seashore, NC 12 provides the primary access to the Refuge. NC 12 runs the full length of the Refuge south to north. NC 12 is in an easement authorized by a permit from the USFWS.

3.5.2.1 Administrative and Management Law

The National Wildlife Refuge System Administration Act of 1966 created and provides for the administration and management of the National Wildlife Refuge System (NWRS). This system includes wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.

The National Wildlife Refuge System Improvement Act of 1997 amends and builds upon the 1966 Act to ensure that the NWRS is managed as a national system of related lands, waters, and interests for the protection and conservation of our nation's wildlife resources. The 1997 Act further defines the mission of the NWRS as to "administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." The 1997 Act also requires the US Secretary of the Interior to ensure the biological integrity, diversity, and environmental health of the NWRS is maintained, and it defines compatible wildlife-dependent recreation as "legitimate and appropriate general public use of the System." It establishes hunting, fishing, wildlife observation and photography, and environmental education and interpretation as "priority public uses" where compatible with the mission and purpose of individual national wildlife refuges. The 1997 Act also retained the refuge managers' authority to use sound professional judgment in determining compatible public uses on national wildlife refuges and whether or not they will be allowed, and established a formal process for determining "compatible use." Proposed uses must be concurrently evaluated for compatibility with refuge goals, objectives, and the refuge's establishing legislation. This evaluation, known as a Compatibility Determination, also requires public notice and comment. However, the 1997 Act was not intended "to in any way change, restrict, or eliminate" existing road right-of-ways within refuges.

3.5.2.2 Refuge Purpose and Objectives

The primary purpose of the Refuge is to be a refuge and breeding ground for migratory birds and other wildlife. Refuge objectives are to:

- "Provide nesting, resting, and wintering habitat for migratory birds, including the greater snow geese and other migratory waterfowl, shorebirds, wading birds, raptors, and neotropical migrants.
- Provide habitat and protection for endangered and threatened species.
- Provide opportunities for public enjoyment of wildlife and wildlands resources. Public use programs focus on interpretation, environmental education, wildlife observation, wildlife photography, and fishing" (Pea Island National Wildlife Refuge web site, August 18, 2008).

3.5.2.3 Facilities

Facilities within the Refuge are shown in Figure 3-1b. They are:

- Salt Flats and North Pond Wildlife Trails;
- Refuge Visitor Center;
- Fishing catwalks at Oregon Inlet;
- A boat ramp;
- Seven parking lots; and
- Headquarters buildings.

The beach is open to the public.

3.5.2.4 Visitors and Their Activities

Based on traffic counts, the Refuge receives 2.7 million visitors annually (Pea Island National Wildlife Refuge web site, August 18, 2008). Most vehicles, however, only pass through the Refuge to and from other destinations on Hatteras Island. Refuge management estimated the number of visitors with the Refuge as a destination to be about 420,000 persons in 2003 and 540,000 persons in 2004. These rough estimates assume that about 80 percent of the vehicles counted are only passing through the Refuge. The peak-season for visitors to the Refuge is June through October.

During the summer peak-season, many families visit the Refuge to participate in typical beach activities. The peak-season for birding is in the fall, but it is also popular in the spring and winter. The peak-season for fishing is also in the fall. All activities in the Refuge during the winter are weather dependent; on many cold and windy days, there is little activity in the Refuge, but nice winter days can be relatively active. Weekends are not necessarily the busiest times in the Refuge because many locals use the Refuge during the week to conduct their activities, including participating in programs put on by the Refuge during the week (Friday is the busiest day for Refuge programs). In particular, retirees and birders visit the Refuge during the week. "Wings over Water" is a program put on by the Refuge staff for birders and other wildlife enthusiasts each fall. It is a large program that visitors come to the Outer Banks specifically to participate in, as opposed to many of the Refuge's other programs that people tend to find out about and participate in while visiting the Outer Banks for other reasons. (Personal communication, February 10, 2005, Bonnie Strawser, USFWS, Manteo, NC.)

Members of the EIS study team conducted site visits during the summer (peak-season), the fall (shoulder-season), and the winter (off-season) in order to obtain information on the seasonality of the numbers of visitors and the types of visitors' activities. The peak-season (Labor Day weekend, September 4 and 5, 2004) and shoulder-season (mid-October weekend, October 16 and 17, 2004) site visits included informal (scientific sampling was not used) parked vehicle counts and visitor interviews. Additional parked vehicle counts were also conducted on an off-season weekend (February 11 and 12, 2005). Vehicles counts were conducted by two-person teams driving the length of NC 12 within the Refuge one time at five different time periods during the day. The catwalks parking lot had by far the highest total number of parked vehicles (992) over the three weekends. The Visitor Center lot had the second highest total (177), but it was less than one-fifth of the total at the catwalks parking lot. The Visitor Center lot also serves the North Pond Wildlife Trail that follows the dike around North Pond. The third highest total (93) was at the parking lot on the east side of NC 12 north of the boat ramp, closely followed by the parking lot on the east side of NC 12 north of Salt Flats Trail (92). The highest total along the side of the road (87) was between Milepost Markers 37 and 38 (in the southern third of the Refuge), which is a popular surfing area. These parking patterns reflect that the most popular parts of the Refuge are towards the north, away from the Refuge's Rodanthe area entrance.

The EIS study team observed and counted visitor activities at the location of parked cars during the September and October weekends. Table 3-10 provides a summary of the visitor activities observed.

During both weekends, the predominant activity observed in the Refuge was fishing, either from the catwalks, the groin, the rock sea walls on both sides of the bridge, or surf fishing from the beach. All of these combined for approximately 52 percent of the total activities observed in September and approximately 61 percent of the activities observed in October. During September, surfing and general beach activities (e.g., sunbathing) each accounted for approximately 21 percent of the total activities observed. However, during October, these activities had reduced substantially and birding accounted for approximately 20 percent of the activities observed.

Table 3-10. Visitor Activities Observed (by Primary Activity, Month, and Number of Participants)

Primary Activity	September 2004		October 2004		Total	
	Number	Percent	Number	Percent	Number	Percent
Fishing from:						
• Catwalks	79	26.3	50	27.3	129	26.7
• Groin/Sea Walls	36	12.0	3	1.6	39	8.1
• Surf	38	12.6	58	31.7	96	19.9
• Boat	2	0.7	0	0	2	0.4
• Total fishing	155	51.6	111	60.6	266	55.1
Birding	8	2.7	36	19.7	44	9.1
Surfing	62	20.7	17	9.3	79	16.4
Beach (sunbathing)	62	20.7	14	7.7	76	15.7
Walking	13	4.3	3	1.6	16	3.3
Kayaking	0	0.0	2	1.1	2	0.4
Total	**300**	**100.0**	**183**	**100.0**	**483**	**100.0**

Informal interviews were conducted with 167 visitors in September and October. Table 3-11 identifies the location of interviewees' homes. More than half of those interviewed over the two weekends were from out-of-state (approximately 57 percent), whereas approximately 29 percent were from other parts of North Carolina and approximately 14 percent were from the local area.

Table 3-11. Where Refuge Visitors Come From (by Month)

Home	September 2004		October 2004		Total	
	Number	Percent	Number	Percent	Number	Percent
Local Area	15	17.9	9	10.9	24	14.4
North Carolina	20	23.8	28	33.7	48	28.7
Out-of-State	49	58.3	46	55.4	95	56.9
Total	**84**	**100.0**	**83**	**100.0**	**167**	**100.0**

Table 3-12 presents the interviewees' frequency of visits to the Outer Banks. Approximately 18 percent of the interviewees said they only visit the Outer Banks occasionally (which included those who visit once every few years or this was their first visit). A similar percent of interviewees (approximately 17 to 18 percent) said they visited either once per year, or two to three times per year. Approximately 35 percent of those interviewed said they visit six or more times per year.

Table 3-12. Frequency of Visits to Outer Banks (by Month)

Visits per Year	September 2004		October 2004		Total	
	Number	Percent	Number	Percent	Number	Percent
One	10	12.8	17	20.5	27	16.8
Two/Three	11	14.1	18	21.7	29	18.0
Four/Five	5	6.4	6	7.2	11	6.8
Six or more	22	28.2	10	12.1	32	19.9
Non-Specific:						
• Occasional	10	12.8	19	22.9	29	18.0
• Several	6	7.7	3	3.6	9	5.6
• Often	14	18.0	10	12.0	24	14.9
Total	**78**	**100.0**	**83**	**100.0**	**161**	**100.0**

One factor in the selection of a Preferred Alternative was the effect on the use of the Refuge resulting from the loss of paved road access to the full length of the Refuge that would be associated with the Pamlico Sound Bridge Corridor. Therefore, visitors also were asked questions related to this potential change in access.

Table 3-13 presents the interviewees' responses related to whether or not there are other locations on the Outer Banks at which they could conduct their activities. Approximately 80 percent of the total number of interviewees indicated that they could do their activity at another location on the Outer Banks, whereas the other 20 percent said they could no longer enjoy their activity if the access to the Refuge was limited (i.e., by not maintaining paved road NC 12 access). However, approximately 85 percent of the visitors interviewed in September said there were other places to conduct their activity on the Outer Banks, whereas only 71 percent of those interviewed in October said there were other places. One reason for this difference is that there are a higher percent of birders and fishers in the fall months, and they are less likely than general beach-goers to state that there is another place to conduct their activity.

Table 3-13. Are There Other Locations to Conduct Activity (by Month)

Other Location?	September 2004		October 2004		Total	
	Number	Percent	Number	Percent	Number	Percent
Yes	57	85.1	30	71.4	87	79.8
No	10	14.9	12	28.6	22	20.2
Total	**67**	**100.0**	**42**	**100.0**	**109**	**100.0**

Table 3-14 presents the interviewees' responses related to whether or not they would still visit the Refuge if access was changed from a paved road to some other means of access (i.e., if visitors could no longer drive to their destinations within the Refuge, but rather had to take a tram or some other form of alternate access). As shown in Table 3-14, approximately 60 percent of visitors said they would still visit the Refuge with changed access; however, the percentage is slightly higher for visitors from the local area (approximately 67 percent) than for visitors from elsewhere in North Carolina (64 percent) or for visitors from out-of-state (56 percent).

Table 3-14. Would Visitors Still Visit Refuge with No Paved Road Access (by Home Location)

Still Visit?	Local Area		North Carolina		Out-of-State		Total	
	Number	%	Number	%	Number	%	Number	%
Yes	16	66.7	28	63.6	49	55.7	93	59.6
No	6	25.0	15	34.1	28	31.8	49	31.4
Maybe/Unsure	2	8.3	1	2.3	11	12.5	14	9.0
Total	**24**	**100.0**	**44**	**100.0**	**88**	**100.0**	**156**	**100.0**

Table 3-15 presents the interviewees' responses related to whether or not they would still visit the Refuge with changed access based on the activity they were participating in. As shown in Table 3-15, birding had the highest percent of visitors that would still visit the Refuge with changed access at approximately 78 percent, whereas general beach activities (i.e., sunbathing) had the lowest percentage at approximately 52 percent. One reason for this is that the Refuge is known as one of the best places in the area for birding and birders generally appear willing to use whatever access is available to visit the Refuge for participating in their activity. On the other hand, sunbathers can participate in their activity in numerous locations on the Outer Banks, so they are less willing to go out of their way to visit the Refuge for this activity. Table 3-15 also shows that approximately 54 percent of visitors fishing from the catwalks would still visit the Refuge with changed access, even with the potential loss of the catwalks.

Table 3-15. Would Visitors Still Visit Refuge with Changed Access (by Activity)

Primary Activity	Yes		No		Maybe/Unsure	
	Number	Percent	Number	Percent	Number	Percent
Fishing from:						
• Catwalks	26	54.2	18	37.5	4	8.3
• Groin/Sea Walls	0	0.0	0	0.0	0	0.0
• Surf	14	66.7	6	28.6	1	4.7
• Boat	1	100.0	0	0.0	0	0.0
• Total fishing	41	58.6	24	34.3	5	7.1
Birding	14	77.8	3	16.7	1	5.5
Surfing	15	68.2	5	22.7	2	9.1
Beach (sunbathing)	11	52.4	7	33.3	3	14.3
Walking	6	75.0	1	12.5	1	12.5
Kayaking	0	0.0	0	0.0	0	0.0
Total	**87**	**62.6**	**40**	**28.8**	**12**	**8.6**

Representatives of five Refuge user-related associations were interviewed. The Cape Hatteras Bird Club (CHBC) has more than 100 members (mostly from out-of-state and elsewhere in North Carolina). Most of the members visit the Refuge one to two times per year. Birders associated with this club choose all areas of the Outer Banks for birding, but in the winter months, the water fowl is the leading draw at the Refuge. (Personal communication, December 14, 2004, Pat Moore, Club President.)

The Cape Hatteras Anglers Club (CHAC) has 600 active members. Approximately 30 percent of them live on Hatteras Island, 20 percent live elsewhere on the Outer Banks, and 50 percent of them are from out of the area. The club's members use the Refuge for striper fishing in the fall, but the visits are infrequent. Very few of the CHAC members are bridge fishers; they are primarily surf fishers. (Personal communication, December 14, 2004, Larry Hardham, Club President.)

The Coastal Wildlife Refuge Society (CWRS) is a non-profit organization established and incorporated in 1989 by a group of local citizens. The purposes of the CWRS are twofold: 1) to generate funds to support Refuge programs and activities; and 2) to assist in the recruitment of Refuge volunteers. The CWRS designed, constructed, and staffs the Refuge Visitor Center, including the gift shop. According to President Tom White, the CWRS has approximately 50 to 60 local members, but they have many more members from outside of the local area who join in order to contribute to the CWRS' efforts. CWRS members visit the Refuge year round, but staff the Visitor Center for longer hours during the summer. In addition to providing staff for the Visitor Center, the CWRS also provides volunteers to work with the Refuge in other ways. (Personal communication, January 11, 2005, Tom White, President.)

The Eastern Surfing Association (ESA) is an organization for competitive surfers that covers the entire east coast of the United States. There are several districts within the ESA; one of them is the Outer Banks District. The Outer Banks District's membership is primarily from Dare County, although some of the membership is from Virginia Beach and Newport News, Virginia. Their members visit the Outer Banks all year long on a regular basis. The ESA hosts three or four contests per year in the Refuge between April and October. The ESA's annual eastern United States surfing championship is also held in the Refuge. During the peak summer season, the ESA's members choose to surf in the Refuge because there are too many people in Nags Head and other areas of the Outer Banks. In addition to the lack of crowds, the Refuge also has the best waves. (Personal communication, January 11, 2005, Julie Leavel, Outer Banks District Representative.)

The North Carolina Beach Buggy Association (NCBBA) has approximately 4,700 members nationally. Although ORVs are prohibited on the beach within the Refuge, NCBBA's members park on the shoulders of NC 12 within the Refuge throughout the year to gain access to many other activities (e.g., fishing, beach, etc.). The primary locations for off-roading for NCBBA members are within the Seashore to the north of Oregon Inlet and on Hatteras Island to the south of the Refuge. Many NCBBA members use their vehicles to transport fishing gear, surfboards, and other large recreational equipment into the Refuge. (Personal communication, March 11, 2005, Jim Keene, President.)

Three of the associations interviewed (Cape Hatteras Bird Club, Cape Hatteras Anglers Club, and Coastal Wildlife Refuge Society) believe that their members would continue to visit the Outer Banks with the loss of paved access through the Refuge. The Eastern Surfing Association and the North Carolina Beach Buggy Association, however, both stated that it is likely that fewer of their members from outside the local area would visit the Outer Banks under this scenario. If there was no paved road access to the Refuge, the ESA representative believes they would not be able to hold their surfing contests in the Refuge.

3.5.2.5 Plan

The USFWS prepared a *Pea Island National Wildlife Refuge Comprehensive Conservation Plan* (USFWS, 2006) to guide the management of the Refuge. The plan, which was published in September 2006, outlines programs and corresponding resource needs for the proceeding 15 years, as mandated by the National Wildlife Refuge System Improvement Act of 1997. The purpose of the plan is to identify the role that the Refuge will play in support of the mission of the National Wildlife Refuge System and to provide long-term guidance to the Refuge's management programs and activities. The plan is described in Section 3.1.3.4.

3.5.2.6 Natural Resources

The Refuge is comprised of ocean beach, dunes, upland, fresh and brackish water ponds, salt flats, and salt marsh (see Figure E-2 in Appendix E). Its bird list boasts more than 365 species; its wildlife list has 25 species of mammals, 24 species of reptiles, and 5 species (low number because of salt environment) of amphibians. Concentrations of ducks, geese, swans, wading birds, shore birds, raptors, and neotropical migrants are seasonally abundant in the Refuge. The Refuge has 1,000 acres (404.7 hectares) of manageable waterfowl impoundments. Several shorebird nesting areas and wading bird rookeries are on the Refuge. Endangered and threatened species include peregrine falcons, loggerhead sea turtles, and piping plovers (Pea Island National Wildlife Refuge web site, August 18, 2008).

Ten types of wetland communities also are in the Refuge portion of the project area (see Section 3.7.4). Eleven USFWS listed threatened or endangered species are documented in the project area and/or have suitable habitat within the project area (see Section 3.7.7).

3.5.2.7 Influence of Beach Erosion and Potential Breach Formation on the Refuge

Hatteras Island is eroding within the Refuge. Forecast 2010 to 2060 high erosion shorelines assumed in this FEIS are presented in Figure E-1 in Appendix E. Shoreline erosion is considered a natural process by Refuge officials and is preferable to artificially maintaining the shoreline, despite its threat to Refuge access and facilities.

As indicated in Chapter 1, shoreline erosion and ocean overwash threaten to sever segments of the NC 12 roadway for several miles (kilometers) south of Bonner Bridge. The highest erosion rates occur in the northern Rodanthe area with an average of 15 feet (4.6 meters) per year. Erosion rates north the Refuge's ponds are as high as 8 feet (2.4 meters) per year. In addition, there is risk that NC 12 could be severed by a future breach at the south end of the Refuge. The formation of a breach in the Refuge would separate almost all of Hatteras Island and its associated communities, tourism businesses, and the Cape Hatteras National Seashore from Bodie Island and the mainland (see Section 3.6.3.4).

In addition to affecting NC 12, ongoing beach erosion would affect several Refuge features. The Refuge Visitor Center and headquarters will be threatened by 2020. By 2050, portions of the Refuge's freshwater ponds will have eroded into the ocean. Starting points for the North Pond and Salt Flats wildlife trails would be affected. Beach erosion at the southern end of the Refuge and/or future breach formation could result in all or part of the Refuge becoming a separate island.

3.6 Coastal Conditions

Coastal processes drive the physical changes in the Oregon Inlet area. This section first discusses the floodplains in the project area. Next, it documents and analyzes historic trends and existing coastal conditions, including:

- Inlet migration;
- Changes in inlet gorge alignment and location;
- Historic shoreline changes for Hatteras and Bodie islands; and
- The natural and manmade factors that drive inlet and shoreline changes.

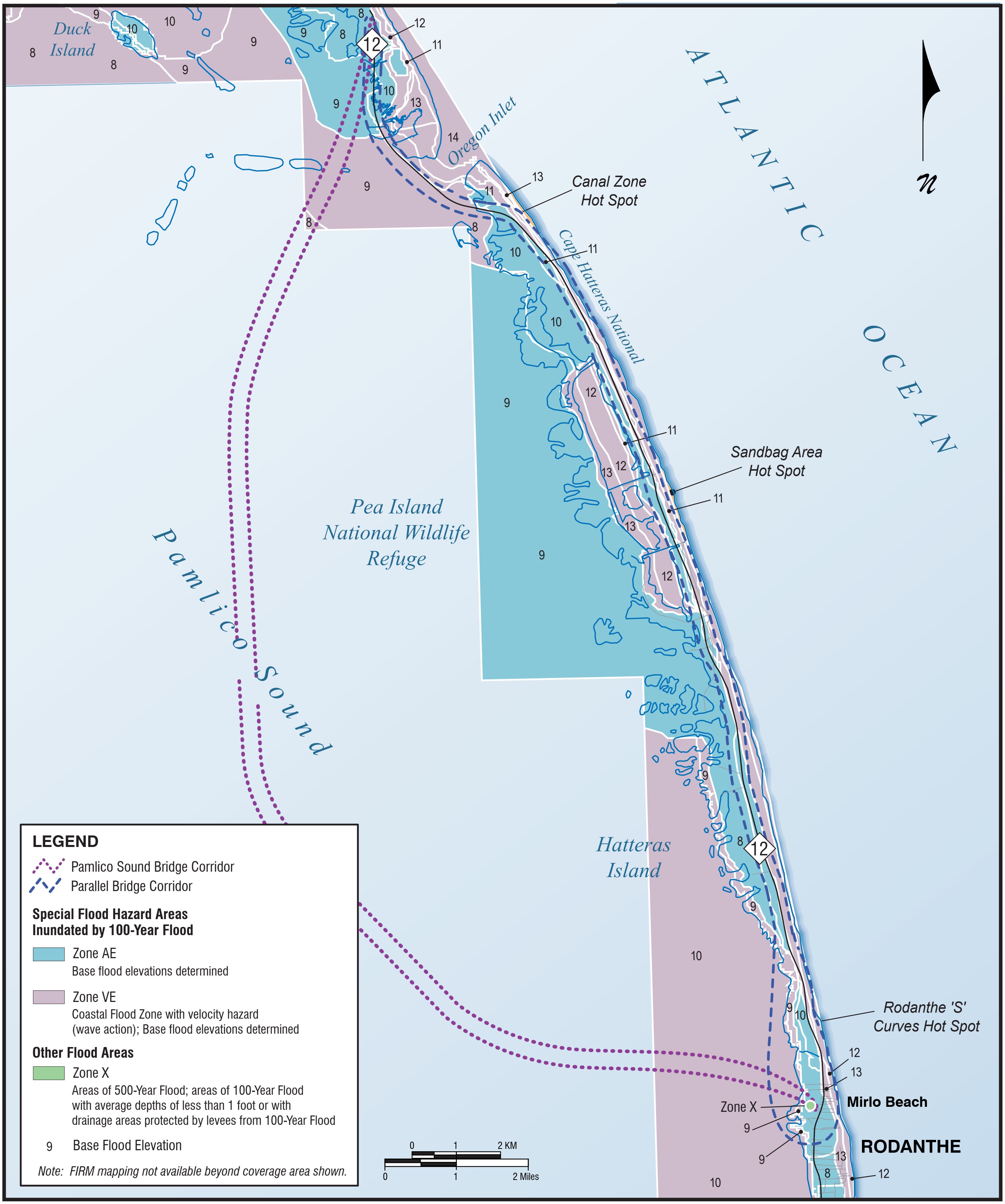
Finally, this section presents projections of future coastal conditions, including:

- The Hatteras Island shoreline through 2060;
- Potential breach locations in the Pea Island National Wildlife Refuge; and
- Oregon Inlet movement through 2085 based on historical data.

The Hatteras Island shoreline material is derived from *Bonner Bridge Replacement – Parallel Bridge Corridor with NC 12 Maintenance – Shoreline Change and Stabilization Analysis* (Overton and Fisher, June 2005). The breach location findings are based on available research materials and the observations of an expert panel based on that research. The material on Oregon Inlet movement summarizes the coastal study findings of *Bonner Bridge Replacement: Oregon Inlet Movement Consideration* (Moffatt & Nichol, September 25, 2003). It is also based on three previous reports: *Existing Coastal Conditions at Oregon Inlet, North Carolina* (Moffatt & Nichol, June 1990), *Future Coastal Conditions at Oregon Inlet, North Carolina* (Moffatt & Nichol, October 1990), and *Coastal Engineering Technical Memorandum* (Moffatt & Nichol, July 1991).

3.6.1 Floodplains

The entire project area is within flood zones mapped by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program (see Figure 3-4). In addition, much of the floodplain within the project area is classified as being a coastal flood zone with velocity hazard because of wave action. However, the floodplains in the project area do not serve the same function (i.e., as a natural moderator of floods) as floodplains in non-coastal areas because water levels in the project area are not dependent on floodplain storage capacity. Rather the project area is subject to coastal flooding caused by both hurricanes in the summer and fall months and northeasters in the winter and spring, both of which can raise water levels substantially via storm surge. The tidal surge comes into shore with the storm, and then begins to retreat almost immediately once the storm moves on. The only storage that occurs in the project area floodplains is during the brief interval between the surge and the ebb of the storm-induced tide. The 100-year storm surge elevation is 6.89 feet (2.1 meters), and the 500-year storm surge



Source: Flood Insurance Rate Maps dated September 20, 2006.

FLOODPLAINS	Figure 3-4

elevation is 7.58 feet (2.3 meters). Beneficial floodplain values are associated with this tidal surge. They are:

- Serving as a buffer (therefore flood control) to protect mainland shoreline areas by dampening tidal surges;
- Contributing to the natural barrier island evolution, whose benefits are discussed in Section 4.7.7; and
- Contributing to beneficial ecological change and habitat creation associated with barrier island evolution, also described in Section 4.7.7.

3.6.2 Existing Coastal Conditions

Oregon Inlet, Bodie Island, and Hatteras Island are part of a migrating barrier system characteristic of the southeast Atlantic Coast. The south end of Bodie Island is an actively prograding (growing) spit system that has back-filled the Bodie Island shoulder of Oregon Inlet with modern beach and island sediments as Oregon Inlet has migrated southward. Oregon Inlet is migrating south-southwest and historically has eroded the north side of Hatteras Island.

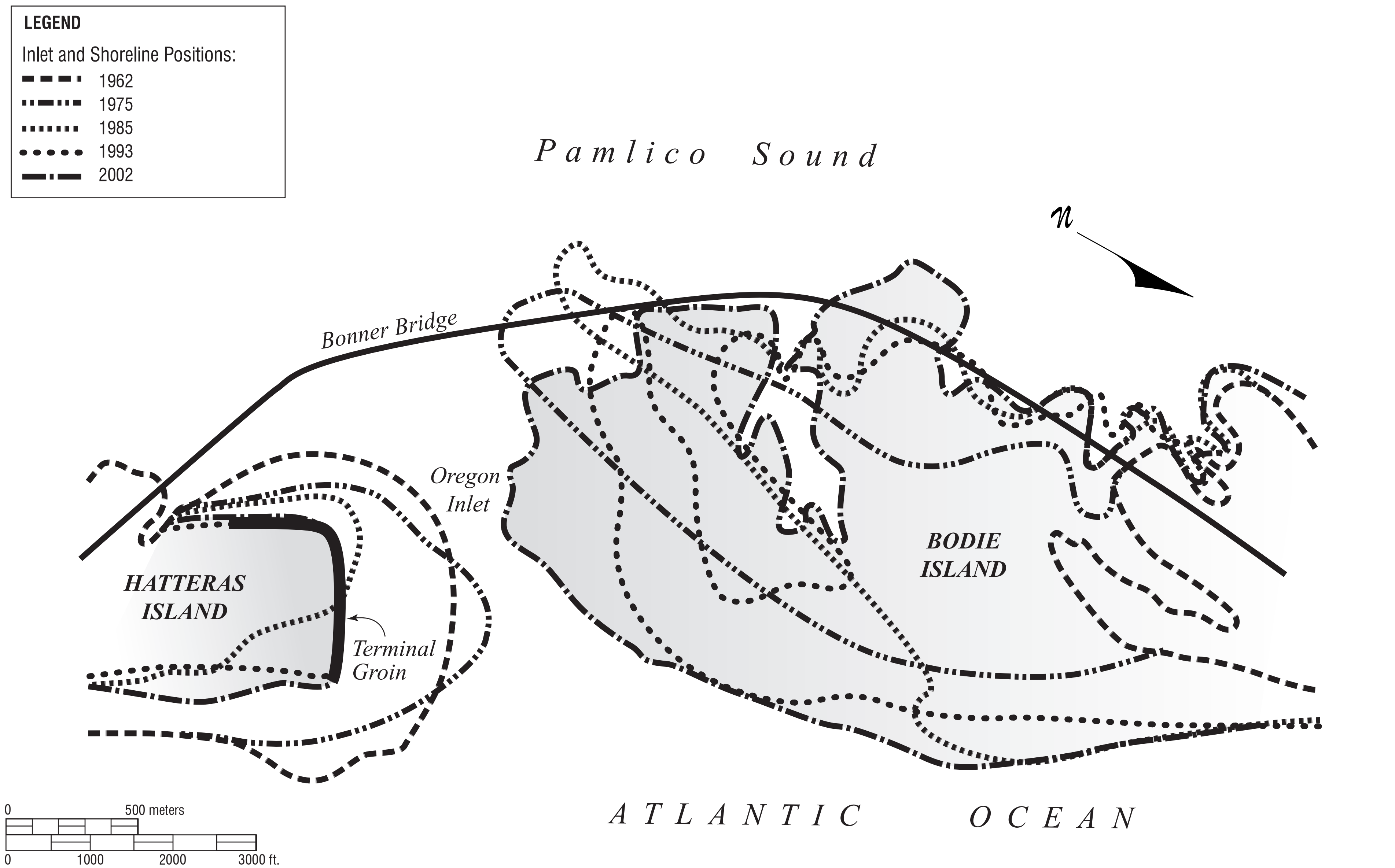
In this natural process, the north end of Hatteras Island (within 3 miles [4.8 kilometers] of Oregon Inlet) historically is a zone of high erosion. As a result of the continued inlet migration threatening the southern terminus of Bonner Bridge and the north end of Hatteras Island, the NCDOT built a terminal groin at the northern end of Hatteras Island to protect the southern approach to Bonner Bridge. The groin was designed by the USACE Wilmington District. Construction of the terminal groin began in October 1989 and was completed in March 1991. As a result of the construction of the terminal groin, Hatteras Island migration has halted. However, Bodie Island has continued to exhibit both along-shore and cross-shore migration. This continued migration has resulted in changes in both inlet width and orientation.

3.6.2.1 Inlet Migration

Since its opening during a storm in 1849, the midpoint of Oregon Inlet has migrated steadily southward just over 2.2 miles (3.5 kilometers) and landward approximately 2,070 feet (630 meters). The history of Oregon Inlet's migration has been punctuated by alternate widening and narrowing, typically in response to severe storms and primarily reflected by the erosion and accretion of the Bodie Island shoulder of Oregon Inlet. Inlet location changes since the opening of Bonner Bridge are illustrated in Figure 3-5. Until the construction of the terminal groin, the Hatteras Island shoulder moved steadily southward, showing little tendency toward significant accretion and northward movement. After construction of the terminal groin commenced, the southern migration of Hatteras Island halted. In recent years, Bodie Island has continued to accrete, causing Oregon Inlet width to narrow further, reaching a minimum width of 2,000 feet (610 meters) in 2002.

During the period from 1849 to 1945 (New Inlet, approximately 15 miles [24 kilometers] south of Oregon Inlet, closed in 1945), the Bodie Island shoulder migrated 6,000 feet (1,830 meters) or 63 feet (19 meters) per year south of its original position. Hatteras Island migrated 8,250 feet (2,510 meters) or 86 feet (26 meters) per year south of its original position.

From 1945 to 1989 (construction of the terminal groin began in 1989), the Bodie Island shoulder migrated 3,770 feet (1,150 meters) or 84 feet (26 meters) per year south of its original position.



Sources: US Army Corps of Engineers "Historic Changes in Oregon Inlet" and 1993 and 2002 aerial photography

INLET AND SHORELINE CHANGES

Figure 3-5

In that period, the Hatteras Island shoulder migrated 4,640 feet (1,410 meters) or 103 feet (31 meters) per year southward. The maximum inlet width of 6,670 feet (2,033 meters) was achieved in 1962, following a storm-laden period from 1953 through 1962, which culminated in the Ash Wednesday Storm of March 1962. The general tendency is for Oregon Inlet to widen after stormy periods, during which both shoulders of Oregon Inlet experience severe erosion. During calm periods, Oregon Inlet tends toward its minimum width of about 2,100 feet (640 meters).

The period from 1962 to 1983 generally was storm-free, and the Bodie Island shoulder spit redeveloped rapidly, accreting southward into Oregon Inlet for a total distance of 6,560 feet (2,000 meters) or 312 feet (95 meters) per year.

From 1983 to 1989, both the Bodie Island and the Hatteras Island shoulders eroded rapidly. The Bodie Island shoulder eroded 1,850 feet (560 meters) or 308 feet (94 meters) per year, and the Hatteras Island shoulder eroded 1,640 feet (500 meters) or 273 feet (83 meters) per year. However, between April 1988 and March 1989, the north end of Hatteras Island eroded at an extreme rate of 1,150 feet (350 meters) per year; with 350 to 400 feet (110 to 120 meters) of erosion occurring in the four-day period of March 6 to 10, 1989, when a severe northeaster storm pounded the coast. The width of Oregon Inlet increased steadily from 1,983 to 5,000 feet (605 to 1,520 meters) in 1989.

From 1990 to 2001, Bodie Island migrated southward 1,955 feet (600 meters) or 163 feet (50 meters) per year. Erosion of Hatteras Island was halted by the terminal groin during this period. Hatteras Island actually accreted 1,120 feet (340 meters) or 93 feet (28 meters) per year with the construction of the terminal groin.

Recent inlet position comparisons from September 2001 and March 2002 surveys show that Bodie Island's inlet shoulder advanced 443 feet (135 meters) over the six-month period. By March 2002, the spit had migrated almost two-thirds of the way across the preferred channel alignment projecting from the navigation span of Bonner Bridge. This updated rate of spit movement equals 886 feet (270 meters) per year.

3.6.2.2 Inlet Profile and Gorge Alignment

As Oregon Inlet migrated, the profile of Oregon Inlet (a cross-section through the narrowest point of Oregon Inlet) has changed configuration. The profile falls between two extreme shapes. Like the location of Oregon Inlet's shoulders, the shapes are related to stormy and storm-free periods. During relatively storm-free periods when the Bodie Island shoulder is in the shape of an elongated spit, the cross-section of Oregon Inlet is narrow but deep with steep banks. After stormy periods, when Oregon Inlet's shoulders are well-rounded, the configuration is a shallow channel with wide overbanks on one or both sides.

Conveyance (the ability to allow the passage of water) of Oregon Inlet generally has been stable since the most recent closure of New Inlet in 1945. The presence of multiple inlets on an estuary results in the separation of tidal flow volumes through each inlet. After New Inlet's closure, its effect on the behavior of Oregon Inlet was removed. During the past 60-year period, Oregon Inlet's conveyance was computed and found to vary by approximately 36 percent over this time. Changes in the cross-sectional area of Oregon Inlet have ranged from 37,440 to 58,700 square feet (3,480 to 5,450 square meters), an approximate 36 percent difference. Despite the changing shape of Oregon Inlet's cross-section, Oregon Inlet's hydraulic efficiency has been relatively stable.

The inlet cross-sectional area and hydraulic conveyance have decreased, however, since 1996. Since 1996, the cross-sectional area decreased by 29 percent, and the conveyance decreased by 24 percent; however, these values still fall within historical ranges. The groin tends to help create a narrower and deeper inlet.

The location of Oregon Inlet's gorge—or the deepest part of Oregon Inlet's cross-section—at times has remained relatively stable, but there is a constant tendency for the gorge to migrate southward. Dramatic shifts in the location of the gorge appear to be associated with the occurrence of major storms and are accomplished during short time frames. The gorge has tended to remain at the center of Oregon Inlet as the inlet migrates southward. After severe storms, however, when the Bodie Island shoulder has retreated northward substantially, the gorge has not also moved northward any great distance.

The movement of Oregon Inlet's gorge has created difficulty for the USACE in maintaining the navigation channel beneath the Bonner Bridge's navigation span. In the first few years after the completion of Bonner Bridge, the location of the channel through the navigation span was maintained by the natural scouring action of tidal currents. However, beginning in 1968, the shoaling rate for this part of the channel increased markedly as the fully developed sand spit on the Bodie Island shoulder began migrating southward toward the span. Bottom profiles have shown the gorge somewhere other than at the navigation span most of the time since 1971. Furthermore, the movement of the gorge has complicated the maintenance of the ocean bar channel. In 1981, the ocean bar channel adjacent to the south end of Bodie Island began to deteriorate, and a new bar channel formed in a more central location between Oregon Inlet's shoulders. Intense dredging efforts have failed to maintain desired depths for any substantial length of time.

3.6.2.3 Island Shoreline Changes

The island shorelines north and south of Oregon Inlet have eroded generally since the opening of Oregon Inlet in 1846. During the period from 1846 to 1980, both the Bodie Island shoreline and the Hatteras Island shoreline eroded at a rate between 10 and 20 feet (3 to 6 meters) per year. The greatest erosion rates occurred in the immediate vicinity of Oregon Inlet and declined with increased distance from Oregon Inlet.

Storms that occurred between September 9, 1960, and March 28, 1962, which included Hurricane Donna and the Ash Wednesday Storm, produced the most dramatic shoreline responses. The cumulative effect of the two storms was a general recession of the shoreline of both Hatteras and Bodie islands. The average annual erosion during this time (1960 to 1962) was approximately 200 feet (60 meters) per year, except near Oregon Inlet and just to the north on Bodie Island where the erosion averaged 389 feet (119 meters) per year. During severe storms such as Hurricane Donna and the Ash Wednesday Storm, sediment along the beach face generally moves offshore as the beach profile flattens to absorb the increased wave energy. During the recovery stage, sediment migrates onshore back to the upper portions of the beach profile. By October 1965, the recovery stage was basically complete.

During the next 10-year period (1965 to 1975, a relatively calm period), the areas adjacent to Oregon Inlet experienced slight accretion. The accretion along Bodie Island likely was associated with the redevelopment of the Bodie Island spit following the Ash Wednesday Storm.

From 1983 to 1990, there was a large build-up of material on the ocean shoreline of Bodie Island extending about 2 miles (3.2 kilometers) north from Oregon Inlet. Shoreline accretion rates averaged about 180 feet (55 meters) per year directly adjacent to Oregon Inlet from November 1983 through January 1990.

Long-term average annual shoreline erosion rates along Bodie Island were released by the DCM through 1998. Within the first 2.5 miles (4.0 kilometers) north of Oregon Inlet on Bodie Island, the shoreline erosion was estimated to be 2 feet (0.6 meters) per year. Over the first 5.5 miles (8.9 kilometers) of shoreline north of Oregon Inlet, the observed shoreline change rates varied, ranging from 2 feet (0.6 meters) per year to 10 feet (3 meters) per year of erosion. Some areas north of Oregon Inlet have been influenced by beach nourishment projects either for beach protection or dredge disposal.

The shoreline of Hatteras Island near Oregon Inlet experienced severe erosion until the construction of the terminal groin began in 1989. From 1983 to 1989, the shoreline area extending 3 miles (0.9 kilometers) south of Oregon Inlet eroded at an average rate of 33 feet (10 meters) per year. During this period, erosion rates increased substantially in proximity to Oregon Inlet; within 6,000 feet (1,830 meters) of Oregon Inlet, the average erosion rate was 53 feet (16 meters) per year.

Long-term average annual shoreline erosion rates along Hatteras Island through 1998 also were released by the DCM. Within the first 0.5 mile (0.8 kilometers) south of the groin, the shoreline erosion was estimated to be 16 feet (4.9 meters) per year. Over the first 4 miles (6.4 kilometers) of shoreline south of the groin, the observed shoreline change rates were highly variable, ranging from 7 feet (2.1 meters) per year to 16 feet (4.9 meters) per year of erosion. In addition to these accelerated rates of erosion, three hot spots (Canal Zone, Sandbag Area, and Rodanthe 'S' Curves) or areas of concern with regard to beach and dune erosion, as well as highway vulnerability to overwash, were identified south of Oregon Inlet and in the project area. There are six such hot spots identified along the length of NC 12. In these areas, NC 12 is particularly vulnerable to overwash because of narrow beaches and low dune heights. See Section 1.1.3 for an additional discussion of these hot spots. The locations of the three hot spots in the project area are shown in Figure 1-1. A forecast of future shoreline erosion on Hatteras Island in the project area was developed and is discussed in Section 3.6.3.1.

3.6.2.4 Natural Factors Affecting Inlet and Shoreline Changes

Storms

The North Carolina coast is subject to two types of severe windstorms: extra-tropical northeasters and hurricanes. Northeasters, with accompanying high tides and waves, can rapidly erode the shoulders of Oregon Inlet. Northeasters are fairly common in this area, with between 30 and 35 of varying severity hitting the coast each year. Hurricanes may be responsible for major events, such as inlet openings and closings and gorge shifts, but because of their relative infrequency (approximately one hurricane every two years) and the north-northwest/south-southeast barrier island orientation, the overall impact of hurricanes is less significant than northeasters on this section of the coast.

Winds

Water levels in Oregon Inlet are determined mainly by local winds rather than by astronomical tides. Winds produce either an increase or decrease in water levels depending upon wind direction. Westerly and southerly winds substantially increase water levels in Pamlico Sound at Oregon Inlet, while easterly winds produce dramatic reductions in water levels. Storm surges associated with hurricanes and extra-tropical lows have dramatic impacts on Oregon Inlet by generating water level differences between the sound and the ocean, which potentially could be more than 10 feet (3 meters). The maximum sound water level of 7.5 feet (2.3 meters) over mean sea level was recorded during Hurricane Donna, in September 1960; during the Ash Wednesday Storm in March 1962, the maximum ocean surge level of 8 feet (2.4 meters) over mean sea level was recorded.

Currents are mostly wind-determined and have been estimated to have reached a maximum of about 7 feet per second (2 meters per second) at the Bonner Bridge navigation span zone during the Ash Wednesday Storm (1962) and Hurricane Donna (1960), with even higher velocities at other points along the bridge. During model studies conducted by the USACE, a peak velocity of 17 feet per second (5 meters per second) in the Oregon Inlet channel was estimated to result from the combined effort of currents and the water particle velocities associated with passing waves.

Local Wave Climate

Significant wave heights at Oregon Inlet average about 3 feet (0.9 meters), with yearly extreme significant wave heights of at least 10 feet (3.0 meters). Research has indicated that waves of 5 feet (1.5 meters) or higher cause some degree of beach change along the mid-Atlantic coast barrier islands. Wave heights exceeding 5 feet (1.5 meters) occur approximately 10 percent of the time in the project area. The majority of the wave energy at Oregon Inlet comes from the northeast and east directions; this accounts for the southward migration of Oregon Inlet.

Scour

Local scour and the shifting navigational channel within Oregon Inlet often have threatened Bonner Bridge since its construction in 1962. Because of such conditions, numerous retrofits have been built.

Sand Bypassing

Sand is driven naturally by waves and currents along the coast until its movement is interrupted by an obstruction, such as a tidal inlet or a large manmade structure like a jetty. These obstructions tend to trap the sand and can cause the downdrift shoreline to erode because it becomes starved of its former supply of sand. In the case of Oregon Inlet, the downdrift shoreline is along Hatteras Island. Eventually, the obstruction becomes filled with sand and movement resumes. This is known as sand bypassing. For a tidal inlet, a common natural bypassing method is movement of sand along the large ebb tidal shoals that follow a curved path out into the ocean and span from one side of Oregon Inlet to the other. In order to mitigate the effects of man-made structures, natural sand bypassing can be supplemented or assisted by placing sand that is dredged from Oregon Inlet on the beach of the downdrift shoreline.

3.6.2.5 Navigation Channel Dredging Operations

Like all active tidal inlets, Oregon Inlet requires periodic dredging to maintain a navigation channel. In 1950, when the Oregon Inlet ocean entrance channel project was authorized, the channel configuration was specified as 14 feet (4.3 meters) deep at mean low water with a bottom width of 400 feet (122 meters). Maintenance dredging began in 1960, and, since then, the USACE has used hopper, sidecast, and ocean-going pipeline dredges for the work. Large amounts of dredging have been needed on a regular basis. Despite the large-scale efforts, however, the Oregon Inlet channel continues to migrate.

3.6.3 Future Coastal Conditions

Three aspects of future coastal conditions were considered. High erosion (i.e., assuming an erosion rate greater than past trends) Hatteras Island shorelines for 2010 to 2060 (in 10-year increments) were developed primarily as an aid to determining the location and other requirements of the NC 12 maintenance component of the Parallel Bridge Corridor. The potential for a breach to occur in Hatteras Island within the project area was examined so that if a breach was likely, the cost of closing the breach and the economic loss to Dare County until the breach was closed could be considered in project decision-making. Finally, the potential for movement of Oregon Inlet with and without the terminal groin was considered, since that with the Pamlico Sound Bridge Corridor, the groin would no longer be needed to protect the southern terminus of a bridge across Oregon Inlet.

3.6.3.1 Hatteras Island Shoreline through 2060

The forecast 2010 to 2060 high erosion shorelines in the project area on Hatteras Island are shown at 10-year intervals in Figure E-1 of Appendix E. Long-term shoreline change was determined from an analysis of aerial photography and historic topographic sheets from the US Coast and Geodetic Survey dating from 1946 to 2004, a 58 year time period. Linear trends were determined for 106 transects (shoreline location cross-sections) within the project area from northern Rodanthe to Oregon Inlet.

The highest erosion rates occur in the northern Rodanthe area with an average of 11 feet (3.4 meters) per year. In the ponds area, the average rate is 7 feet (2.1 meters) per year. For the area north of the ponds, the erosion rate is approximately 5 feet (1.5 meters) per year.

In order to capture the uncertainty of predicting shoreline locations through 2060 with these data, 95 percent prediction intervals also were calculated from the data (i.e., a range of shoreline locations for which there is a 95 percent chance that the future shoreline will actually lay within these bounds). The width of the prediction interval depended on the variability and quantity of the historical shoreline data at each transect and therefore varied from transect to transect. The spatial average of the prediction interval in 2060 was found to be 240 feet (73.2 meters), with a maximum value of 600 feet (182.9 meters) and a minimum value of about 80 feet (24.4 meters).

The prediction of future shoreline position assumes that the trend in the shoreline change from the historical data will continue for the next 55 years. Because of the complex interactions that cause shoreline change, a high erosion shoreline (i.e., a shoreline that experiences an erosion rate greater than past trends) was assumed in developing alternatives for NC 12 maintenance through 2060. This high erosion scenario is assumed to be the upper bound (or landward extent) of the shoreline position range determined by the mean (average) plus the prediction interval. In addition, highway vulnerability to long-term erosion is defined as being susceptible to flooding and overwash when the distance from the edge-of-pavement to the active shoreline (i.e., the mean high water line) becomes less than or equal to 230 feet (70.1 meters) (i.e., the buffer width between the road and the ocean discussed in Section 2.6.2.1). This distance of 230 feet (70.1 meters) was added to the 2060 high erosion shoreline in order to establish the closest point to the ocean appropriate for NC 12 relocation alternatives. (The 2060 high erosion shoreline was referred to as the “2060 worst-case shoreline” in the SDEIS and SSDEIS.)

High erosion rates, when combined with narrow island widths in several locations, correspond with potential storm-caused Hatteras Island breach locations. The processes described above do not include potential alongshore and cross-shore changes that might occur if a breach forms and is allowed to remain open.

3.6.3.2 Sound-Side Erosion near Oregon Inlet

Erosion on the estuarine side of the terminal groin has developed since 1993. The observed erosion mimics the inner-bank erosion processes found in inlets stabilized with jetties (Seabergh, 2002). The ebb flow (tide returning to ocean) channel on the Hatteras Island side of Oregon Inlet has migrated to be relatively shore parallel. The channel currents have capacity to scour at the base of the rock revetment, the terminus of the protection for Bonner Bridge. The maximum shoreline erosion to 2006 is 275 feet (83.8 meters), and substantial shoreline change extends approximately 1,000 feet (304.8 meters) south of the rock revetment. Similar erosion in stabilized inlets with jetties has been observed to lead to breaching and subsequent isolation of the jetty from the shoreline (Seabergh, 2002).

If this inner-bank erosion continues near Oregon Inlet, it could contribute to breaching and could cause substantial changes in the geomorphology around the inlet. If the breach develops into an inlet just south of Oregon Inlet and isolates the terminal groin, this breach will compete with the existing Oregon Inlet for hydraulic control. In this case, the assumptions associated with the location of the navigation channel, the maintenance dredging required for the desired level of performance, and the long-term erosion expected south of the new inlet would be affected.

This potential for breaching, because of inner-bank erosion, is highly dependent on the characteristics of the ebb and flood (tide coming from the ocean) channels, associated ebb and flood deltas, and the impact these features have on the estuarine shoreline. Both long-term and short-term change resulting from storm events play an important role.

The potential breach can be accounted for in the Parallel Bridge Corridor alternatives that extend the Oregon Inlet bridge south of the inlet (with All Bridge and with Phased Approach [including the Preferred Alternative]) in the design of their substructure. The Pamlico Sound Corridor would bypass this location and associated issue.

3.6.3.3 Accelerated Sea Level Rise

As noted above, the data used to compute the shoreline change rates and the prediction intervals are derived from 58 years of shore line data. Thus any rise in sea level during that time is captured in the data. Data collected from 1978 to 2002 at Duck, North Carolina reveal past sea level rise trends in the area are 4.27 (+/-1.45) millimeters per year (0.17 inches per year, +/- 0.06 inches per year).

The potential for shoreline change because of accelerated sea level rise along the Mid-Atlantic region was recently reported by Gutierrez et al (2007) using four scenarios. The time frame was defined in this report as long-term, or up through the end of this century (i.e., 2100). The scenarios are:

1. A continuation of the 20th century sea level rise rate (accounted for in project shoreline change rates);

2. The 20th century rate + two millimeters (0.08 inches) per year;

3. The 20th century rate + seven millimeters (0.28 inches) per year; and

4. A two meter (6.6 feet) rise over the next few hundred years.

Scenarios 2 and 3 were developed to be within the range of increased rates presented by the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Bindoff et al., 2007) and are the two addressed in this Final Environmental Impact Statement (FEIS). For wave dominated barriers such as Hatteras Island, Gutierrez et al (2007) report that for scenario 2 it is “virtually certain” morphological change such as overwash, erosion and inlet formation will continue, and that it is “very likely” that portions of the barriers will exhibit “threshold behavior.” Indicators of threshold behavior are "a) rapid landward recession of the ocean shoreline, b) decrease in barrier width and height, c) increased overwash during storms, d) increased barrier breaching and inlet formation, and e) chronic loss of beach and dune sand volume." For scenario 3, it is "about as likely as not" that there will be loss of the back barrier marshes and shallow shoals, leading to changes in the hydrodynamic conditions and thus the evolution of the barriers.

During the development of the FEIS, FHWA hosted a Peer Exchange workshop seeking to incorporate recent scientific research on global climate change effects and accelerated sea-level rise into the previous shoreline analysis for this project. The outcome of the Peer Exchange was to identify if any analytical gaps exist between the shoreline erosion forecast conducted for the project (see Section 3.6.3.1) compared to recent and relevant research on global climate change. The Peer Exchange included a panel of coastal engineering and geology experts with knowledge of the local area as well as experts with knowledge of recent research on global climate change. The Peer Exchange panelists agreed that there is not a good predictive model that should be considered further in regards to shoreline change as a result of accelerated sea level rise. Therefore, the best response to considering accelerated sea level rise is to address how the shoreline studies completed for this FEIS reflect the outcomes of accelerated sea level rise. As described in Section 3.6.3.1, the overall approach to the coastal analysis through 2060 in this FEIS takes into account shoreline change predictions based on past conditions and episodic events (e.g., formation of the inlets), data which is based on geologic and geomorphological characteristics, combined with site specific knowledge of the history of the barrier islands. The conditions expected to occur in the shoreline forecasts in this FEIS are precisely those which scenario 2 above considers “virtually certain” to occur (overwash, erosion, and inlet formation). Project planning acknowledges this expected certainty. The effect of uncertainties in determining exact location and timing of shoreline change are addressed to different extents by the detailed study alternatives, as discussed in the impact assessment in Chapter 4.

In the Rodanthe area, the shoreline issues reflected in project planning are consistent with the indicators of "threshold behavior", also a potential partial outcome of scenario 2:

- Rapid landward recession (forecast shoreline change);

- Decrease in barrier width and height, increased overwash, and loss of sand volume (reflected in the potential for storm maintenance activities in the Rodanthe area prior to the completion of the project; and

- The potential for a breach or inlet.

With scenario 3, the characterization is that sea level will rise at such a fast rate that the barrier islands will not have a chance to “roll over.” That is, the naturally expected overwash, deposition on the back barrier, erosion on the oceanside will not occur. Though not stated by Gutierrez et al, (2007), this will lead to further loss of island width and “threshold behavior” leading to island segmentation and disintegration.

3.6.3.4 Potential for Island Breaches

This section addresses potential breach locations, the potential for a breach to open in the project area, potential depth of breaches, and the potential affect of breach formation on coastal change assumptions.

Potential Breach Locations

The starting point for the consideration of potential breach locations was a draft product of the ongoing Coastal Cooperative Research Program, sponsored by East Carolina University, the US Geological Survey, and the North Carolina Geological Survey, which has been intensively studying the northeastern North Carolina coastal system since 2000. This study found that there are five potential breach locations within the Refuge (see Figure E-1 in Appendix E and Figure 2-8). The word "breach" is used rather than the word "inlet" because, if a breach were to occur, it would likely close eventually (although not necessarily immediately) and likely would not become a long-term phenomenon like Oregon Inlet. The one possible exception to this likelihood is Site 5 (described below). Following is a brief description of the characteristics of the five potential breach locations:

- Site 1. A molar-tooth (shaped) marsh platform with sand-filled overwash tidal channels underlies the entire barrier island. This site could open from either the ocean or the sound, with multiple channels that would be 100 to 300 feet (30.5 to 91.5 meters) wide and 10 to 25 feet (3.0 to 7.6 meters) deep (similar to the Hurricane Isabel breach that opened in 2003 at the north end of Hatteras Village).

- Site 2. The historic New Inlet (open during the early twentieth century) and associated flood-tide delta with one large sand-filled inlet channel underlying the entire barrier island. This breach could open from either the ocean or sound, with a single channel that could be 500 to 2,500 feet (152.4 to 762.2 meters) wide and 15 to 35 feet (4.6 to 10.7 meters) deep.

- Site 3. The historic Chickinacommock Inlet (open during the eighteenth and nineteenth centuries) with one large sand-filled inlet channel underlying the entire barrier island. This breach could open from either the ocean or sound, with a single channel that could be 500 to 2,500 feet (152.4 to 762.2 meters) wide and 15 to 35 feet (4.6 to 10.7 meters) deep (similar to the historic New Inlet).

- Sites 4 and 5. A single molar-tooth marsh platform has two sand-filled overwash tidal channels on each side of the platform that probably do not yet underlie the east side of the barrier island. However, in an exceptionally large storm or if Oregon Inlet is stabilized, the flooding or ebbing storm surge could flank the existing inlet channel and open small flanking channels that would be 100 to 300 feet (30.5 to 91.5 meters) wide and 10 to 25 feet (3.0 to 7.6 meters) deep or perhaps deeper adjacent to the terminal groin.

Breaching generally occurs during storm events and results from overtopping from the oceanside, elevated water levels and flow from sound to ocean, and/or seepage and liquefaction. Following a breach, the hydraulics of the system will dictate whether the breach grows into an inlet or whether it naturally closes. Longshore sediment transport (movement of sand along the ocean bottom parallel to the shore) will tend to close the breach, while the tidal exchange will tend to scour out the breach. Assuming that the flux (flow or movement of water) between ocean and sound is in equilibrium before the breach, the new breach will compete with the existing inlets for hydraulic exchange (water movement between the ocean and sound). In other words, the total hydraulic exchange quantified in terms of volume flow rate (e.g., cubic feet per second [meter per second]) could be split between multiple inlets. In addition, since flow rate is the product of average flow velocity times cross-sectional area, a wider inlet with smaller depths and velocity may exchange the same amount as narrower, deeper, higher velocity inlet. How this balance is achieved may either serve to continue the growth of the new inlet while closing down the old inlet, or it may serve to close the breach. A breach in the vicinity of a coastal structure (jetty, terminal groin, etc.) has the potential to undermine the structure and/or isolate it (leave it surrounded by water). If the new inlet grows in size, the navigation channel of the existing inlet will likely shoal at a more rapid rate than previously observed. If the trend continues toward "closure" of the existing inlet, the navigation channel will have to be relocated in the new inlet (Kraus, 2003).

Potential for a Breach to Open in the Project Area

The information from the Coastal Cooperative Research Program provided the starting point for an expert panel that considered the likelihood that a storm would open a breach in Hatteras Island at one of these five locations by 2060. The expert panel also reviewed other models and techniques for inlet prediction and met to reach a consensus estimate on potential inlet formation. The panel members were:

- Dr. Robert Dean, coastal engineer, Professor Emeritus, University of Florida;
- Dr. Robert Dolan, coastal geologist, Professor, University of Virginia;
- Mr. Carl Miller, research oceanographer, Field Research Facility, USACE, Duck, North Carolina;
- Mr. Michael Wutkowski, coastal engineer, Wilmington District, USACE;
- Dr. Stanley Riggs, coastal geologist, Professor Emeritus, East Carolina University;
- Dr. Margery Overton, coastal engineer, FDH Engineering/Professor, North Carolina State University;
- Mr. Tom Jarrett, coastal engineer, FDH Engineering, recently retired head of the Coastal Processes Branch, Wilmington District, USACE; and
- Dr. John Fisher, coastal engineer, FDH Engineering/Professor, North Carolina State University.

Prior to the meeting of the expert panel, members were sent the recent potential inlet report prepared by Dr. Riggs as well as a paper written by Mike Wutkowski on the Hatteras Village breach closure. In addition, the panel was sent an overview of the problem and the objectives of the meeting.

There was general agreement that there is a risk of a storm-related breach forming in the southern part of the Refuge (Site 3) prior to 2060. In addition, a storm event of the nature required to create a breach would probably occur once during that period. The southern part of the Refuge is the location of a prior inlet, and this part of the island is very narrow with relatively small dunes. There is also a relic channel across the estuarine marsh.

There was little panel agreement for a storm-related breach to develop at the other potential locations in the next 50 years. The panel noted that there are several factors that might preclude the occurrence of a storm-related breach at any site other than the southern part of the Refuge. These factors include the proximity to Oregon Inlet, that the Rodanthe site is the weakest section, and the current shoaling in Pamlico Sound (e.g., Oregon Inlet Shoal, see Figure 3-7 in Section 3.7.2.1) at the north end of Hatteras Island because of the shift in the channel through Oregon

Inlet. Dr. Dean noted that beach nourishment would greatly reduce the potential for breach formation.

At Site 5 near Oregon Inlet and the terminal groin, erosion on the estuarine (sound) side of the terminal groin has been observed since 1993. The observed erosion mimics the inner-bank erosion processes found in inlets stabilized with jetties (Seabergh, 2002). The ebb flow (water flow back towards the ocean) channel on the Hatteras Island side of the inlet (Davis Slough) has migrated to be relatively parallel to the shore. The Davis Slough channel's currents provide the capacity for scour at the base of the rock revetment protecting the southern terminus of Bonner Bridge. As indicated by Seabergh, if left "unabated, a crenulated [notched or scalloped] shaped shoreline region will develop from the terminus…" The maximum shoreline erosion to date is 275 feet (83.8 meters), and substantial shoreline change extends approximately 1,000 feet (304.8 meters) south of the rock revetment. Similar erosion in stabilized inlets with jetties has been observed to lead to breaching and subsequent isolation of the structure from the shoreline (Seabergh, 2002). If this inner-bank erosion continues, the immediate vicinity of the terminal groin (the northern portion of Site 5) will become more vulnerable than was concluded by the panel. This potential for breaching because of sound-side erosion at Site 5 in the immediate vicinity of the terminal groin is highly dependent upon the characteristics of the ebb and flood (flowing in of the tide) channels and associated ebb and flood deltas (area of sediment deposits) and the impact these features have on the estuarine shoreline. Both long-term (e.g., erosion) and short-term change because of storm events are important.

Shoreline change on the ocean side at Site 5 is also dependent on the natural inlet processes, as well as on the continuity of USACE's maintenance dredging and disposal program for Oregon Inlet. Accretion of the shoreline has occurred just south of Oregon Inlet since 1993, and this accretion is reflected in the shoreline model used to determine the future shoreline positions described in Section 3.6.3.1. Two features serve to promote accretion in this location. One is the disposal of dredged material in this location by the USACE. The USACE placed dredged material in this location in 1991 and in 2004. Two additional times, sand has been placed just south of Site 5, potentially supplying sand to Site 5 to the north. Longshore sediment transport is south to north in the vicinity of the terminal groin. Evidence of this is seen in the material deposited on the inlet side of the terminal groin. In addition, the USACE has placed dredged material in the nearshore off of Hatteras Island, effectively bypassing sand around the inlet and keeping it within the littoral system. These features provide a sediment rich environment on the ocean side of Site 5, serving to reduce the vulnerability of this location to a breach because of ocean overwash, where as noted in the previous paragraph, soundside erosion increases the vulnerability for a breach near the terminal groin.

Potential Depth of Breaches

The tidal prism is the volume of water moving through an inlet between high and low tides (or alternatively low and high tides). If Hatteras Island is breached, the relationship between the tidal prism and the cross-sectional area of flow in Oregon Inlet will be altered. Opening a breach will increase the inlet cross-sectional area of the two inlet system and will tend to decrease the velocities in the existing inlet (Kraus and Wamsley, 2003). It is not possible to precisely predict the depth and cross-sectional areas of the potential breaches given the unknowns (e.g., magnitude and duration of the storm, storm track, water elevation in the sound) related to the storm scenarios that might trigger a breach. Further, breaches have been documented to grow in depth and width after opening.

Documentation of breaching on Hatteras Island indicate varied depth responses. The breach on Hatteras Island that opened near Hatteras Village as a result of Hurricane Isabel in 2003 developed three channels that were truncated by more resistant peat filled deposits in between the channels. The west channel developed depths of 8 to 10 feet (2.4 to 3.0 meters), the middle channel approximately 5 feet (1.5 meters), and the east channel up to 20 feet (6.1 meters) before it was closed (Wamsley and Hathaway, 2004). Just north of Buxton, the Ash Wednesday storm opened a breach (Buxton Inlet) which developed depths of 8 to 11 feet (2.4 to 3.4 meters) before being closed (Wamsley and Kraus, 2005).

A review of historic US Coast and Geodetic Survey Hydrographic charts available through National Oceanic and Atmospheric Administration (NOAA) Historical Map and Chart Project reveals one chart with depth soundings during a period when both Oregon Inlet and New Inlet were open. At that time, 1913, Oregon Inlet is mapped with maximum depths of 4 fathoms (24 feet/7.3 meters) while New Inlet has a maximum depth of 2.5 fathoms (15 feet/4.6 meters). Later charts (1932, 1933) show New Inlet to be closed but indicate up to 11 feet (3.4 meters) of depth in the sound side channel associated with the historic location of New Inlet. The 1942 charts show New Inlet to be open, but no soundings are charted within New Inlet or the remnant sound side channels. Oregon Inlet is charted with a maximum depth of 32 feet (9.8 meters).

Recent experience with barrier breaching on Hatteras Island, as well as the documented relationship between Oregon Inlet and New Inlet (and assuming similar storm characteristics), suggest that expecting up to 10 to 20 feet (3.0 to 6.1 meters) post-storm depths in the three potential inlet sites (i.e., Sites 1, 2, and 3) from Rodanthe to the New Inlet area south of the Refuge's ponds would be reasonable given the range of what has been observed. At the northern-most sites, as described in Section 3.6.3.2, inner-bank erosion near Oregon Inlet could contribute to breaching and could cause substantial changes in the geomorphology around the inlet. If the breach develops into an inlet just south of Oregon Inlet and isolates the terminal groin, this breach will compete with the existing Oregon Inlet for hydraulic control. In this case, depths of a breach at the north end of Hatteras Island would be similar to depths experienced in Oregon Inlet.

Effect of Breach Formation on Coastal Change Assumptions

If breaches at Sites 1, 2, or 3 were to remain open, they would compete hydraulically with Oregon Inlet; however, the separation distance between the inlets would affect how the flow patterns between the ocean and the sound would be reestablished. In addition, the location of the throat of the inlet and the influence of the inlet on the up and downdrift beaches would affect predicted shoreline change. Shoreline change estimates presented in Section 3.6.3.1 would have to be reconsidered once a new dynamic is achieved. As noted in the previous section, Site 3 is the most likely location for a future storm-related breach.

Site 4 is close enough to Oregon inlet to compete for hydraulic exchange and thus potentially change the preferred location for maintaining a navigation channel. Further, shoreline change estimates between Oregon Inlet and an inlet at Site 4, as well as the area south of Site 4, would be affected by the opening of a breach at Site 4. However as noted in the previous section, the likelihood of an inlet forming in this location is thought to be less than other locations. In addition, a comparison of 1993 and 2006 aerial photographs indicates that sound-side erosion has not occurred in the Site 4 area since 1993 to the extent it has at Site 5.

For Site 5, the close proximity of the potential breach to the terminal groin suggests that an opening in that location could affect the performance of the terminal groin in terms of accelerated destabilization and increased costs of repair, as well as result in increased costs for channel maintenance dredging and loss of navigability in Oregon Inlet (based on Kraus and Wamsley's list of ten impacts of an unintended breach in a barrier island, 2003). A breach from the sound side just south of Oregon Inlet (Site 5) could cause substantial changes in the geomorphology (development of the land forms) around Oregon Inlet, particularly if the breach isolates the terminal groin from Hatteras Island and the existing channel shoals (fills in or becomes more shallow). Thus, unlike other potential breach locations, a breach at this location is more likely to become permanent and deep. In this case, the assumptions associated with the location of the navigation channel, the maintenance dredging required for the desired level of performance, and the long-term erosion expected south of the new inlet would necessarily change.

3.6.3.5 Oregon Inlet Movement Through 2085

As described above, the Oregon Inlet area is highly dynamic. In order for a replacement crossing to be sited properly in either of the project corridors, future inlet migration, shoreline erosion/ accretion, and channel movement and depth must be predicted, taking into account naturally occurring and man-induced influences.

The permit from the Refuge that allowed the construction of the terminal groin states that the purpose of the terminal groin is to: "…protect the southern segment of the existing Herbert C. Bonner Bridge and its southern approach of North Carolina Highway 12." The permit also states that the NCDOT can use the lands and waters occupied by the terminal groin for as long as they "are used for the purpose granted." The NCDOT has no current plans to remove the terminal groin on Hatteras Island after Bonner Bridge is demolished. If an Oregon Inlet bridge were built in the Parallel Bridge Corridor, the groin would be needed to protect its south approach, just as it currently protects Bonner Bridge's south approach. If a bridge were built in the Pamlico Sound Bridge Corridor, the terminal groin could serve parties other than the NCDOT and other immediate needs besides protecting Bonner Bridge or its replacement. It is conceivable, however, that circumstances could change at some time in the future, and it could prove prudent to remove the terminal groin if the Pamlico Sound Bridge Corridor is used for the replacement bridge. A new Special Use Permit for the retention of the terminal groin and revetment would be required if it is to remain in place with any of the replacement bridge corridor alternatives once Bonner Bridge is demolished. Without a new permit, the NCDOT would be obligated under the terms of the existing permit to remove the terminal groin and revetment two years after the construction of a replacement bridge at the request of the USFWS.

Thus, the effects of both the continued presence and the removal of the terminal groin on Oregon Inlet were examined, and these would be considered when placing the navigation zone as described for the proposed bridge in the Pamlico Sound Bridge Corridor in Section 2.9.2. For the Oregon Inlet bridge in the Parallel Bridge Corridor, the navigation zone would span much of Oregon Inlet. Findings presented below are based entirely on engineering judgments derived from a critical review of the information presented in the report, *Bonner Bridge Replacement: Oregon Inlet Movement Consideration* (Moffatt & Nichol, September 25, 2003). No quantitative analyses or numerical modeling were performed. At the time of the study in 2003, it was assumed that if a bridge were build in the Pamlico Sound Bridge Corridor that the project would be complete by 2010 and the groin removed at that time. The findings of the post-groin removal Oregon Inlet movement trends described in this section would begin in whatever year the groin would be removed and the constraint on inlet movement applied by the groin is released.

Oregon Inlet Conditions with the Terminal Groin

As of March 2002, the Bodie Island spit has migrated almost two-thirds across the preferred natural channel alignment projecting from the navigation span of Bonner Bridge. Between 1999 and 2001, the channel gorge at the narrowest cross-section had moved south approximately 830 feet (250 meters). If left unattended, the migration of Bodie Island likely will engulf the existing navigation span and channel, and scour could become a potential threat at the terminal groin on

Hatteras Island. The rate of spit movement could not continue to be as great as 886 feet per year (270 meters per year) (see Section 3.6.2.1) over the next 10 to 15 years with the terminal groin remaining in place. At that rate, Oregon Inlet, which is approximately 2,000 feet (610 meters) wide, would have closed within only three years.

Until the proposed project is completed, it is assumed that the USACE will use dredging to maintain the navigation channel by trimming off the end of the Bodie Island spit. This will result in Oregon Inlet maintaining an almost constant width of 2,000 feet (610 meters), assuming no major storm activity. Oregon Inlet dredging will help to channel a large volume of water through the navigation span section, thereby increasing water velocities at that location and reducing the propensity for Oregon Inlet's gorge to move farther south toward the terminal groin. The gorge depth should remain generally constant barring any extreme storm activity.

After the construction of the proposed project, it is assumed the USACE will cease to dredge a channel at the Bonner Bridge navigation span, given the flexibility of either the long navigation zone with the Parallel Bridge Corridor or the lack of a navigation span in Oregon Inlet (but rather further back in Pamlico Sound) with the Pamlico Sound Bridge Corridor. As a result, Oregon Inlet likely will narrow slightly, but it is not expected to close completely because of the tidal prism that must continue to pass through Oregon Inlet. Also, the gorge might re-establish its historical migration southward toward the terminal groin.

Short-Term Impacts of the Removal of the Terminal Groin

Should the terminal groin be removed at some point after completion of a bridge in the Pamlico Sound Bridge Corridor, the ocean shoreline could respond initially by adjusting back to a position that corresponds to a continuation of historic trends. This means that substantial shoreline erosion could occur on the northern end of Hatteras Island. Since Oregon Inlet is currently very narrow compared to historical trends, Oregon Inlet likely would widen and become shallower, while maintaining a consistent conveyance as it has done throughout its existence. The average width after the closure of New Inlet—and prior to the construction of the groin—was approximately 3,925 feet (1,200 meters) based on available historical data. If Oregon Inlet were to revert to its historical migration patterns, and assuming that there is no substantial erosion on the Bodie Island spit, the Hatteras Island shoulder might migrate south nearly 2,000 feet (610 meters) to assume an average width similar to those prior to the construction of the terminal groin. This trend could be accelerated by storm events, which historically have caused Oregon Inlet to widen and shallow. Conversely, if this period were relatively storm-free, this reversion to a wider inlet could be mitigated. Thus, the period for this to occur is unpredictable because of the randomness of such events. Figure 3-6 illustrates the predicted short-term migration of Hatteras Island. It first shows the history of movement for the Bodie Island shoulder, the mid-point of Oregon Inlet, and Hatteras Island from 1930 to the current time. It shows that Hatteras Island stopped its movement when the terminal groin was constructed. After the completion date of a bridge in the Pamlico Sound Bridge Corridor, the figure shows first the potential short-term movement of Hatteras Island as described above.

As stated previously, the movement of Oregon Inlet's gorge has created difficulty for the USACE in maintaining the navigation channel beneath the Bonner Bridge's navigation span. The removal of the terminal groin would pose new challenges for maintaining the current navigation channel because of probable inlet migration.

Long-Term Impacts of the Removal of the Terminal Groin

If the terminal groin is removed, Oregon Inlet eventually would be expected to revert to historical migration trends. Since the closure of New Inlet (and in the 15 years prior to its closure), Oregon

Inlet followed a nearly linear migration pattern with the exception of the Ash Wednesday Storm in 1962. The Hatteras Island shoulder has migrated in a linear (i.e., constant) fashion over the last 70 years (within ± 1,500 feet [460 meters] for a 3,000-foot [910-meter] total range). With the exception of the migration after the Ash Wednesday Storm of 1962, the entire inlet has migrated linearly (within ± 1,700 feet [520 meters] for a 3,400-foot [1,040-meter] total range). Figure 3-6 depicts the linear migration of Oregon Inlet over the last 70 years.

Figure 3-6 also illustrates the potential migration of Oregon Inlet through 2090. It illustrates the potential short-term and maximum long-term location of the north end of Hatteras Island, assuming both the retention of the terminal groin and a return to past trends should the groin be removed.

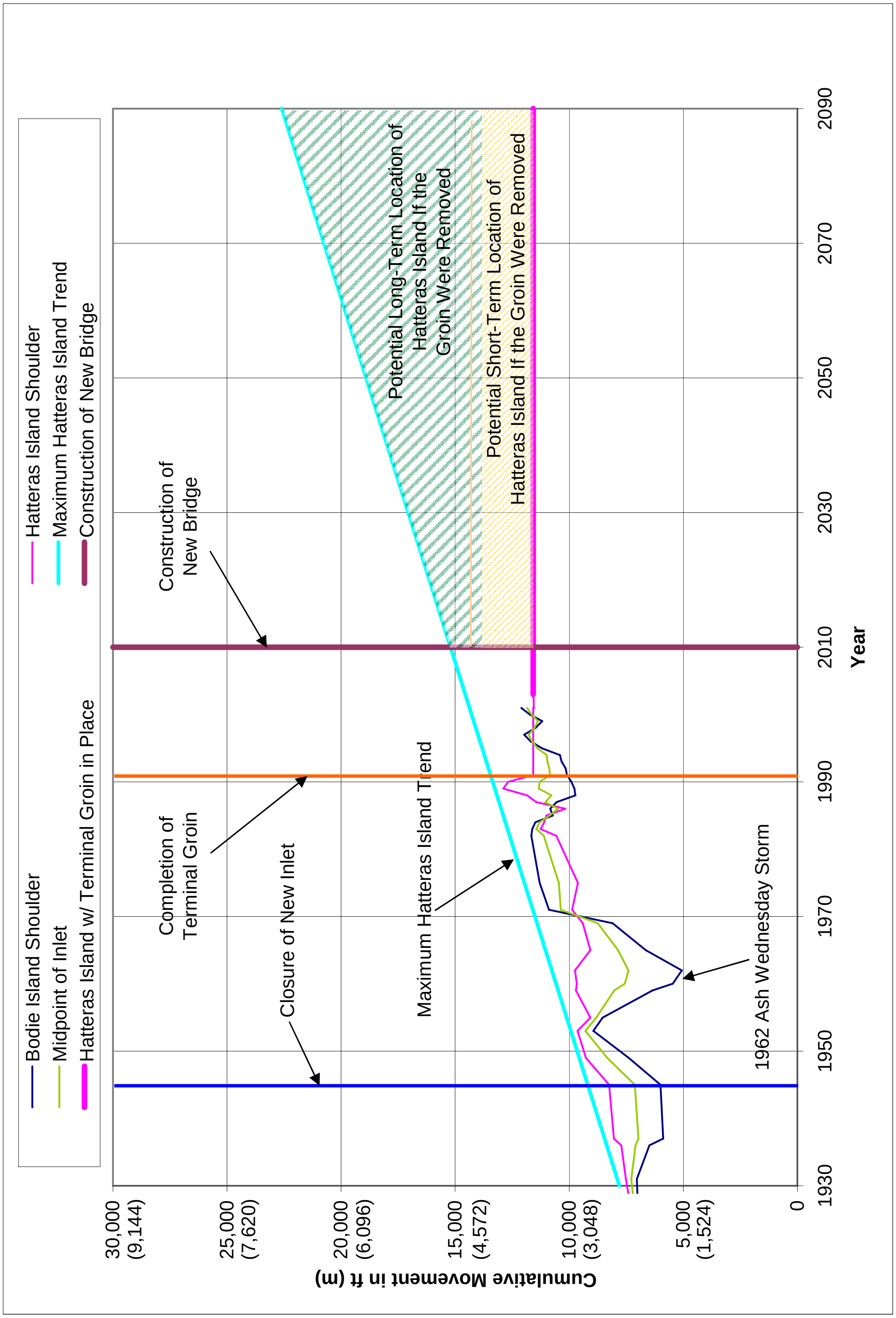
The movement south of the northern end of Hatteras Island over the life of a Pamlico Sound bridge would be the greatest if the groin were removed shortly after the bridge opens. For example, if the groin were removed 3 years after the bridge opens, and Oregon Inlet began to migrate in the same linear fashion as it did before the groin was built, then 50 years after the bridge opens, the Oregon Inlet shoulders of Hatteras and Bodie islands would migrate between 4,600 and 8,000 feet (1,400 and 2,440 meters) south. (This range represents the ± 1,700-foot [520-meter] deviation.) After 75 years, Oregon Inlet would have migrated between 6,900 and 10,300 feet (2,100 and 3,140 meters) south. (This range also represents the ± 1,700-foot [520-meter] deviation.) This example represents a "worst-case" situation, which is prudent to consider in long-range planning. It does not represent FHWA's and NCDOT's present expectations or their intent to remove the groin. If USFWS officials ask the NCDOT to remove the groin following completion of the demolition and removal of Bonner Bridge, the NCDOT and representatives of the USFWS would assess the impacts of groin removal in a separate environmental study, as needed, prior to any final decision to remove the terminal groin.

If Oregon Inlet were to migrate between 6,900 and 10,300 feet (2,100 and 3,140 meters) south, it would be located in the north pond of the Refuge, which is also just behind the Canal Zone hot spot. If Oregon Inlet migrates in a southward direction, another channel, Davis Channel (Slough), could become the more-preferred flow pattern, since it is already substantially deep and a notable connection of Oregon Inlet to Pamlico Sound. According to a 2001 survey, Davis Channel depths reached almost -50 feet (-15 meters) NAVD-88.

Relation of Hatteras Island Change to Navigation Zone Location with the Pamlico Sound Bridge Corridor

One navigation zone would be built for a bridge in the Pamlico Sound Bridge Corridor to serve boats passing through Oregon Inlet. The location of the zone would be determined in coordination with the USACE and the US Coast Guard. The USACE currently maintains the Oregon Inlet/Old House navigation channel. As discussed above, movement of Oregon Inlet over the life of the bridge could shift the natural channel gorge to the Davis Channel area. This eventuality would be addressed in conversations with the USACE. The NCDOT's goal would be to place the navigation zone of the bridge in a location that facilitates channel maintenance over the full life of the bridge.

Figure 3-6. Historic and Predicted Migration of Oregon Inlet



3.7 Natural Systems

3.7.1 Geology, Topography, and Soils

The project area is in the northeastern portion of the lower Atlantic Coastal Plain physiographic region of North Carolina. Fluvial processes and a history of alternating shoreline advance and retreat have shaped the geomorphology of the region. Predominate geographic features in the project area are the Pamlico Sound, the Outer Banks, and Oregon Inlet. Marine-derived sediments underlie the entire Pamlico Sound. Above the Pamlico Sound's crystalline bedrock are layers of sedimentary rock deposited during periods of high sea level. The most recent sedimentary layers, dating from the Upper Miocene to the Pliocene, are composed of primarily quartz sand, shell, and silt.

The North Carolina Outer Banks comprise a dynamic barrier island system formed by wind and wave action. Underlying the sandy ridges that make up the barrier islands are layers of limestone, sand, and clay. The topography of the Outer Banks consists of nearly level and gently sloping land draining into the Pamlico Sound and Atlantic Ocean.

Oregon Inlet connects the Atlantic Ocean and the Pamlico Sound. The inlet was formed in 1846 after a severe storm. Since that time, the location and size of Oregon Inlet have changed (see Section 3.6.2.1).

Based on the US NRCS (formerly US Soil Conservation Service) survey of Dare County (Soil Conservation Service, 1992), the soils found on the Atlantic Ocean side of the Outer Banks are mostly well-drained sand beaches with sparse vegetation, while soils found on the Pamlico Sound side are sandy but poorly drained and heavily vegetated. Two soil associations are present in the project area, the Newhan-Duckston-Corolla and Hobonny-Carteret-Currituck associations. Soil associations are defined as landscapes that exhibit distinctive proportional patterns of soils and consist of one or more major soils and at least one minor soil. The soils within an association generally vary in slope, depth, stoniness, drainage, and other characteristics (Tant, 1996). Descriptions of the soil series associated with the Newhan-Duckston-Corolla and Hobonny-Carteret-Currituck associations are presented in Table 3-16.

3.7.2 Surface Waters and Water Quality

The primary water bodies in the project area are Pamlico Sound and Oregon Inlet (see Figure 3-7). Also present within the project area are tidal creeks along the sound side of the Outer Banks.

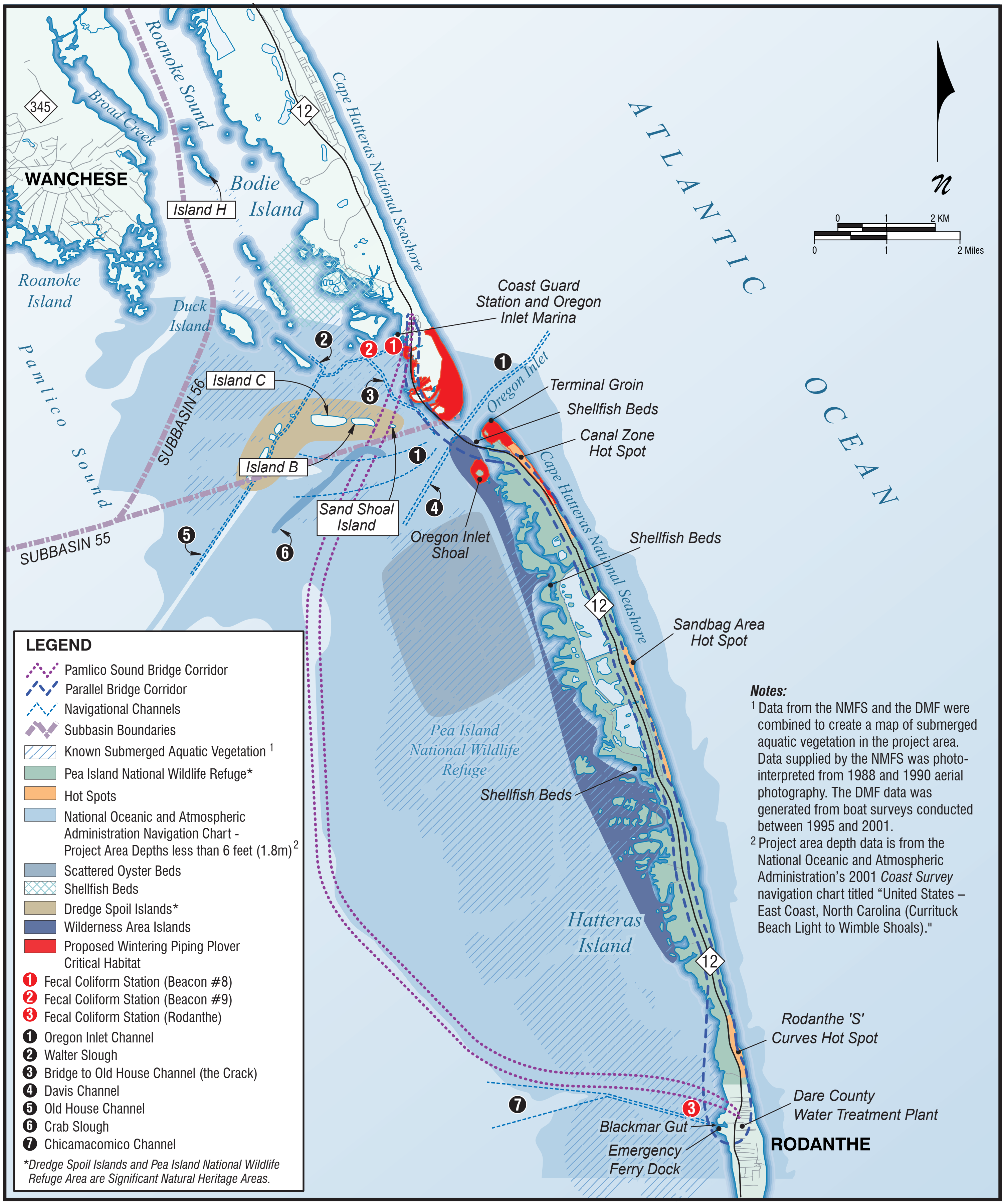
3.7.2.1 Surface Water Characteristics

The Pamlico Sound is a large estuarine water body separating the Outer Banks and the mainland of North Carolina. Water depth in the project area generally is less than 4 feet (1.2 meters), except in deeper channels and the western boundary of the project area (at the location of the Pamlico Sound Bridge Corridor) where depths greater than 6 feet (1.8 meters) are common. The Pamlico Sound drains several water bodies, but those closest to the project area are the Albemarle Sound (see Figure 1-1) and the Roanoke Sound (see Figure 3-7), both north of Oregon Inlet. Wind tides are one of the primary forces controlling hydrologic fluctuations within the Pamlico Sound. (Personal communication, May 20, 2003, Dr. Stan Riggs, East Carolina University.) Water levels also are influenced by lunar tides, but lunar effects diminish with distance from

Table 3-16. Soils Series Occurring within the Bonner Bridge Project Area

Map Unit	Soil Series	Slope	Drainage	General Characteristics
BnD*	Beaches-Newhan Complex	0-25%	Excessively Drained	Permeability is very rapid with daily tidal flooding. These soils are on long narrow areas of coastal beaches, typically on the ocean side of the Outer Banks and on inlets and islands.
CeA*	Carteret Sand	0-2%	Very Poorly Drained	These soils are frequently flooded by tides and have a seasonal high water table 3 feet (0.9 meter) above to 1 foot (0.3 meter) below the soil surface. These soils are found in broad marshes on the sound side of the Outer Banks.
CoB*	Corolla Fine Sand	0-6%	Moderately Well-Drained or Somewhat Poorly Drained	Permeability is very rapid, and the seasonal high water table is 1.5 feet (0.5 meter) to 3 feet (0.9 meter) below the soil surface. These soils occur in troughs and on flats between dunes on the Outer Banks.
CrB*	Corolla-Duckston Complex	0-6%	Moderately Well-Drained	Permeability is very rapid and the seasonal high water table is 1.5 feet (0.5 meter) to 3 feet (0.9 meter) below the soil surface. These soils are commonly found directly inland from some of the frontal dunes.
DtA*	Duckston Fine Sand	0-2%	Poorly Drained	Permeability is very rapid above the water table. The seasonal high water table is at or near the soil surface and fluctuates somewhat in relation to the tides. These soils are on flats and in slight depressions on the Outer Banks.
DwE	Dune Land-Newhan Complex	2-40%	Excessively Drained	Permeability is very rapid, and the available water capacity is very low. The seasonal high water table is more than 6 feet (1.8 meters) below the soil surface. These soils are found along the Outer Banks situated parallel to the ocean.
NhC*	Newhan-Corolla Complex	2-40%	Excessively Drained	Permeability is very rapid, and the available water capacity is very low in the Newhan soil. The seasonal high water table is more than 6 feet (1.8 meters) below the soil surface. These soils are found on the Outer Banks lying parallel to the ocean, often forming a transition zone between the soils along the ocean and the wet, flat soils adjacent to the sound. The soils are typically 60 percent dune land and 35 percent Newhan soils.
NeC*	Newhan Fine Sand	0-10%	Excessively Drained	Permeability is very rapid. The seasonal high water table is more than 6 feet (1.8 meters) below the soil surface. These soils are found on dunes on the Outer Banks. It is within the salty spray zone and supports salt-tolerant vegetation.
PsB	Psamments	0-6%	-	This map unit consists of areas where the surface layer and most of the subsoil have been removed. It includes borrow pits, fill and dredge areas, and areas of landfill. Soil properties within this map unit vary significantly.

*Occurs on Hydric Soils list, Gregory, 2001.
Source: Tant, 1996.



WATER BODIES AND OTHER NATURAL RESOURCE-RELATED FEATURES

Figure 3-7

Oregon Inlet. Similarly, waters near Oregon Inlet have high flushing rates compared to waters farther away.

The project area is in the Pasquotank River basin. The NCDENR's DWQ has divided North Carolina's major drainage basins into sub basins. The project area falls within two sub basins:

- The southern end of Bodie Island is in sub basin 56.

- The southern portion of Oregon Inlet south to Rodanthe is in sub basin 55 (NCDENR, 2002).

Surface waters within the Refuge portion of the project area include four manmade ditches, a manmade pond, three manmade impoundments (North Pond, New Field Pond, and South Pond), and estuarine waters directly associated with the Pamlico Sound.

The DWQ assigns further water body classifications according to the best usage of waters; water quality standards are applied according to classification. The waters of the Pamlico Sound from Croatan and Roanoke Sounds to Sandy Point south to Stumpy Point Bay to the northeast tip of Ocracoke Island are classified as SA waters (Class A salt waters) (15A North Carolina Administrative Code [NCAC] 2B.0317); therefore, all of the project area's waters are classified as SA waters. SA waters are suitable for commercial shellfishing and all other tidal saltwater uses including:

- Swimming;

- Primary and secondary recreation; and

- The propagation of aquatic life.

All Class SA waters have a supplemental classification of High-Quality Waters (15A NCAC 2B.0100). Water quality standards for SA waters are listed in the *Natural Resources Technical Memorandum* (CZR, Incorporated, 2005).

3.7.2.2 Water Quality

For the project area, there is little recent comprehensive water quality data available from the DWQ, and there are no ambient water quality monitoring stations within or near the project area. Overall, water quality in sub basin 55 is considered to be high (NCDENR, 2002). In 1989, DWQ (at that time known as the Division of Environmental Management of the North Carolina Department of Environment, Health, and Natural Resources) conducted a synoptic water quality study of the Albemarle/Pamlico system. A total of 33 water quality parameters were sampled from the surface, photic zone, bottom, and throughout the water column. Two locations sampled near Oregon Inlet (Pamlico Sound near channel marker R 4M14 "PA" and Roanoke Sound at channel marker G "9") indicated that the parameters tested were within state standards and expected ranges. Specific chemical and biological data for these locations are listed in the *Natural Resources Technical Memorandum* (CZR, Incorporated, 2005).

The USACE conducted elutriate testing during its Manteo (Shallowbag) Bay project to determine if dissolved constituents are released from the bottom sediments when agitated. Of the numerous parameters tested, it was found that only mercury and zinc were at elevated levels. It was stated, however, that the rapid reduction of these metals to existing background levels is typical

(USACE, 1980a,b,c). The continual inflow and outflow of waters through Oregon Inlet reduces the chances of any permanent water quality problems near Oregon Inlet.

The NCDENR's Division of Environmental Health, Shellfish Sanitation Section monitors fecal coliform levels at one station in the Oregon Inlet Marina and a second station at Rodanthe. A third station, at Fishing Center channel, was monitored until 2000 (see Figure 3-7). Yearly average coliform levels from 1997 to 2007 range from 1.8 to 8.1 per 100 milliliters, and in no year did fecal coliform levels exceed the standards for SA waters (14/100 ml). The specific levels measured from 1997 to 2002 at the three locations are listed in the *Natural Resources Technical Memorandum* (CZR, Incorporated, 2008).

Point source and non-point source pollution within the project area are limited. There is only one facility requiring a National Pollution Discharge Elimination System Permit. The facility is the reverse osmosis water treatment plant in Rodanthe that is permitted to discharge low salinity wastewater into the Pamlico Sound at Blackmar Gut (see Figure 3-7). Local non-point source pollution is typical of developed areas and generally is in the form of stormwater runoff.

Additional potential pollution sources are incidental spills of petroleum and exhaust emissions associated with the heavy boat traffic in the area. While significant agricultural activity is not found locally, the project area is influenced by basin-wide land use, including runoff from agricultural and livestock operations.

3.7.2.3 NC 12 Runoff

Current highway runoff from Bonner Bridge is directly discharged to Oregon Inlet via scuppers along either side of the main span of the bridge. Runoff from the rest of NC 12 in the project area is discharged into the road's unpaved shoulders and ditches.

NC 12 in the project area, including Bonner Bridge, was constructed prior to the development of federal (e.g., Clean Water Act) and state stormwater regulations; therefore, no stormwater controls or best management practices (BMPs) are in place. Water quality impacts associated with current NC 12 operations are mainly related to the potential for contamination of receiving surface waters by runoff from impervious roadway surfaces. NC 12 in the project area contains approximately 47 acres (19 hectares) of impervious roadway surface.

Common sources of highway pollutants include vehicles, dustfall, and precipitation. Other potential sources of runoff pollutants include highway maintenance (e.g., sanding and deicing), accidental oil and/or gas spills, and losses from accidents (FHWA, 1996). Common highway runoff constituents and their corresponding primary sources are presented in Table 3-17.

Generally, heavy metals, nutrients, organic compounds, and particulates are the primary constituents of concern in highway runoff. The water quality impacts from each of these constituent groups are described in further detail below:

- <u>Heavy Metals.</u> Heavy metals (specifically copper, lead, and zinc) are typically the priority pollutants of concern in highway runoff (Transportation Research Board, 1993). The main concern surrounding presence of heavy metals is related to their long-term accumulation in bottom sediments and animal tissue. Increased impervious surfaces and vehicle use can result in elevated concentration of heavy metals in surface waters.

Table 3-17. Common Highway Runoff Constituents and Primary Sources

Constituent	Primary Sources
Particulates	Pavement wear, vehicles, atmosphere, maintenance, snow/ice abrasives, sediment disturbance
Nitrogen, Phosphorus	Atmosphere, roadside fertilizer use, sediments
Lead	Leaded gasoline (auto exhaust), tire wear, lubricating oil and grease, bearing wear, atmospheric fallout
Zinc	Tire wear, motor oil, grease
Iron	Auto body rust, steel highway structures, engine parts
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fungicides and insecticides use
Cadmium	Tire wear, insecticide application
Chromium	Metal plating, engine parts, brake lining wear
Nickel	Diesel fuel and gasoline, lubricating oil, metal plating, brake lining wear, asphalt paving
Manganese	Engine parts
Bromide	Exhaust
Cyanide	Anticake compound used to keep deicing salt granular
Sodium, Calcium	Deicing salts, grease
Chloride	Deicing salts
Sulfate	Roadway beds, fuel, deicing salts
Petroleum	Spills, leaks, blow-by motor lubricants, antifreeze, hydraulic fluids, asphalt surface leachate
Polychlorinated Biphenyls (PCBs), pesticides	Spraying of highway right-of-ways, atmospheric deposition, PCB catalyst in synthetic tires
Pathogenic bacteria	Soil litter, bird droppings, trucks hauling livestock/stockyard waste
Rubber	Tire wear
Asbestos	Clutch and brake lining wear

Source: Kobringer, 1984

- Nutrients. Nutrients also are a substantial constituent present in highway runoff and are deposited via atmospheric deposition and fossil fuel combustion by vehicles. High levels of nitrogen and phosphorus can cause algae blooms, which ultimately lead to a decrease in dissolved oxygen as the algae decompose.

- Organic Compounds. Organic compound sources include exhaust, fuel, lubricants, and asphalt and have been detected in higher concentrations along roadways. Organic pollutants are of particular concern because of their ability to accumulate to concentrations that are harmful to aquatic organisms (e.g., impacts to growth and reproduction and mortality). Chemical oxygen demand (COD) is a common indicator of the amount of organic compounds in surface water and represents the mass of oxygen consumed per liter of solution (mg/L).

- Particulates. Particulates and solid materials are a primary concern in highway runoff with an increase in impervious surfaces because of their ability to capture and transport other pollutants. For example, phosphorus and various metals readily adsorb to solids, particularly fine particles. These pollutants are often released when introduced to water, which in turn affects the water quality of the receiving water body and has the potential to reduce the variety and abundance of aquatic life.

The accumulation of pollutants on highway surfaces is affected by various factors including the following (Gupta et al,. 1981):

- Traffic characteristics (volume, speed, braking);
- Climate conditions (precipitation, wind, temperature);
- Maintenance (sweeping, mowing, repair, deicing, herbicides);
- Land use (residential, industrial, commercial, rural);
- Percent pervious and impervious areas;
- Vehicle characteristics (age and condition);
- Anti-litter laws and vehicle emission regulations;
- Use of special additives in vehicle operation;
- Vegetation types on highway right-of-way; and
- Accidental spills.

Traffic characteristics, atmospheric deposition, and site-specific conditions (e.g., land use, highway surface, and maintenance practices) are often considered as the major contributing factors to pollutant constituents and concentrations.

3.7.3 Biotic Communities

The conceptual term "biotic community" is used to designate a distinct assemblage of plants and animals. The following sections describe each biotic community within the project area in terms of its characteristic physical environmental factors, biota, and functional role. Biotic communities within the project area were delineated through interpretation of July 12, 2002, color aerial photographs and field verification during May and June 2003. Project area biotic community delineations were also conducted during field investigations in March 2003 and May and June 2004 in association with NCDOT Transportation Improvement Program (TIP) Project Nos. R-3116D and R-3116E/F, as well as during further field investigations associated with this project (TIP No. B-2500) during November and December 2004. Additional habitat and delineated wetland mapping was completed in June 2005 based on the expanded project area selected for detailed evaluation. Biotic communities of the project area are presented in Figure E-2a through Figure E-2h in Appendix E. Approximate acreage (hectares) for each community is presented in Table 3-18. Plant species listed represent species observed on-site as well as species associated with natural communities, as described by Shafale and Weakley (1990), which are

Table 3-18. Biotic Communities Within the Project Area

Biotic Community[1]	Acres (hectares)			
	Bodie Island	Rodanthe	Pea Island National Wildlife Refuge	Total
Open water	251.30 (101.70)	149.54 (60.52)	615.62 (249.13)	1,016.46 (411.35)
Beach	0.80 (0.30)	19.36 (7.83)	235.18 (95.17)	255.34 (103.32)
Dunes	3.70 (1.50)	17.29 (6.99)	408.71 (165.40)	429.70 (173.90)
Wetland man-dominated	9.00 (3.64)	4.15 (1.68)	0.38 (0.15)	13.53 (5.47)
Upland man-dominated	21.90 (8.86)	130.52 (52.82)	109.79 (44.43)	262.21 (106.11)
Wetland salt shrub/grasslands	3.90 (1.58)	14.47 (5.86)	270.98 (109.66)	289.35 (117.10)
Upland salt shrub/grasslands	0.00 (0.00)	9.71 (3.93)	55.49 (22.46)	65.20 (26.39)
Wetland maritime grassland	3.20 (1.29)	23.79 (9.63)	32.89 (13.31)	59.88 (24.23)
Upland maritime grassland	0.00 (0.00)	0.00 (0.00)	50.92 (20.61)	50.92 (20.61)
Wetland overwash	0.00 (0.00)	0.00 (0.00)	34.36 (13.91)	34.36 (13.91)
Upland overwash	0.00 (0.00)	0.00 (0.00)	37.52 (15.18)	37.52 (15.18)
Wetland maritime shrub thicket	6.70 (2.71)	18.26 (7.39)	176.17 (71.29)	201.13 (81.39)
Upland maritime shrub thicket	8.90 (3.60)	37.62 (15.22)	312.59 (126.50)	359.11 (145.32)
Wetland reed stand	0.00 (0.00)	3.95 (1.59)	11.41 (4.62)	15.36 (6.22)
Upland reed stand	0.00 (0.00)	0.00 (0.00)	2.85 (1.15)	2.85 (1.15)
Salt flat	0.00 (0.00)	0.00 (0.00)	0.16 (0.06)	0.16 (0.06)
Brackish marsh	1.30 (0.53)	0.00 (0.00)	2.24 (0.91)	3.54 (1.44)
Smooth cordgrass	27.30 (11.05)	5.93 (2.40)	8.82 (3.57)	42.05 (17.02)
Wetland black needlerush	24.70 (10.00)	3.51 (1.42)	226.10 (91.50)	254.31 (102.92)
Upland black needlerush	0.00 (0.00)	0.00 (0.00)	7.82 (3.16)	7.82 (3.16)
TOTAL	**362.70 (146.78)**	**438.10 (177.30)**	**2,600.00 (1,052.17)**	**3,400.80 (1,376.25)**

NOTE: Hectares calculated from acres, thus minor rounding error exists when adding the individual hectare numbers.

[1] Biotic community acreages calculated based on 363-acre (146.8-hectare) wetland delineation area confirmed by the USACE on February 2, 2005.

found in the project area. Wildlife listings are from a review of literature for the project area as well as species records documented from the area. The appendices of the *Natural Resources Technical Memorandum* (CZR, Incorporated, 2005) contain complete lists of vascular flora referenced in this section, as well as species lists and scientific names for fish and wildlife documented or expected in the project area.

The following biotic communities/habitats were identified within the project area:

- Open water;
- Beach;
- Dunes;
- Wetland man-dominated;
- Upland man-dominated;
- Wetland salt shrub/grasslands;
- Upland salt shrub/grasslands;
- Wetland maritime grassland;
- Upland maritime grassland;
- Wetland overwash;
- Upland overwash;
- Wetland maritime shrub thicket;
- Upland maritime shrub thicket;
- Wetland reed stand;
- Upland reed stand;
- Salt flat;
- Brackish marsh;
- Smooth cordgrass;
- Wetland black needlerush; and
- Upland black needlerush.

The man-dominated communities and reed stands are the result of human disturbance. Open water and sound areas exist naturally within the project area; however, some open water areas in the Refuge, such as ditches, a manmade pond, and freshwater impoundments, are the result of human disturbance within the project area. The remaining communities are considered "natural" systems: beach, dunes, overwash, salt shrub/grasslands, maritime grassland, maritime shrub thicket, salt flat, black needlerush, smooth cordgrass stands, and brackish marsh.

The habitat categories are described below. In selecting these categories, heavy reliance was placed on the plant communities identified and described by the North Carolina Natural Heritage

Program (NCNHP) classification and the 1993 Bonner Bridge Replacement DEIS (Shafale and Weakley, 1990; McCrain, 1988). McCrain identified ten plant communities. Although some of these communities were retained for the current study, various stages of community development and physiographic differences between Bodie Island and Hatteras Island required further breakdown and additional categories provided by NCNHP classifications. Previous community descriptions of this area and adjacent habitats include Quay (1959), who defined 16 major habitats of the Seashore, and Cooper (1963), who described five basic groups of vegetation types from the Bodie Island marshes. Brown (1959) and Burke (1962) each provided general floristic descriptions of the Outer Banks. Additional comparisons were made with updated plant community descriptions in the International Classification of Ecological Communities (NatureServe, 2002). Based on the expanded project area, community classifications have been modified in some instances to better reflect field observations. Biotic communities are further described below.

3.7.3.1 Open Water

Marine open water, as defined by Quay (1959), includes the waters of Oregon Inlet, Atlantic Ocean, and Pamlico Sound. Waters of the Atlantic Ocean abut the eastern project boundary. The project area is situated in North Carolina DWQ Sub basin 03-01-55 and US Geologic Survey (USGS) Hydrologic Unit 03020105.

Open water is also used to describe the estuarine waters directly associated with Pamlico Sound within the project area, as well as creeks, ponds, ditches adjacent to NC 12, freshwater impoundments, and intertidal mudflats. Some open water areas, such as the pond in the northern section of Rodanthe, also provide mudflat habitat in drought or low water conditions. Ditches (Pauls Ditch and other unnamed manmade ditches), ponds, and the impoundments do not have DWQ Index Numbers.

Pamlico Sound is a shallow, coastal lagoon that is separated from the ocean by the Outer Banks. The Sound is approximately 60 miles (96.8 kilometers) long and 15 to 30 miles (24.2 to 48.4 kilometers) wide. The maximum depth is about 22 feet (6.7 meters); the average depth is less than 15 feet (4.6 meters). The watershed is approximately 12,500 square miles (32,518 square kilometers) (Epperly and Ross, 1986). Because of restricted tidal flow, the mean tidal range is generally less than 0.5 feet (0.15 meters), with no designated times of high water and low water except near the inlets. Currents are weak and depend mainly on the direction and velocity of the wind, not upon lunar tidal oscillation. Because of intense vertical mixing, sound waters are vertically homogeneous; that is, salinity, temperature, and dissolved oxygen show little or no vertical stratification. Water temperatures closely follow air temperatures, normally ranging from around 39ºF (4ºC) in January to 84ºF (29ºC) in July. The salinity ranges from moderate to high; near Oregon Inlet, the salinity can range from 6 to 32 parts per thousand. (Personal communication, August 30, 1990, Beth Burns, NCDENR-DMF.)

Extensive seagrass (also known as submerged aquatic vegetation or SAV) beds occur near Oregon Inlet and throughout shallow portions of Pamlico Sound. These seagrass beds form a complex and important ecosystem. Submerged beds of eelgrass (*Zostera marina*), shoalgrass (*Halodule wrightii*), and widgeongrass (*Ruppia maritima*) exist together and separately. Seagrasses can occur in isolated patches and as extensive beds. The importance of seagrass systems to estuarine ecology has been widely recognized (Thayer et al., 1975, 1979, 1981; Zieman, 1975; Thayer and Phillips, 1977; Fonseca et al., 1979; McRoy and Helfferich, 1980; Ferguson et al., 1981; Zimmerman and Minello, 1984; Weinstein, 1985). Numerous studies have documented seagrass habitats as important nursery areas for many fish species (Adams, 1976;

Thayer et al., 1979; Weinstein and Heck, 1979; Orth and Heck, 1980; Miller and Dunn, 1980; Stoner, 1980; Homziak et al., 1982; Epperly and Ross, 1986; Kenworthy et al., 1988; McMichael and Peters, 1989; Noble and Monroe, 1990). Data from the National Marine Fisheries Service (NMFS) and the DMF were combined to create a map of SAV in the project area (see Figure 3-7). Data supplied by the NMFS was photo-interpreted from 1988 and 1990 aerial photography. The DMF data was generated from boat surveys conducted between 1995 and 2001. The dynamic nature of the area around Oregon Inlet results in ephemeral habitats, particularly in shallow water and shoreline areas. A survey conducted by NCDOT in the fall of 2007 found that only 25 percent of the SAV habitat contained SAV. SAV can be affected by a variety of factors including light availability, water temperature, sediment composition, wave energy, tidal range, and a variety of other factors. These factors may influence the location and the amount of SAV from year to year.

Other vascular plants are absent from this community; however, phytoplankton and seaweed frequently are found where sufficient light penetration and suitable habitat occur. Species of *Ulva*, *Fucus*, *Gracilaria*, *Cladophora*, *Polysiphonia*, and *Ectocarpus* typically are seen along the shore or intertidal zone.

Loons, grebes, shearwaters, cormorants, scoters, mergansers, gulls, and terns are birds commonly encountered in open water habitat (Parnell et al., 1989). The bottlenose porpoise (*Tursiops truncatus*) is a common marine mammal of the near-shore ocean. Marine sea turtles periodically encountered include the loggerhead sea turtle (*Caretta caretta*), Atlantic green turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempi*), and leatherback turtle (*Dermochelys coriacea*). (Personal communication, July 16, 1990, L. K. Gantt, USFWS.) Sea turtle abundance and seasonality are influenced by both currents and water temperature (Schwartz, 1989). Hawksbill sea turtles (*Eretmochelys imbricata*) also can be found in the project area, though they are very rarely encountered.

3.7.3.2 Beach

These bare, transitional areas between the open water and upland terrestrial community are characterized by sand flats. They typically consist of a dry berm zone beyond the mean high tide line, an intertidal zone that is regularly covered by tidal action, and a subtidal zone that exists below the low tide mark, including the top and beachside of dunes. This community undergoes frequent, natural disturbance and is typically void of vegetation, however, it can be characterized by a small number of species and the dominance of succulents. Within the project area, sea kale (*Cakile harperi*) and seaside pennywort (*Hydrocotyle bonariensis*) dominate, with small occurrences of beach pea (*Strophostyles helvola*), beach spurge (*Euphorbia polygonifolia*), and sea rocket (*Cakile edentula*) situated along the highest wrack or seaweed lines. Substantial erosion of the beachside of the dunes in the Refuge occurred during Hurricane Isabel in 2003. Along the southern end of Bodie Island near the campground, the beach within the project boundary is approximately 400 feet (122.0 meters) wide; the widest point within the project boundary at Rodanthe is approximately 700 feet (213.4 meters) wide.

The brown pelican (*Pelecanus occidentalis*), double-crested cormorant (*Phalacrocorax auritus*), American oystercatcher (*Haematopus palliatus*), and numerous gulls and terns often are found resting or feeding at the water's edge. Shorebird surveys conducted by the USFWS in the Refuge estimate that typically 3,600 to 4,800 shorebirds might use the beach during the peak of migration (USFWS, 1988a). The North Carolina Audubon Society estimates that greater than 10,000 shorebirds use the Refuge (North Carolina Audubon Society, Unpublished USFWS data, 2003). Also, loggerhead sea turtles frequently use the beach/foredune habitats for nesting.

3.7.3.3 Dunes

Dunes in the project area are landward and generally parallel to the beach community. This community undergoes constant gradual movement and is subject to abrupt changes during storms, particularly during strong northeasterly winds. The primary dune system developed as winds moved intertidal sands landward. Mobile sand was trapped by vegetation and by fences in many areas. Although dunes do occur naturally, most dunes along the Seashore are not natural features. Under the direction of the NPS, sand fencing (more than 600 miles [967.7 kilometers]) was erected to create a protective, continuous barrier dune between 1936 and 1940. Additional stabilization, including planting efforts by the NPS, also was undertaken in the 1950s. Presently, a continuous mass of vegetation blankets most of the dunes (Dolan, 1973).

Extensive dunes exist immediately north and south of the campground on the southern end of Bodie Island, while a narrow band of dunes can be found parallel to NC 12 on Hatteras Island. A non-continuous band of dunes that is broken by development exists along the eastern shore of Rodanthe.

Dominant vegetation observed include sea oats (*Uniola paniculata*), sea kale, pennywort, croton (*Croton punctatus*), American beach grass (*Ammophila breviligulata*), silver panic grass (*Panicum amarum*), saltmeadow cordgrass (*Spartina patens*), broom sedge (*Andropogon virginicus*), seaside goldenrod (*Solidago sempervirens*), and beach elder (*Iva imbricata*). Other common species include seaside evening primrose (*Oenothera humifusa*), fire wheel (*Gaillarida pulchella*), prickly pear (*Opuntia drummondii*), hoary plantain (*Plantago virginica*), English plantain (*P. lanceolata major*), yellow thistle (*Cirsium horridulum*), blackberry (*Rubus cuneifolius*), and cyrillo (*Stellaria media*). Species less frequently encountered included ground cherry (*Physalis viscosa* spp. *maritima*), beach spurge, sand spur (*Cenchrus tribuloides*), and beach bean (*Strophostyles helvola*). The vine layer consists of catbrier (*Smilax auriculata* and *bona-nox*), arrowleaf morning glory (*Ipomeoea saggittata*), fox grape (*Vitis aestivalis*), and beach pea. Small patches of red cedar (*Juniperus silicicola*) and silverling (*Baccharis halimifolia*) are sparsely distributed throughout the dune community.

Birds frequently encountered on the dune fields include the red-winged blackbird (*Agelaius phoeniceus*), boat-tailed grackle (*Quiscalus major*), and savannah sparrow (*Passerculus sandwichensis*) (Parnell et al., 1989).

Mammals found in the dune community include Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), house mouse (*Mus musculus*), gray fox (*Urocyon cinereoargenteus*), and the raccoon (*Procyon lotor*). Common reptile and amphibians include eastern hognose snake (*Heterodon platyrhinos*), black racer (*Coluber constrictor*), six-lined racerunner (*Cnemidophorus sexlineatus*), and Fowler's toad (*Bufo woodhousei*).

3.7.3.4 Man-Dominated Areas (Wetland and Upland)

This community is typical of areas where man's structures or activities prevent natural plant succession. Roadside margins, areas around the campground, the US Coast Guard Station on Bodie Island, NC 12, the Oregon Inlet Marina and Fishing Center, parking areas and access roads, developed areas associated with the Refuge Visitor Center, USFWS buildings, and residential development in Rodanthe all receive regular mowing and pruning. Consequently, plant growth patterns are modified and species composition stays relatively stable and limited to low-growing, herbaceous species. Much of the original vegetative communities were altered in areas where permanent structures were constructed within Rodanthe. Extensive residential and commercial development has occurred in Rodanthe creating the need to define further this community type into wetland and upland man-dominated areas. Wetland man-dominated areas occur in areas that sustain wetland hydrology, vegetation, and soils, but are maintained by regular mowing, such as the wetlands around the Oregon Inlet Marina and Fishing Center. A variety of grasses, sedges, and rushes are common around these areas with seaside pennywort, yellow thistle, various asters (*Aster* spp.), hoary plantain, English plantain, panic grass (*Panicum* spp.) spadeleaf (*Centella asiatica*), frog fruit (*Lippia nodiflora*), fire wheel, white-top sedge (*Dichromena colorata*), and various grasses (*Poaceae* spp. and *Festuca* spp.) frequently encountered.

Birds commonly sighted around roadsides include cattle egret (*Babulcus ibis*), killdeer (*Charadrius vociferus*), and northern mockingbird (*Mimus polyglottos*). Species frequently sighted nesting or foraging in this community include barn swallow (*Hirundo rustica*), purple martin (*Progne subis*), American robin (*Turdus migratorius*), European starling (*Sturnus vulgaris*), and red-winged blackbird (Parnell et al., 1989).

Mammals commonly found near these man-dominated areas include the red bat (*Lasiurus borealis*) seen foraging overhead, the marsh rabbit (*Sylvilagus palustris*) along highway edges, and the Norway rat (*Rattus norregicus*) and the house mouse near buildings and dumps (Parnell et al., 1989).

3.7.3.5 Salt Shrub/Grasslands (Wetland and Upland)

This is often a transitional community between small, high areas of salt marshes (smooth cordgrass and black needlerush) and the more stable maritime shrub thicket. This community can have an open to closed canopy and can include up to 50 percent shrubs and grasses. Dense vegetation, generally dominated by saltmeadow cordgrass with a mixture of wetland and mesic species creates a community with high diversity. This community is co-dominated by salt-tolerant shrubs such as marsh elder (*Iva frutescens*), silverling, and wax myrtle (*Myrica cerifera*). Other common shrub species are yaupon (*Ilex* vomitoria), saltwater false willow (*Baccharis angustifolia*), red bay (*Persea borbonia*), and black cherry (*Prunus serotina*). Vines present in this community include catbrier (*Smilax bona-nox*) and Japanese honeysuckle (*Lonicera japonica*). Blackberry and poison ivy (*Toxicodendron radicans*) are also found within the salt shrub/grassland community. Herbaceous species include black needlerush (*Juncus roemerianus*), poison ivy, seaside evening primrose (*Oenotherna humifusa*), marsh pink (*Sabatia campanulata*), seaside goldenrod, and sea ox-eye (*Borrichia frutescens*). Salt shrub/grassland community occurs predominately on the sound side of the project area.

The fauna of salt shrub/grasslands is similar to those species found in maritime grassland (Section 3.7.3.6) and the maritime shrub thicket (Section 3.7.3.8), representing a diverse assemblage of animals.

3.7.3.6 Maritime Grassland (Wetland and Upland)

The maritime grassland community is within the dune swales and along sand flats with elevations near the water table, which is normally just below the surface. The maritime grassland community also occurs in old overwash terraces and relic marsh areas that have been filled in with sand. This interdunal community is protected from salt spray and contains a variety of grassland vegetation. Most swales in the project area are seasonally flooded or saturated wetlands in which vegetation is usually dense and diverse. These areas are co-dominated by American bulrush (*Scirpus americanus*), saltmeadow cordgrass, and sand rush (*Fimbristylis spadicea*). Other common species include saltgrass, spadeleaf, smartweeds (*Polygonum* spp.), buttonweed (*Diodia virginiana*), fimbristylis (*Fimbristylis spp.*), pink muhlenbergia (*Muhlenbergia filipes*), Virginia broomsedge (*Andropogon virginicus*), and black needlerush.

Isolated pockets of maritime dry or upland grassland are excessively drained at the surface, with occasional overwashing by salt water in severe storms. Overwash sand deposits may temporarily bury the vegetation, but the dominant species are well adapted to recover quickly from such natural disturbance. There is generally moderate to dense herbaceous cover in upland maritime grasslands and are typically dominated by saltmeadow cordgrass and those species found in the wet maritime grassland. The maritime grassland community transitions into dune grass, maritime shrub, and brackish and salt marsh communities.

A large marshy interdunal swale adjacent to a trailer park in Rodanthe is included with this community. This particular swale is lower in elevation and flooded more regularly than other swales in the project area. Vegetation in this swale contains a mixture of dominants including common cattail (*Typha latifolia*), black needlerush, saw grass (*Cladium jamaicense*), wool-grass (*Scirpus cyperinus*), swamp rose mallow (*Hibiscus moscheutos*), and seashore mallow (*Kosteletskya virginica*). Other species include salt-marsh bulrush (*Scirpus robustus*), arrowleaf morning glory (*Ipomoea sagittata*), climbing hempweed (*Mikania scandens*), and royal fern (*Osmunda regalis* var. *spectabilis*).

This typically wet transition zone supports a variety of animals species found in both the drier dune communities and the wet marsh areas.

3.7.3.7 Overwash (Wetland and Upland)

The overwash community consists of areas that have been recently overwashed by saltwater and sand from severe storm events, and areas in which NC 12 abuts the dunes and sand removal from the roadway is performed on a regular basis. As previously mentioned, a majority of the overwash areas observed at the time of site reconnaissance in 2005 occurred during Hurricane Isabel in September 2003. Sand deposition in most of the overwash areas varies from 6 to 24 inches (6.2 to 61.0 centimeters). In general, overwash areas contain less than 10 percent vegetation.

3.7.3.8 Maritime Shrub Thicket (Wetland and Upland)

Maritime shrub thicket typically occurs landward of the salt shrub/grassland community or behind dune fields where it is protected from salt spray and harsh winds. It is characterized by low shrubs that usually are entangled with vines. Maritime shrub thicket is found predominantly on the west side of NC 12 along the sound side within the Rodanthe project area, especially behind the Liberty service station on the west side of NC 12. This community also borders the northwest side of the US Coast Guard Station on Bodie Island, as well as the Oregon Inlet Marina and Fishing Center.

Variations in elevation within the project area have created the need to break this community type into wetland and upland shrub thickets. Wetland shrub thickets occur predominantly adjacent to sound side marsh communities and in some interdunal areas. Upland shrub thickets primarily occur on higher elevations such as on the backside of stabilized sand dunes and dune swales. A large upland shrub thicket exists on the southern edge of the campground on Bodie Island.

Shrubs that dominate the higher elevations include wax myrtle, yaupon (*Ilex vomitoria*), red cedar (*Juniperus virginiana*), bayberry (*Myrica pennsylvanica*), black cherry (*Prunus serotina*), live oak (*Quercus virginiana*), and loblolly pine (*Pinus taeda*). Vegetation common in lower areas are silverling, marsh elder, and wax myrtle. Common vines include poison ivy, catbrier (*Smilax bona-nox*), pepper-vine (*Ampelopsis arborea*), and muscadine (*Vitis rotundifolia*).

A diverse community of animals occurs in the maritime shrub thicket. Common resident birds include Carolina wren (*Thryothorus ludovicianus*), gray catbird (*Dumetella carolinensis*), northern cardinal (*Cardinalis cardinalis*), and boat-tailed grackle (Parnell et al., 1989). Mammal species that are common in shrub thickets (especially on Bodie Island) include the Virginia opossum, least shrew (*Cryptotis parva*), gray fox, and raccoon. Quay (1959) noted that the southeastern five-lined skink (*Eumeces inexpectatus*), eastern glass lizard (*Ophisaurus ventralis*), ribbon snake (*Thamnopyhis sauritus*), eastern hognose snake, black racer, and eastern king snake (*Lampropeltis getulus*) are found in shrub thickets.

3.7.3.9 Reed Stand

This community exists in small to large patches on Hatteras Island. Giant reed (*Phragmites communis*) occurs on both sides of NC 12 at the northern tip of Hatteras Island and at the emergency ferry dock in Rodanthe adjacent to areas of wetland maritime shrub thicket. A large stand occurs in the northern portion of the Rodanthe area where a wetland maritime grassland community was disturbed by a man-dominated walkway and gazebo. Characteristic of previous disturbance, this opportunistic species often is associated with wetter shrub thickets.

While providing only limited food resources, reed stands do offer cover and roosting habitat for birds such as grackles. Marsh rice rat (*Oryzomys palustris*), raccoons, muskrats (*Ondatra zibethicus*), and nutria (*Myocaster coypus*) also are found in reed stands.

3.7.3.10 Salt Flat

The salt flat community consists of a shallow depression in which salt is concentrated by the evaporation of seawater. Salt flat communities are sparse in vegetation and are dominated by plants with high salt tolerances, such as glasswort (*Salicornia spp.*), saltgrass (*Distichlis spicata*), and sea ox-eye (*Borrichia frutescens*). Salt flat communities transition into salt marshes and brackish marshes. This community is found within the Refuge on both the sound and ocean sides of the black needlerush communities.

3.7.3.11 Brackish Marsh

Brackish marsh is similar to other saltmarsh communities and consists of mixed stands of rushes (*Juncus* spp.*)*, saw grass, smooth cordgrass, and poison ivy. Sparse shrub vegetation also can be found in brackish marsh communities. This community is present on southern Bodie Island near the current terminus of Bonner Bridge and north of the Oregon Inlet Marina and Fishing Center. Cattails (*Typha* spp.) also are found in brackish marsh, especially on the sound side of Bodie Island.

Red-winged blackbirds and marsh wrens (*Cistothorus palustris*) are common in brackish marsh, as are mammals typical of emergent estuarine wetland habitats.

3.7.3.12 Smooth Cordgrass

This emergent wetland community, like the black needlerush community, is within the intertidal zone. It occurs in pure stands along the sound side of both Hatteras and Bodie islands and on the southern tip of Bodie Island. Along the fringe of intertidal creeks, the community receives regular tidal inundation and provides stability for the shoreline margins. Spoil islands in the sound often are fringed with smooth cordgrass (*Spartina alterniflora*) where the land is regularly flooded. This low marsh community typically provides nursery areas for various species of shrimp, crabs, and marine and estuarine fish.

Commonly encountered fauna include clapper rails (*Rallus longirostris*) and seaside sparrow (*Ammodramus maritimus*). Marsh rice rat, raccoons, muskrats, and nutria are also common.

3.7.3.13 Black Needlerush (Wetland and Upland)

The black needlerush community occurs primarily along the margins of the Pamlico Sound and extends east, eventually grading into the salt shrub, salt shrub/grassland, and maritime grassland community. Within the intertidal zone, this emergent wetland community is composed of pure stands of needlerush. Large stands are found throughout the southern tip of Bodie Island where unconsolidated sand has accreted, resulting in the irregular flooding that facilitates the establishment of this common marsh species. A large patch of needlerush also exists just north of the emergency ferry dock at Rodanthe. Organic soils underlay this community, and the regular input of nutrients from lunar tides makes this a very productive community. Smooth cordgrass often is found fringing the lower edges of this community. At higher elevations, this marsh community is almost entirely dominated by black needlerush; however, other species such as cattail (*Typha angustifolia*), common reed, swordgrass, salt meadow hay (*Spartina patens*), and various other rushes are common throughout this community. Other species occurring along the fringe of the marsh community, such as, silverling, marsh elder, sea-ox-eye, sea myrtle, saltmeadow cordgrass, and sand rush become co-dominant. Several dredge spoil islands in the sound are dominated by this community, as is the fringe of intertidal creeks on Hatteras Island. Large stands of pure needlerush also occur on the sound side of Bodie Island.

Areas that are designated as upland black needlerush result from several factors. There are substantially disturbed locations that are not jurisdictional wetlands. Also, areas contain needlerush as the dominant vegetation but are affected by overwash, including less than major hurricane storm events, and are not jurisdictional wetlands. These areas are not denoted as overwash since overwash communities are defined, in general, as communities with less than 10 percent vegetative coverage. Over time these communities are anticipated to transition into upland communities.

The tidal marsh functions to provide inorganic and organic nutrients to adjacent aquatic communities, as well as to protect the sound side of the barrier island from wind and wave action. Many aquatic organisms depend on the tidal marsh. As a source of primary production, this community aids in forming the base of estuarine food webs.

Commonly encountered fauna include rails and wading birds. Marsh rice rat, raccoons, and nutria also are common.

3.7.4 Wetlands and Open Water Habitat

3.7.4.1 Definitions

Wetlands are defined by the USACE (33 *Code of Federal Regulations* [CFR] 328.3) and the US Environmental Protection Agency (USEPA, 40 CFR 230.3) as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands possess three essential characteristics: hydrophytic vegetation, hydric soils, and wetland hydrology. All three characteristics must be present to be identified as wetland (USACE Environmental Laboratory, 1987). The USACE and the USEPA are federal agencies charged with regulating the discharge of dredged or fill material in jurisdictional wetlands and open waters under Section 404 of the Clean Water Act of 1977, as amended.

Open water habitats are permanently flooded lands below the deepwater boundary of wetlands. These habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live (Cowardin et al., 1979). Open water habitats of the project area are found primarily in association with the surface water of Pamlico Sound, Oregon Inlet, and the Atlantic Ocean.

Coastal wetlands are marshy areas subject to regular or occasional flooding by lunar or wind tides. These wetlands play a vital role in the productivity of estuaries. Coastal wetland protection in North Carolina is limited to marsh areas in its 20 coastal counties. The DCM administers state laws and regulations that provide protection for Areas of Environmental Concern (including coastal wetlands). The two main state legislative acts are CAMA and the North Carolina Dredge and Fill Act of 1969.

Ten wetland communities occur within the project area: wetland man-dominated, wetland salt shrub/grasslands, wetland maritime grassland, wetland overwash, wetland maritime shrub thicket, reed stand, salt flat brackish marsh, smooth cordgrass stands, and black needlerush. Approximate wetland habitat boundaries are depicted in Figure E-2a through Figure E-2h in Appendix E. Descriptions of these wetland communities are in Section 3.7.3 and Table 3-19. Jurisdictional wetlands were delineated using the three-parameter approach prescribed in the *1987 Corps of Engineers Wetlands Delineation Manual* (USACE Environmental Laboratory, 1987). Supplementary technical literature describing the parameters of hydrophytic vegetation, hydric soils, and wetland hydrologic indicators was also utilized.

3.7.4.2 Classification of Wetlands and Open Water Areas

Classification of Section 404 wetlands and the open water areas in Table 3-19 is based on *Classifications of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979).

The marine system consists of the near-shore ocean and the associated beach. Near-shore ocean is characterized by subtidal conditions and possesses an unconsolidated sandy bottom. Submerged aquatic vegetation (SAV) is comprised of seagrasses and also comprises a portion of estuarine subtidal wetlands in Pamlico Sound. Permanently flooded seagrass beds consist of rooted vascular species such as eelgrass, shoalgrass, and widgeongrass. The SAV provides vital nursery habitat for fish, shellfish, and other animal species. The SAV habitats in the waters of the Albemarle-Pamlico Sound, especially along the eastern periphery of the sound, are the most productive habitats for fish and shellfish (Ferguson et al., 1989). Overall, the importance of seagrasses and their role in many coastal ecosystems have been extensively documented.

The beach is an intertidal unconsolidated shore that is irregularly flooded from storms and spring high tides. The landward limit of this system extends to where tidal inundation stops on the beach during the high spring tides and to the seaward limit of the estuarine system within Oregon Inlet (approximated by the line of demarcation in Figures E-2a through E-2h in Appendix E). The open water areas also are classified as wetlands by the USFWS. Oregon Inlet and the nearby Pamlico Sound are both estuarine subtidal wetlands that possess an unconsolidated sandy bottom.

Table 3-19. Classification of Jurisdictional Waters and Wetlands in the Project Area by Community Type

Biotic Community Classification[1]	USFWS Classification[2]	Approximate Acres (hectares)[3]
Open water		
• Near-shore ocean	Marine, subtidal, unconsolidated bottom, sand, subtidal	NA
• Submerged aquatic vegetation (SAV)	Estuarine, subtidal, aquatic bed, rooted vascular, sand, subtidal	600.00 (242.81)
• Inlet and sound	Estuarine, subtidal, unconsolidated bottom, sand, subtidal	NA
• Impoundments	Lacustrine, littoral, aquatic bed, rooted vascular, artificially flooded, brackish, diked impoundments	290.00 (117.36)
Man-dominated[4]	NA	NA
Salt/shrub grasslands	Estuarine, intertidal, emergent, persistent, irregularly flooded; and estuarine, intertidal, shrub-scrub, broad-leaved evergreen, irregularly flooded	289.35 (117.10)
Maritime grassland	Palustrine and estuarine, intertidal, emergent, persistent, irregularly flooded	59.88 (24.23)
Overwash[5]	NA	NA
Maritime shrub thicket	Estuarine, intertidal, shrub-scrub, broad-leaved evergreen, irregularly flooded; and Palustrine, shrub-scrub, broad-leaved evergreen	201.13 (81.39)
Reed stand	Palustrine, emergent, persistent, seasonally flooded/saturated	15.36 (6.22)
Salt flat	Estuarine, subtidal, unconsolidated bottom	0.16 (0.06)
Brackish marsh	Estuarine, intertidal, emergent, persistent, irregularly flooded	3.54 (1.44)
Smooth cordgrass	Estuarine, intertidal, emergent, persistent, regularly flooded	42.05 (17.02)
Black needlerush	Estuarine, intertidal, emergent, persistent, irregularly flooded	254.31 (102.92)

1 The project area for the natural systems analysis is the area shown on Figure E-2a through Figure E-2h in Appendix E.
2 Equivalent USFWS classification based on *Classifications of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979).
3 Determined from CZR, Incorporated biotic communities mapping; near-shore ocean and inlet and sound areas were not quantified because these resources are pervasive and extend well beyond the project's area of effect.
4 Disturbed and not a natural area so is not classified.
5 Biotic community includes less than 10 percent vegetation cover and is not applicable to wetland classification.

The CAMA defines coastal wetlands as areas that contain at least one of the following species: smooth cordgrass, black needlerush, glasswort, salt grass, sea lavender (*Limonium carolinianum*), bulrush, saw grass, cattail, saltmeadow grass, and giant cordgrass. Within the project area, extensive coastal wetlands are present. The most abundant estuarine wetland class within the project area is the persistent emergent wetland, which consists of erect, rooted herbaceous hydrophytes. The communities included in this category are black needlerush, smooth cordgrass, and brackish marsh on Bodie Island and Hatteras Island. The frequency and duration of tidal flooding control the floristic composition in these communities; smooth cordgrass is restricted to regularly flooded areas; irregularly flooded areas are dominated by black needlerush and brackish marsh.

A second common wetland class in the project area is the estuarine shrub-scrub and/or emergent wetland. This class is dominated by woody vegetation, typically less than 20 feet (6.1 meters) tall or persistent herbaceous vegetation (Cowardin et al., 1979). This class commonly includes broad-leaved evergreen shrubs and trees that are found in the low shrub/grassland and maritime shrub thicket communities. Wet maritime grasslands and salt shrub/grasslands that are seasonally flooded and remain saturated fall under this classification.

Most of the wetland areas are on the west side of NC 12 and are part of a large estuarine system that extends along the eastern boundary of Pamlico Sound. The wetland boundary associated with the estuarine system of Pamlico Sound crosses in and out of the project area. Therefore, separate wetland areas are part of a larger system whose wetland boundary does not always occur within the project area.

The beach, dune community, man-dominated areas, and isolated salt shrub/grassland, maritime grassland, overwash, reed stand, and maritime shrub thickets comprise the upland communities within the project area. Additional isolated areas designated as upland black needlerush located in disturbed overwash areas are not jurisdictional wetlands.

Physical marking of the wetland boundary was not permitted within the Refuge. The wetland boundaries were mapped at the time of the wetland delineation using a Trimble Global Positioning System (GPS) backpack unit with sub-meter accuracy. The USACE has performed a jurisdictional determination of the project area, including areas on Bodie Island and Hatteras Island.

Two soil associations are present in the project area, the Newhan-Duckston-Corolla and Hobonny-Carteret-Currituck associations. Soil associations are defined as landscapes that exhibit distinctive proportional patterns of soils and consist of one or more major soils and at least one minor soil. The soils within an association generally vary in slope, depth, stoniness, drainage, and other characteristics (Tant, 1996). Field verification along with examination of soils, vegetation, and hydrology on Bodie Island and Hatteras Island, substantiated that most uplands are found on beaches, dunes, and in man-dominated areas occurring on Beaches-Newhan Complex, Newhan fine sand soils or Duneland-Newhan complex. These generally are upland areas lacking the hydrology and soils required for wetlands. Other soils that are not considered hydric include the dredge spoil placed on a point of land west of the Oregon Inlet Marina and the area underlying the Oregon Inlet Marina and Fishing Center buildings and parking lots.

A few isolated patches of upland are dominated by dunes, man-dominated areas and shrub thickets. These areas exist on one of these soils:

- A Newhan-Corolla complex soil;
- Newhan fine sand; or

- Corolla fine sand.

These soils also have inclusions of Duckston hydric soils within the numerous wet depressions and troughs. These wet interdunal swales and small shrub thickets have sandy, saturated soils and are high in organics. Soil samples taken during field verification indicate hydric soils throughout most of these communities. Characteristic soil colors from these wet swales were 10 YR 5/1 and contained organics (obtained from Munsell Soil Color Charts, 1988).

Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (Cowardin, et al., 1979). Hydric soils cover approximately 70 percent of the study area and include the Beaches portion of the Beaches-Newhan complex, Carteret sand, the Duckston portion of the Corolla-Duckston complex, and Duckston fine sand (Gregory, 1996). Soil types that are known to contain hydric inclusions occupy an additional 30 percent of the project area and include Corolla fine sand, Newhan fine sand, and the Newhan-Corolla complex (Gregory, 1996). Less than 1 percent of the project area is covered by non-hydric soils and includes Dune land-Newhan complex and Psamments (Gregory, 1996).

Functional values associated with wetlands are flood control, improving water quality, shoreline stabilization, groundwater recharge and discharge, and aquatic food chain support, as well as important wildlife habitat. The aesthetic, recreational, educational, and economic value of wetlands also contribute to the concern for wetland habitat.

3.7.4.3 Intertidal Zone

The area of beach that is exposed between high tide and low tide is referred to as the intertidal zone. The difference between elevation of high and low tide for Cape Hatteras is small (0.0 to 6.5 feet [0.0 to 2.0 meters]), and is dependent on the stage of the moon. However, a vertical change in ocean elevation may result in flooding or exposure of a varying amount of area depending on the slope of the beach. The intertidal zone within the project area is classified as M2US2 (Marine, Intertidal, Unconsolidated Shore, Sand) in the wetlands and deepwater habitats classification system (Cowardin et al., 1979). As a navigable water of the United States, the intertidal zone falls under the jurisdiction of Section 404 of the Clean Water Act, and therefore falls under the jurisdiction of the USACE and the USEPA.

3.7.5 Unique and Rare Habitats

The Wilderness Act of 1964 established the National Wilderness and Preservation System. Under the 1964 Act, the US Secretary of the Interior must review the suitability for preservation of all designated Wilderness areas in the NWRS. Included under designated Wilderness areas are roadless islands within the NWRS. Therefore, in 1974 the USFWS recommended for Wilderness status “recognizable” islands on the sound side of the Refuge (USFWS, 1975). Most of the proposed unnamed islands identified in the 1975 report were just southwest of the southernmost freshwater pond and within 1 mile (1.6 kilometers) of Hatteras Island. Also recommended for Wilderness designation and within the project area is the Oregon Inlet Shoal, which is west of the northern end of Hatteras Island. The islands are dominated in the low marsh by black needlerush, marsh elder, bulrush, and spikerushes (*Elocharis sp.*); there is saltmarsh cordgrass along the island perimeter. In total, approximately 180 acres (72.9 hectares) were proposed as Wilderness. While a final decision was never made as to the islands’ status, the USFWS manages them as if they are Wilderness areas. Although some of these islands might have changed since 1975, the criterion for Wilderness status is the same and applies to currently recognizable islands on the sound side of the Refuge. The approximate locations of these islands are outlined in Figure 3-7.

The NCNHP has identified Significant Natural Heritage Areas (SNHA) throughout the state. The NCNHP compiles the NCDENR list of Significant Natural Heritage Areas as required by the Nature Preserve Act (North Carolina Geodetic Survey [NCGS] Chapter 113-A-164 of Article 9A). The list is based on the program's inventory of natural diversity in the state (NCDENR, 1997). Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determines a site's significance rating. SNHA designation is used for locations of ecological significance or rarity. The NCNHP has further classified these SNHAs by priority ranking, which takes into account the relative value of each SNHA.

Two SNHAs are found in the project area. The first are the dredge spoil islands around Oregon Inlet, which are important nesting and feeding areas for colonial waterbirds. The islands closest to the Pamlico Sound Bridge Corridor are Island B, Island C, and Sand Shoal Island (see Figure 3-7). These dredge spoil islands, which were recommended for Wilderness designation, were given a priority ranking of B meaning that these islands contain the "best" occurrences of colonial waterbird nesting islands found in the state; "best" usually is restricted to the top five examples. The island closest to the Parallel Bridge Corridor is Oregon Inlet Shoal, which is west of the northern boundary of the Refuge and west of the Parallel Bridge Corridor. Oregon Inlet Shoal, which was also recommended for Wilderness designation, developed from natural shoaling because of interactions of the Oregon Inlet Shoal Channel, the Oregon Inlet Channel, and several less defined channels in the area. (Personal communication, July 20, 2005, Dennis Stewart, Wildlife Biologist, USFWS.)

The second SNHA is the Refuge. Because of its value to migratory waterfowl, the Refuge was given a priority ranking of A, meaning that the site contains the "best" occurrences of migratory birds known to exist anywhere in the United States; "best" usually is defined as the top five sites. This refuge is made up of 5,843 acres of barrier island beach, dunes, salt flats, and salt marsh. An additional proclamation area of approximately 25,000 acres (10,117 hectares) is adjacent and west of the Refuge in the Pamlico Sound. A wide variety of wading birds, waterfowl, and shorebirds utilize the Refuge, including the endangered piping plover. The beaches provide nesting habitat for sea turtles such as the threatened green and loggerhead sea turtles.

3.7.6 Water Resources, Fisheries, and Wildlife

3.7.6.1 Water Resources

DWQ classifies surface waters of the state based on their intended best uses. Unnamed tributaries receive the same best usage classification as the named streams into which they flow. Waters within the project area, have been classified as Class SA waters, denoting suitability for commercial shell fishing and all other tidal saltwater uses (NCDENR, 2002). In addition, Class SA waters are also suitable for all Class SC and SB uses, which include primary and secondary recreation and aquatic life propagation and survival.

High Quality Waters (HQWs) are waters that are rated as excellent based on biological and physical/chemical characteristics through monitoring or special studies, native and special trout waters, primary nursery areas, critical habitat areas, water supply watersheds classified as Water Supply Watersheds (WS-I or WS-II), and all Class SA waters. The waters in the project area have been classified as Class SA waters; therefore, these waters are HQWs. No WS-I or WS-II or Outstanding Resource Waters occur within the project area. The Pamlico Sound at Hatteras Island has been identified as a Habitat Area of Particular Concern (HAPC) in the Fisheries Management Plan for the Southeast and Caribbean (NMFS, 1999). HAPCs are subsets of essential fish habitat (EFH).

The Ambient Monitoring System (AMS) is a network of stream, lake, and estuarine water quality monitoring stations strategically located for the collection of physical and chemical water quality data. The type of water quality data or parameters collected is determined by the waterbody's classification and corresponding water quality standards. Data from the AMS determines the "use-support" status of waterbodies, meaning how well a waterbody supports its designated uses. Surface waters (streams, lakes, or estuaries) are rated as *fully supporting*, *partially supporting*, or *not supporting*. These terms refer to how well the surface water supports the classified uses thereof. The DWQ did not sample benthic macroinvertebrates, fish communities, fish tissue, or ambient water quality in this sub basin. Therefore, the DWQ relies on information from the North Carolina Division of Environmental Health, local water treatment plant (WTP) operators, and county health departments for determining "use support" ratings in this sub basin. The majority of the waters of the Pamlico Sound are rated as *fully supporting* for aquatic life, primary and secondary recreation, and shellfish harvesting. Blackmar Gut, which abuts the southwestern project boundary, is rated as *not supporting* for secondary recreation and shellfish harvesting. The Atlantic coastal waters are rated as *partially supporting* for fish consumption and *fully supporting* for primary recreation (NCDENR, 2002).

Over 460 miles (740.3 kilometers) of freshwater streams and rivers are within the Pasquotank River Basin. Of these freshwater resources, more than 60 percent are considered impaired because of low dissolved oxygen and high turbidity, which are attributed to nonpoint source runoff from agricultural land use (NCDENR, 1994). Within the project area's sub basins, some areas are closed to shellfish harvesting because of unacceptably high levels of fecal coliform bacteria believed to be associated with urban runoff, septic tanks, and marinas. There are no areas in which shellfish harvesting is restricted within the project area (NCDENR, 2002).

The effort to develop a method to assess water quality based on macroinvertebrates in estuarine waters began in late 1990. An estuarine biotic index (EBI) designed for Florida was modified to create the North Carolina EBI, which more closely reflects taxa and tolerances in North Carolina and can accurately rank sites of different water quality. However, the DWQ has not collected macroinvertebrate data in this sub basin and cannot assign a rating to these waters (NCDENR, 2002).

3.7.6.2 Fish and Shellfish

The estuarine waters of Pamlico Sound provide habitat for a diversity of aquatic life. Larvae of various marine and estuarine fish, invertebrates, and zooplankters graze upon large phytoplankton populations dominated by various diatoms. Many of the shallow creeks, bays, extensive marshes, and submerged aquatic vegetation beds function as nursery areas for finfish and shellfish species. Estuarine-dependent fish, crustaceans, and other organisms use the sound as a passage way to spawning areas or feeding grounds. The waters are used by resident estuarine species, as well as transient anadromous (move from the ocean to rivers to spawn), catadromous (move from freshwaters to the ocean to spawn), and marine species. The DMF conducts juvenile trawl sampling from waters adjacent to Oregon Inlet. During these surveys, more than 100 different species of fish and shellfish have been captured in the immediate vicinity of the project area. The Walter Slough area behind Bodie Island is particularly productive. (Personal communication, August 1, 1990, Beth Burns, NCDENR-DMF.) In 1990 to 2002 juvenile trawl surveys at Walter Slough, Pea Island Flats, and Rodanthe Flats, the most abundant species at all sites during the

May to June sample period were pinfish (*Lagodon rhomboides*), pigfish (*Orthopristis chrysoptera*), spot (*Leiostomus xanthurus*), silver perch (*Bairdiella chrysoura*), pipefish (*Syngnathus* spp.), and blue crabs (*Callinectes sapidus*). During July to September, the most frequently collected species were pink shrimp (*Penaeus duorarum*), grass shrimp (*Palaemonetes* spp.), pigfish, pipefish, and blue crabs (NCDENR-DMF, unpublished data, 1990-2003).

The sound supports many recreationally and commercially important fish and shellfish including: blue crab, Atlantic croaker (*Micropogonias undulatus*), spot, shrimp (*Penaeus aztecus*, *P. duorarum*, and *P. setiferus*), weakfish (*Cynoscion regalis*), and flounder (*Paralichthys lethostigma*, *P. dentatus*, and *P. albigutta*). In assessing commercial fisheries, an attempt was made to use only the fish and shellfish data collected for those locations and vessels most relevant to the project area. Therefore, the fish and shellfish catch statistics are limited to boats leaving from Dare County. Furthermore, commercial landings are broken down by these water bodies:

- The Roanoke Sound;
- The waters of the Pamlico Sound within Dare County; and
- The Atlantic Ocean less than 3 miles (4.8 kilometers) from shore.

Based on these data, blue crabs and flounder are by far the most valuable commercial species in the Roanoke and Pamlico sounds. Also of commercial significance are striped mullet (*Mugil cephalus*), commercial shrimp (*Penaeus sp.*), striped bass (*Morone saxatilis*), and sea trout (*Cynoscion sp.*). The weight and dollar value of finfish and shellfish harvests for each water body in 2002 are shown in Table 3-20. Harvests from 1990 to 2002 are presented in the *Natural Resources Technical Memorandum* (CZR, Incorporated, 2005).

Table 3-20. 2002 Fish Harvests in the Project Area

Atlantic Ocean[1]		Pamlico Sound		Roanoke Sound	
Dollars	Pounds	Dollars	Pounds	Dollars	Pounds
Shellfish Harvest[2]					
$1,123,228	500,043	$2,009,757	1,923,248	$2,099,565	1,796,542
Finfish Harvest					
$12,052,456	17,664,154	$1,306,496	1,842,488	$183,052	206,791

Source: NCDENR-Division of Marine Fisheries. *Commercial Fish Landings by Boats Leaving from Dare County*, unpublished data, 2002.
[1] Atlantic Ocean refers to fish caught less than 3 miles (4.8 kilometers) from shore by boats leaving from Dare County, NC.
[2] Shellfish includes all non-finfish such as crabs, shrimp, clams, scallops, and oysters.

The areas of highest shellfish density (primarily clams and oysters) in the project area are Crab Slough, directly southwest of Oregon Inlet, and various locations along the shoreline of the Refuge. (Personal communication, July 28, 2003, Greg Allen, NCDENR-DMF.) There also are scattered shellfish beds west of Hatteras Island in 2 to 3 feet (0.6 to 0.9 meters) of water. Near the project area, shellfish beds also are found along the sound side of Bodie Island, just north of

Walter Slough. There are no leased shellfish areas within the project area. The closest leased bed is adjacent to Duck Island, more than 3 miles (4.8 kilometers) from southern Bodie Island. (Personal communication, June 18, 2003, Craig Hardy, NCDENR-DMF.)

Oyster restoration efforts in the Pamlico Sound have been underway for decades. Part of this effort involves yearly seeding with immature oysters by the DMF. Also included in cultch plantings were surf clams and scallops. During the period from 1985 to 1999, there were plantings in Walter Slough, Davis Slough, Old House Channel, and the area in between—all just west of Oregon Inlet. During the same period, several plantings also occurred within 2 miles (3.7 kilometers) west of Hatteras Island and Rodanthe. However, the only recent cultch plantings in the project area were at Walter Slough; 12,000 bushels of oysters were planted in 2000 and 2001. Another 18,000 bushels were planted in 2002 (NCDENR-DMF, unpublished data, 2003).

Several commercial fishing vessels and gear types are used in the Pamlico Sound. Among the most common gears are crab pots and crab trawls, flounder and shrimp trawls, gill nets, and pound nets (NCDENR-DMF, unpublished data, 2003). Most vessels operating in the waters of Dare County and the Atlantic Ocean are categorized as 19 to 50 feet (5.8 to 15.2 meters) in length. Most vessels longer than 50 feet (15.2 meters) are operating in the ocean, although some can be found in the Pamlico Sound as well. Table 3-21 presents commercial fishing vessel numbers and sizes for boats leaving from Dare County and operating in the Pamlico Sound or Atlantic Ocean.

Table 3-21. Dare County Commercial Fishing Vessels

Location (Where They Operate)	Vessel Length in Feet (Meters)	Year		
		2000	2001	2002
Waters of Dare County	1.0 – 18.0 (0.3 – 5.5)	266	246	226
	19.0 – 50.0 (5.8 – 15.2)	492	448	426
	> 50.0 (15.2)	19	17	20
Atlantic Ocean	1.0 – 18.0 (0.3 – 5.5)	62	66	100
	19.0 – 50.0 (5.8 – 15.2)	291	295	342
	> 50.0 (15.2)	71	96	88

Source: NCDENR-Division of Marine Fisheries, unpublished data, 2003.

3.7.6.3 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 et seq.) requires the US Secretary of Commerce to develop guidelines assisting regional fisheries management councils in identifying and creating management and conservation plans for EFH. Each council is required to amend existing fisheries management plans (FMPs) to include EFH designations and conservation requirements. The Act also requires federal agencies to consult with the Secretary on all actions, or proposed actions—authorized, funded, or undertaken by the agency—that might adversely affect EFH.

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 USC 1802(10)). “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and can include aquatic areas historically used by fish where appropriate. “Substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities. “Necessary” means the habitat is required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem. “Spawning, breeding, feeding, or growth to maturity” covers a species’ full life cycle. EFH designations are required only for species or species units for which councils have developed FMPs.

Managed species found in the project area fall under the joint responsibility of the South Atlantic Fisheries Management Council (SAFMC), the Mid-Atlantic Fisheries Management Council (MAFMC), and NMFS. The SAFMC has defined several habitats to be EFH for managed species (SAFMC, 1998). Habitat types and their presence in the project area (SAFMC, 1998) are shown in Table 3-22.

The paragraphs that follow present brief descriptions of EFH habitats in the project area. More detail is presented in the *Essential Fish Habitat Assessment* (CZR, Incorporated, 2008).

Table 3-22. Inshore and Marine Essential Fish Habitats

Inshore	**Found in Project Area**
Estuarine emergent	Yes
Estuarine shrub/scrub (mangrove)	No
Seagrass	Yes
Oyster reef and shell bank	Yes
Intertidal flats	Yes
Palustrine emergent and forested (freshwater)	Yes (interdunal swales)
Aquatic bed (tidal freshwater)	No
Estuarine water column	Yes
Marine	
Live/hard bottom	No
Coral and coral reef	No
Artificial/manmade reef	No
Sargassum	No
Water column	Yes

Source: South Atlantic Fisheries Management Council, 1998

Estuarine Emergent

Estuarine emergent wetlands are brackish and salt marsh habitats. The sound side wetlands that fringe Bodie Island, Hatteras Island, and Rodanthe are almost entirely wetlands of this type. Salt marshes are nutrient-rich and have high primary productivity, allowing these habitats to support a diversity of fish, invertebrates, and waterfowl. Fish use salt marsh wetlands during multiple life stages because they provide nursery habitat for juveniles and foraging areas for adults. Descriptions of estuarine emergent habitats within the project area are presented in Section 3.7.3.

Palustrine Emergent

Palustrine emergent systems include tidal and non-tidal marshes. Because of the primary productivity of this habitat, this typically wet transition zone supports a variety of aquatic organisms. Like estuarine emergent wetlands, palustrine emergent wetlands serve an important function as nursery habitat for managed species. However, the palustrine emergent wetlands within the project area usually are interdune maritime grasslands, as described in Section 3.7.3.5, and do not have the ecological function typical of other palustrine emergent wetlands.

Seagrass

Seagrasses, mainly eelgrass and shoalgrass, are found in the high salinity areas of the Pamlico Sound generally in waters less than 6 feet (1.8 meters) deep. The Pamlico Sound has some of the most expansive seagrass (or SAV) beds in North Carolina. The distribution and composition of seagrass communities are influenced by several factors; among the most important factors are light, salinity, wave action, and nutrient levels. For many juvenile and adult fish, the structural complexity of seagrass habitat provides refuge from predators. These habitats are also rich in invertebrates and, therefore, serve as important foraging areas.

Oyster Reef and Shell Bank

Oyster reefs and shell banks are intertidal or subtidal habitats composed of living shellfish or artifact shell material. Several species of specialized fish and invertebrates are associated with oyster reefs as these habitats provide food and cover. Living oyster populations are limited by, among other things, siltation, salinity, and substrate. Throughout their entire Atlantic range, oyster reefs have declined substantially in the last century because of natural and anthropogenic stressors. Efforts currently are underway to regenerate oyster reefs. Bottom surveys conducted by the DMF suggest that shell bottom and large living oyster reefs are uncommon in the project area (NCDENR-DMF, unpublished data, 2003). The heaviest concentrations are in Crab Slough. (See Section 3.7.6.2 for a description of shellfish resources.)

Intertidal Flats

Intertidal flats are un-vegetated or sparsely vegetated, sandy or soft bottom areas and are found throughout the project area. The flats provide year round habitat for invertebrates and are important feeding areas for both resident fishes and seasonal migrants. Particularly important is the microhabitat known as the "marsh edge," or the detritus-rich area where the flats interface with marsh vegetation. The spatial extent of intertidal flats is determined by local topography and tidal amplitude.

Estuarine Water Column

The estuarine water column extends from the estuarine bottom to the surface waters. This habitat encompasses oligohaline (low salinity), mesohaline (moderate salinity), and polyhaline (high salinity) waters, which includes all open water of the Pamlico Sound. Distinct zones within the water column can be defined by several parameters such as temperature, salinity, and dissolved oxygen. Water column zonation is continually fluctuating and is a function of tidal dynamics, season, nutrient levels, and proximity to the ocean.

Fish and shellfish often exploit distinct resources within the water column based on species-specific diet, behavior, and morphology. For example, demersal fishes (bottom dwelling) are adapted for bottom habitat and typically exhibit specialized feeding organs, body shape, and coloration, whereas estuarine pelagic fishes are those adapted for swimming and feeding higher in the water column.

Marine Water Column

The marine water column in the project area includes the waters of Oregon Inlet. Like the estuarine water column, marine waters have biological and chemical gradients that exhibit spatial and temporal variation. Non-estuarine-dependent fish and shellfish use this habitat during all stages of their life-cycle.

Oregon Inlet is a key corridor for larval fish to enter estuarine nursery areas. Several studies of larval fish flux exist for Oregon Inlet. Joyeux (1999) found five taxa to be most abundant: Atlantic menhaden (*Brevoortia tyrannus*), Atlantic croaker (*Micropogonius undulatus*), spot (*Leiostomus xanthurus*), pinfish (*Lagodon rhomboides*), and flatfishes of the genus *Paralichthys.* Hettler and Barker (1993) found 60 taxa, with anchovies (*Anchoa* sp.), clupeoids, and Atlantic croaker larvae to be the most abundant at Oregon Inlet. They also found that ichthyoplankton abundance was greatest in August and lowest in February. Larval fish use active (vertical migration) and passive processes (tidal transport; wind driven currents) for transport through Oregon Inlet.

The SAFMC and MAFMC have developed fisheries management plans for several species, or species units (SAFMC, 1998; MAFMC, 1998), although not all species are found in the project area. In addition, highly migratory species FMPs and Atlantic billfish FMPs were developed by the Highly Migratory Species Management Unit, Office of Sustainable Fisheries, National Marine Fisheries Service (NMFS, 1999a; NMFS, 1999b). As part of each FMP, the council designates not only EFH, but also Habitat Areas of Particular Concern (HAPC), a subset of EFH that refers to specific locations required by a life stage(s) of that managed species. Table 3-23 presents the species or species units for which FMPs exist, whether these species are found within the project area, and designated EFH and HAPC in the project area. Below is a description of managed species with EFH found in the project area.

Atlantic mackerel (Scomber scombrus)

Atlantic Mackerel are pelagic, primarily piscivorous species (fish that eat other fish) found along the Atlantic coast from Labrador to Cape Hatteras. Spawning occurs throughout its range along the continental shelf in waters less than 50 feet (15.2 meters) in depth. Inshore waters around Oregon Inlet, but not the Pamlico Sound, are considered EFH for all life stages. Atlantic mackerel generally are not found in the Pamlico Sound at any life stage, but do use the more northern estuaries. No HAPC has been designated by the MAFMC.

Black Sea Bass (Centropristis striata)

The black sea bass is a demersal species (bottom dwelling) found from Maine to Florida. Spawning occurs offshore from May to October along the continental shelf in an area extending from southern New England to North Carolina. Larvae develop in coastal waters and estuaries, with highest concentrations from Virginia to New York. As juveniles and adults, this species is associated with submerged structure in estuarine and marine waters. Black sea bass enter Pamlico Sound during the late spring, summer, and fall to take advantage of seasonally abundant fish and invertebrate prey. Inshore waters around Oregon Inlet are designated EFH by the MAFMC for larval, juvenile, and adult life stages. Black sea bass are considered part of the Snapper Grouper Complex by the SAFMC, and all estuarine emergent wetlands, SAV, oyster reef and shell banks, and unconsolidated bottom habitats within the project area are designated EFH by the SAFMC. In addition, oyster shell bank habitat within the Pamlico Sound is designated EFH-HAPC for black sea bass by the SAFMC. This species is considered over-fished by the MAFMC.

Table 3-23. Managed Fish Species or Species Units Listed by Manager

Species	Present in Project Area	Life stages for EFH Present in Project Area	Designated EFH in Project Area	HAPC in Project Area
Mid-Atlantic Fisheries Management Council (MAFMC)				
Atlantic mackerel (*Scomber scombrus*)	Yes	Eggs, larvae, juveniles, adults	Inshore coastal waters	None
Atlantic surfclam (*Spisula solidissima*)	No	None	None	None
Black sea bass (*Centropristis striata*)	Yes	Eggs, larvae, juveniles, adults	Inshore coastal waters; Pamlico Sound	SAV, oyster/ shellbank
Bluefish (*Pomatomus saltatrix*)	Yes	Eggs, larvae, juveniles, adults	Inshore coastal waters, Pamlico Sound	None
Butterfish (*Peprilus triacanthus*)	Yes	Eggs, larvae, juveniles, adults	Inshore coastal waters	None
Spiny dogfish (*Squalus acanthius*)	Yes	Juveniles, adults	Inshore coastal waters	None
Longfin squid (*Loligo pealei*)	Yes	Pre-recruit, recruit	Inshore coastal waters	None
Monkfish (*Lophius americanus*)	No	None	None	None
Ocean quahog (*Artica islandica*)	No	None	None	None
Summer flounder (*Paralichthys dentatus*)	Yes	Eggs, larvae, juveniles, adults	Inshore coastal waters, Pamlico Sound	SAV
Scup (*Stenotomus chrysops*)	Yes	Juveniles, adults	Inshore coastal waters; Pamlico Sound	SAV, oyster/ shellbank
Shortfin squid (*Illex Illecebrosus*)	Yes	Pre-recruit, recruit	Inshore coastal waters	None
Tilefish (*Lopholatilus chamaeleonticeps*)	No	None	None	None
South Atlantic Fisheries Management Council (SAFMC)				
Penaeid and rock shrimp (Penaeus sp. & Sicyonia sp.)	Yes	Eggs, larvae, juveniles, adults	Pamlico Sound, Inshore coastal waters	Oregon Inlet; Pamlico Sound
Red drum (*Sciaenops ocellatus*)	Yes	Eggs, larvae, juveniles, adults	Pamlico Sound, Inshore coastal waters	Oregon Inlet, SAV
Snapper Grouper management unit	Yes	Juveniles, adults	Pamlico Sound, Inshore coastal waters	Oregon Inlet, SAV, oyster/shell bank
Golden crab (*Chaeceon fenneri*)	No	None	None	None
Spiny lobster (*Panulirus argus*)	No	None	None	None
Coastal migratory pelagic species	Yes	Eggs, larvae, juveniles, adults	Pamlico Sound, Inshore coastal waters	None
Sargassum (*Sargassum* sp.)	No	None	None	None
Calico scallop (*Agopecten gibbus*)	No	None	None	None
Coral, coral reef, and live/hardbottom habitat	No	None	None	None
National Marine Fisheries Service (NMFS)				
Highly migratory species (sharks, tuna, swordfish)	Yes	Juveniles, adults	Pamlico Sound, Atlantic coast	Pamlico Sound adjacent to Hatteras Island
Billfish	No	None	None	None

Source: MAFMC, 1998; SAFMC 1998, NMFS, 1999a, 1999b.

Bluefish (Pomatomus saltatrix)

Bluefish are pelagic fish found in coastal waters from Nova Scotia to South America. Adults are piscivorous (eat other fish) and generally feed on small baitfish in inshore and estuarine habitats. This species makes long-distance migrations to Florida during the fall and migrate north during the spring. They are seasonal visitors to the Pamlico Sound, with the greatest abundance from April to October. Spawning takes place on the continental shelf at various times of the year depending on location. Inshore waters around Oregon Inlet are designated EFH for all life stages. The estuaries of the Pamlico Sound are designated EFH for juvenile and adult life stages by the MAFMC. No HAPC has been designated by the MAFMC. This species is considered over-fished by the MAFMC.

Butterfish (Peprilus triacanthus)

Butterfish are found in coastal waters from Newfoundland to Florida. Spawning occurs offshore, but larvae and juveniles make use of estuaries during growth. Adults are seasonal migrants that winter in offshore waters or warm coastal waters near the southern states. The MAFMC has designated pelagic waters greater than 33 feet (10.1 meters) in depth as EFH for all life stages. No HAPC has been designated by the MAFMC.

Spiny Dogfish (Squalus acanthius)

Spiny dogfish are cartilaginous fish (having a skeleton made of cartilage) found in shallow and deep waters of the continental shelf from Labrador to Cuba. This species is a livebearer that gives birth to litters of 1 to 15 pups during winter in inshore waters. The primary prey items for dogfish are fish and, to a lesser extent, squid and crustaceans. For juveniles and adults, the MAFMC has designated inshore waters around Oregon Inlet as spiny dogfish EFH. This species is considered over-fished by the MAFMC, but no HAPC has been designated by the MAFMC.

Summer flounder (Paralichys dentatus)

The summer flounder is an estuarine-dependent species found along the Atlantic coast from Maine to Florida. Spawning occurs from Cape Cod to Cape Hatteras between October and May along the continental shelf in waters 30 to 360 feet (9.1 to 109.8 meters) in depth. Larvae enter the estuaries, including the Pamlico Sound, in the late winter and spring where they develop into juveniles before migrating to the ocean during the fall. As adults, summer flounder continue to make seasonal use of estuaries. The MAFMC designates inshore waters around Oregon Inlet as EFH for all life stages and designates the estuaries of the Pamlico Sound as EFH for larval, juvenile, and adult life stages. In addition, the SAV beds of the Pamlico Sound are designated HAPC by the MAFMC. This species is considered over-fished by the MAFMC.

Scup (Stenotomus chrysops)

Scup are found from Nova Scotia to eastern Florida, but are rare south of North Carolina. Scup are migratory species that occupy offshore waters in winter and inshore waters from spring to fall. Their diet consists mainly of invertebrates such as crustaceans and mollusks. The MAFMC has not designated EFH for scup in the Pamlico Sound or Oregon Inlet; however, this species is considered over-fished by the MAFMC. Scup are considered part of the Snapper Grouper Complex by the SAFMC. Therefore, all estuarine emergent wetlands, SAV, oyster reef and shell banks, and unconsolidated bottom habitats within the project area are designated EFH by the SAFMC. In addition, the SAFMC designated SAV and oyster shell bank habitat within the Pamlico Sound as EFH-HAPC for scup.

Shortfin Squid (Ilex illecebrosus)

Shortfin squid are distributed from Labrador to Florida, with the greatest abundance between Cape Hatteras and Newfoundland. Shortfin squid make long-distance fall migrations to spawning areas south of Cape Hatteras, after which larvae and juveniles are transported by the Gulf Stream to more northern waters. Adults feed primarily on small fish, crustaceans, and other squid. The most important predators of shortfin squid are billfish, sharks, tunas, and marine mammals. EFH in the project area includes nearshore coastal waters around Oregon Inlet. No EFH is designated for the Pamlico Sound.

Longfin Squid (Loligo pealeii)

Longfin squid are distributed from Labrador to the Gulf of Venezuela, with the greatest abundance between Cape Hatteras and Georges Bank. Like shortfin squid, longfin squid make long-distance migrations along the coast and from inshore to offshore waters of the continental shelf. Typically, this species overwinters offshore and moves in to warm inshore waters during the spring and summer months. Spawning occurs year-round. Adults feed primarily on small fish, crustaceans, and other squid. The most important predators of shortfin squid are billfish, sharks, tunas, and marine mammals. EFH in the project area includes nearshore coastal waters around Oregon Inlet. No EFH is designated for the Pamlico Sound.

Penaeid and Rock Shrimp (Penaeus sp.)

Penaeid shrimp (white, pink, and brown shrimp) are estuarine dependent species of ecological and commercial importance. Penaeid shrimp spawn offshore where larval and postlarval development occurs as well. After currents carry postlarvae into estuaries, shrimp distribute themselves according to substrate and salinity preference. As shrimp grow, they migrate to deeper, high salinity waters before leaving for offshore spawning grounds. All estuarine emergent wetlands, SAV, oyster reef and shell banks, subtidal and intertidal flats, and ocean surf zone habitats within the project area are designated penaeid shrimp EFH. Also, portions of the project area are designated HAPCs for penaeid shrimp. There are no rock shrimp or rock shrimp EFH in the project area.

Red Drum (Sciaenops ocellatus)

Red drum are found in the coastal waters, inlets, and estuaries of the Atlantic coast from Massachusetts to northern Mexico. Spawning occurs in shallow water along beaches and inlets after which eggs and larvae are carried into estuaries where juvenile development takes place. Juvenile feed and grow during the warmer months before moving into deep estuarine or oceanic waters. As adults, red drum make pronounced seasonal migrations along the coast, moving offshore or to southern waters in fall and back to more northern, inshore waters in the spring. Red drum arrive at the Pamlico Sound between March and April, with a second peak in abundance during fall as fish begin migrating south from the Mid-Atlantic states. All estuarine emergent wetlands, SAV, oyster reef and shell banks, unconsolidated bottom, and ocean surf zone habitats within the project area are designated red drum EFH. Oregon Inlet and the SAV beds of the Pamlico Sound are designated HAPCs for red drum.

Snapper Grouper Management Unit

More than 70 species of fish, occupying a range of niches, are included in the snapper grouper management unit. Although most of these species occupy offshore structure and are not found within the project area, several representatives from the following families of fish are seasonally present: snapper (*Lutjanidae*), triggerfish (*Balistidae*), jacks (*Carangidae*), spadefish (*Ephippidae*), sea bass and grouper (*Serranidae*), and porgies (*Sparidae*). In addition, several estuarine dependent species like mutton snapper (*Lutjanus analis*), gray snapper (*L. griseus*), and lane snapper (*L. synagris*) can be found in the Pamlico Sound. For these estuarine dependent species, all estuarine emergent wetlands, SAV, oyster reef and shell banks, and unconsolidated bottom habitats within the project area are designated EFH. Oregon Inlet, SAV, and oyster shell bank habitat within the project area are designated HAPC for the snapper grouper species complex.

Coastal Migratory Pelagics

This category refers to six species of migratory fish found along the Atlantic coast from nearshore to the edge of the continental shelf. While adults generally are found offshore, their prey is often estuarine dependent; therefore, estuarine habitats are considered part of the coastal migratory pelagic management unit. Coastal migratory pelagics occurring in the project area include cobia (*Rachycentron canadum*), Spanish mackerel (*Scomberomorus maculatus*) and king mackerel (*Scomberomorus cavalla*). Oregon inlet is designated as EFH for all these species; additionally, the high salinity portions of the Pamlico Sound are considered EFH for cobia. No HAPC for coastal migratory pelagics are designated in the project area.

Highly Migratory Species and Atlantic Billfish

Highly migratory species include swordfish (*Xiphias galdius*), five species of tuna, and 39 species of shark. The billfish FMP designates EFH for blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), sailfish (*Istiophorus platypterus*), and longbill spearfish (*Tetrapturus pfluegeri*). Highly migratory species display a wide diversity of geographic distributions and life-histories. Billfish, tuna, and swordfish generally are offshore pelagic species at all life stages and NMFS has not designated any EFH within the project area for these fish. Several managed sharks do make use of inshore coastal habitat and estuaries; for these species, designated EFH includes shallow inshore waters around Oregon Inlet. These sharks are: scalloped hammerhead (*Sphyrna lewini*), blacktip shark (*Carcharhinus limbatus*), dusky shark (*Carcharhinus obscurus*), sandbar shark (*Carcharhinus plumbeus*), spinner shark (*Charcharhinus brevipinna*), tiger shark (*Galeocerdo cuvieri*), sand tiger shark, (*Odontaspis taurus*), and Atlantic sharpnose (*Rhizoprionodon terraenovae*).

Some species also make use of estuarine habitat, including the dusky shark and Atlantic sharpnose. For these species, EFH includes high-salinity estuarine waters of the Pamlico Sound. Additionally, shallow areas near the Outer Banks and in areas of the Pamlico Sound adjacent to Hatteras and Ocracoke islands and offshore of those islands are important nursery and pupping grounds for the sandbar shark; therefore, these locations are designated HAPC for this species.

3.7.6.4 Benthic Communities

Bottom-dwelling polychaetes, oligochaetes, amphipods, isopods, and the commercially valuable oyster (*Crassostrea virginica*) and hard clam (*Mercenaria mercenaria*) ingest both phytoplankton and zooplankton. Benthos (organisms that live on or in the bottom sediments of a body of water) found near Oregon Inlet, as documented by the NCDENR, indicate that polychaetes (*Nereis succinea*, *Laeonereis culveri*, and *Heteromastus filiformis*), decapods (*Rithropanopeus harrisii* and *Palaemonetes pugio*), amphipods (*Corophium lacustre*, *Gammarus fasciatus* and *G. palustrus*), isopods (*Cyathura polita* and *Cassidinidea ovalis*), tanaids (*Hargeria repax*), and mollusks (*Rangia cuneata*, *Geukensia demissa*, *Macoma balthica* and *Teredo* sp.) are frequently found in the nearby sounds. (Personal communication, August 14, 1990, Lawrence Eaton, Division of Environmental Management.)

The DWQ conducts benthic sampling biannually throughout the state as part of the Benthic Macroinvertebrate Ambient Network (BMAN) monitoring program. Using these surveys, an index of biotic integrity (BI) can be formulated and used to assess water quality at the sample location. The most recent survey, conducted in 1995 near Hatteras Island, found 76 species of macroinvertebrates and yielded a BI score of 2.8. The species richness and BI value for the Hatteras Island sample were higher than those found for estuaries along the Croatan Sound, Currituck Sound, Roanoke Sound, and the Alligator River (NCDENR, 2002).

3.7.6.5 Wildlife

Compared to the Dare County mainland, the project area contains fewer species of mammals, reptiles, and amphibians. Terrestrial species diversity likely is limited by commercial and residential development; however, natural factors (e.g., corridors, access, fragmented communities) are responsible as well. As a series of islands, geographic barriers exist that prevent the immigration of individuals from mainland populations. Also, most of the surface water resources are brackish to salt, limiting habitat use by reptiles and amphibians.

The greatest faunal abundance and species richness is typically found in the dune, marsh, and maritime shrub communities. Biotic community types and their associated fauna are described in Section 3.7.3.

Hunting is not permitted in the project area. Waterfowl hunting is permitted in certain locations, as described below in Section 3.7.6.6.

During surveys, wildlife identification involved a variety of observation techniques, including visual observations (both with and without the use of binoculars) and observing the characteristic signs of wildlife (sounds, scats, tracks, and burrows). Quantitative water sampling was not undertaken to support existing data. Evidence or individuals of a wide variety of animal species were observed within the project area. Species observed and evidence of species observed are indicated with an asterisk (*).

The project area likely exhibits a limited diversity of amphibian species. Environments such as freshwater ponds, bogs, and damp forests are very scarce on the island, and few amphibians survive in the salty ecosystem. Typical amphibians likely to be found in the project area include the two-toed amphiuma (*Amphiuma means*), green treefrog (*Hyla cinerea*), squirrel treefrog (*Hyla squirella*), leopard frog (*Rana utricularia*), and bullfrog (*Rana catesbiana*).

The variety of reptiles on the islands is greater than that of amphibians. Reptiles in the project area likely include rat snake* (*Elaphe obsolete*), black racer snake* (*Coluber constrictor*), rough green snake (*Opheodrys aestiva*), brown water snake* (*Nerodia taxispilota*), yellowbelly slider turtle* (*Chrysemys scripta*), mud turtle (*Kinosternon subrubrum*), snapping turtle* (*Chelydra serpentina*), Carolina diamondback terrapin (*Malaclemys terrapin centrata*), southeastern five-lined skink (*Eumeces inexpectatus*), and six-lined racerunner (*Cnemidophorus sexlineatus*).

Many birds utilize marsh environments for breeding sites and foraging. Red-winged blackbird* (*Agelaius phoeniceus*) was the most commonly observed bird in both the black needlerush and salt shrub communities. Other birds observed in the marshes were northern mockingbird* (*Mimus polyglottus*), merlin* (*Falco columbarius*), killdeer* (*Charadrius vociferous*), great horned owl* (*Bubo virginianus*), snowy egret* (*Egretta thula*), boat-tailed grackle* (*Quiscalus major*), and common grackle* (*Q. quiscula*). Waterfowl and other birds observed in open water habitats in the project area included tundra swan* (*Cygnuss columbianus*), snow goose* (*Chen caerulescens*), American black duck* (*Anas rubrides*), Canada goose* (*Branta canadensis*), double-crested cormorant* (*Phalacrocorax auritus*), hooded merganser* (*Ophodytes cucullatus*), belted kingfisher* (*Ceryle alcyon*), dunlin* (*Calidris alpine*), blue-winged teal* (*Anas discors*), and great blue heron* (*Ardea herodias*). Additional birds observed include the house finch*

(*Carpodacus mexicanus*), white ibis* (*Eudocimus albus*), and American white pelican* (P*elecanus erythrorhynchos*). Many birds were observed fishing over Pamlico Sound. They included several species of gulls* (*Larus* spp.), brown pelican* (*Pelecanus occidentalis*), and northern harrier* (*Circus cyaneus*). Other bird species expected to be found in these communities, but not observed, include marsh wren (*Cistothorus palustris*), salt marsh sharp-tailed sparrow (*Ammodramus caudacutus*), prothonotary warbler (*Protonotaria citrea*), and osprey (*Pandion haliaetus*).

The diversity of mammals on the Outer Banks is limited because of the over-water distance from the mainland. Evidence of marsh rabbits* (*Sylvilagus palustris*) and/or eastern cottontails* (*Sylvilagus floridanus*) were readily observed throughout the project area. White-tailed deer* (*Odocoileus virginianus*) and raccoon* (*Procyon lotor*) were observed throughout the project area. Evidence of red fox* (*Vulpes vulpes*) and river otter* (*Lutra canadensis*) was also observed throughout the area. Nutria* (*Myocastor coypus*), an introduced South American rodent, is a common inhabitant of the marshes along the Outer Banks. Other mammals likely to be in the project area include muskrat (*Ondatra zibethicus*), marsh rice rat (*Oryzomys palustris*), cotton mouse (*Peromyscus gossypinus*), and mink (*Mustela vison*). In addition, present all along the Outer Banks are feral cats* (*Felis sylvestris*), which have likely increased predation on native fauna.

3.7.6.6 Migratory Birds

Birds represent a highly visible and important resource of the Outer Banks. Because of the diversity and abundance of bird life on Hatteras Island, it is often referred to as "birder's paradise”. Along the Atlantic Flyway, the Refuge has a bird list of 365 species that occur with regularity, and another 50 species that are considered accidental visitors. Although wintering waterfowl may find suitable refuge sites along much of the Outer Banks, the presence of an abundant food source attracts most species to the Refuge. Shifting shoals, coastal marshes, and submersed beds of aquatic vegetation offer a variety of substrates for feeding waterfowl.

The National Audubon Society has designated Important Bird Areas based on criteria that includes the presence of protected or vulnerable species and bird habitats, the importance of the site to bird research, and locations that hold significant concentrations of one or more species during the year (e.g., greater than 1,000 waterfowl or shorebirds). Using these criteria, the National Audubon Society has designated the entire Seashore and Refuge as Important Bird Areas. Also, because of their importance to protected species and habitat use by terns, all Oregon Inlet shoals are designated Important Bird Areas by the National Audubon Society.

The diverse habitats surrounding Bonner Bridge are used throughout the year by many avian species. To document habitat use by birds, the North Carolina Wildlife Resources Commission (NCWRC), the USFWS, and the NPS coordinate periodic bird population and nesting surveys at the southern and northern sides of Oregon Inlet. Data from nesting surveys at the north end of the Refuge illustrate the importance of this area to breeding shorebirds such as black skimmers (*Rynchops niger*), common terns (*Sterna hirunda*), gull-billed terns (*Sterna nilotica*), and least terns (*Sterna antillarum*). Based on 2002 survey data, sanderling (*Calidris alba*), willet (*Catoptrophorus semipalmatus*), semipalmated plovers (*Charadrius semipalmatus*) and semipalmated sandpipers (*Calidris pusilla*) were the most common shorebirds at south Bodie Island near Oregon Inlet (NPS, unpublished data, 2003). The sand and mudflats at the south end of Bodie Island also attract many shorebirds, including federally protected piping plover (*Charadrius melodus*). Pearson et al. (1959) indicates the species was a casual summer resident at Hatteras Island (then Pea Island), with nests found in 1901 and 1902. During the last ten years, piping plover breeding pairs were observed during several years at the south end of Bodie Island

(NCWRC, unpublished data, 2003). Over the same period, piping plover breeding pairs also were recorded at the north end of the Refuge near Oregon Inlet (NCWRC, unpublished data, 2003). See Section 3.7.7 for a complete description of habitat use by piping plover. The federally-listed threatened roseate terns (*S. dougallii*) occasionally forage and rest on the mudflats and adjacent inshore ocean. In addition, two protected species, the southeastern bald eagle (*Haliaeetus leucocephalus)* and peregrine falcon (*Falco peregrinus*), are found regularly during migration and occasionally as winter residents in the area (USFWS, 1988a).

The Refuge encompasses, or has some jurisdiction over, 25,700 acres (10,405 hectares) of Pamlico Sound waters and a series of manmade ponds/impoundments that also provide substantial habitat for waterfowl. Water levels in the impoundments are seasonally manipulated in such a way as to maximize food production and produce optimal feeding conditions for waterfowl and shorebirds. The Refuge is an important wintering ground for tundra swan (*Cygnus columbianus*), Canada geese, snow geese (*Chen caerulescens*), and more than 25 species of ducks (USFWS, 1988a). Winter waterfowl surveys conducted by the USFWS from 1999 to 2003 revealed that the most abundant waterfowl on the Refuge are black ducks (*Anas rubripes*), northern pintails (*Anas acuta*), American widgeons (*Anas americana*), gadwalls (*Anas strepeva*), green winged teals (*Anas crecca*), and snow geese. Surveys of the Pamlico Sound also are conducted by the USFWS. However, surveys are limited to within 1 mile (1.6 kilometers) west of Hatteras Island and do not extend out to the Pamlico Sound Bridge Corridor. The most abundant species in the sound are black ducks, buffleheads (*Bucephala albeola*), and pintails, with American widgeons, gadwalls, and snow geese also being common (USFWS, unpublished data, 2003). Survey results for 1999 to 2003 are presented in the *Natural Resources Technical Memorandum* (CZR, Incorporated, 2005).

In the past, high numbers of birds have wintered or nested in the Pamlico Sound on dredge spoil islands adjacent to Bonner Bridge. For example, several dredge spoil islands just west and northwest of Oregon Inlet (see Figure 3-7) traditionally support large colonies of nesting waterbirds. Royal terns (*Sterna maxima*) and brown pelicans (*Pelecanus occidentalis*) comprise the majority of nesting birds (Parnell and Soots, 1979; USFWS, 1988a). Common tern, least tern, sandwich tern (*S. sandvicensis*), gull-billed tern, Caspian tern (*Sterna caspia*), and black skimmer have nested on these islands as well (Parnell and Soots, 1979; Parnell and McCrimmon, 1984; Parnell and Shields, 1990). Similarly, Oregon Inlet Shoal (see Figure 3-7) also has large nesting populations of skimmers and terns. During a June 2003 survey, 73 black skimmer nests, three gull-billed tern nests, and 129 common tern nests were found on Oregon Inlet Shoal. (Personal communication, June 13, 2003, Marcia Lyons, NPS.) Although some dredge spoil islands, such as Island C (a nesting site for herons, egrets, and ibis), continue to provide nesting habitat, some of the spoil islands historically used by colonial waterbirds no longer serve as viable nesting areas. One dredge spoil island historically in the project area, Sand Shoal Island, washed out in the early 1990s; it no longer supports colonial waterbirds. Another island supported nesting waterbirds until 1999, but is now substantially eroded and nesting no longer occurs. However, both islands still serve as intertidal foraging areas. (Personal communication, September 3, 2003, Sue Cameron, NCWRC.)

Waterfowl hunting is permitted on Bodie Island but not in the waters of the Pamlico Sound from the Refuge to the community of Salvo. On Bodie Island, hunting is restricted by a lottery system that allows hunting from 20 permanent duck blinds, all of which are north of the project area. No temporary blinds are allowed on Bodie Island. Where permitted, hunting is regulated by the NPS in cooperation with the USFWS and the State of North Carolina.

3.7.7 Protected Species

Federally-listed floral and faunal species have been granted protection under the Endangered Species Act of 1973 (16 USC 1531-1543), which mandates federal agencies to ensure that any actions authorized, funded, or carried out by that agency do not jeopardize the "continued existence" of listed species, or result in the destruction or adverse modification of critical habitat (16 USC 1536). Proposed species are offered "limited protection" under Section 7(A)(C) of the Endangered Species Act of 1973, as amended.

Plants and animals with state designations of endangered, threatened, or special concern are granted protection by the State Endangered Species Act (GS 113-331 to 113-337) and the State of North Carolina Plant Protection and Conservation Act of 1979 (GS 196 106-202.19). These acts are administered and enforced by the North Carolina Wildlife Resources Commission (NCWRC) and the NC Department of Agriculture, respectively.

Federally-listed endangered, threatened, and proposed species that occur in the project area were identified from 15A North Carolina Administrative Code 101 and USFWS listings (Title 50 *Code of Federal Regulations* Sections 17.11 and 17.12, January 16, 2008) for Dare County. State-listed species were obtained from the North Carolina Natural Heritage Program (NCNHP) official list of protected species found in Dare County (NCNHP, July 2, 2007). The most current NCNHP database, NPS publications, and personal communication with NPS and NCWRC biologists were used to document species occurrence specifically within the Oregon Inlet area. The NCNHP database was also used to document species occurrence within the Refuge and northern Rodanthe during development of the Parallel Bridge Corridor. Plant and animal species that occur in Dare County and that are state- or federally-listed endangered or threatened, as well as federal species of concern, are listed in Table 3-24.

3.7.7.1 Federally-Listed Threatened and Endangered Species

The USFWS lists 13 federally-listed threatened or endangered species for Dare County as of January 16, 2008. The eight federally-listed endangered species are:

1. Red-cockaded woodpecker (*Picoides borealis*);

2. Hawksbill sea turtle (*Eretmochelys imbricata*);

3. Kemp’s ridley sea turtle (*Lepidochelys kempii*);

4. Leatherback sea turtle (*Dermochelys coriacea*);

5. West Indian manatee (*Trichechus manatus*);

6. Shortnose sturgeon (*Acipenser brevirostrum*); and

7. Roseate tern (*Sterna dougallii*);

8. Red wolf (*Canis rufus*)—experimental.

Table 3-24. State and Federal Protected Species Listed for Dare County

Species	Current Status[1]		Habitat Type	Potential to Occur in the Project Area
	USFWS	NCNHP		
Mammals				
"Buxton Woods" white-footed mouse (*Peromyscus leucopus* ssp. 1)	FSC	SR	Maritime forests in Cape Hatteras vicinity	No
West Indian manatee (*Trichechus manatus)*	E	E	Coastal waters; warm waters of estuaries and river mouths	Yes
Red wolf (*Canis rufus*)	E-EXP	SR	Swamps, pocosins, extensive forests	No
Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)	FSC[2]	T	Caves, mines, buildings; near water	No
Birds				
Bald eagle (*Haliaeetus leucocephalus*)	Not listed	T	Mature forests near large bodies of water (for nesting): lakes and sounds	Yes
Black rail (*Laterallus jamaicensis*)	FSC	SR	Brackish marsh	Yes
Gull-billed tern (*Gelochelidon nilotica*)	Not listed	T	Summer resident; ocean, sound, tidal flats, dunes	Yes
Peregrine falcon (*Falco peregrinus*)	Not listed	E	Transient and winter resident; ponds, marshes, tidal flats, and beaches	Yes
Piping plover (*Charadrius melodus*)	T	T	Resident; tidal flats, beach pools, and open beaches; northern and southern tips of Oregon Inlet are proposed piping plover critical habitat by the USFWS	Yes
Red-cockaded woodpecker (*Picoides borealis*)	E	E	Resident; mature open pine woodlands	No
Roseate tern (*Sterna dougallii*)	E	E	Transient; sound, open beaches, maritime islands	Yes
Reptiles				
American alligator (*Alligator mississippiensis*)	T[3]	T	Ponds, fresh to slightly brackish rivers and marshes	No
Green sea turtle (*Chelonia mydas*)	T	T	Ocean, sounds, nests on beaches	Yes
Hawksbill sea turtle (*Eretmochelys imbricata*)	E	E	Ocean, nests on beaches	Yes[5]
Kemp's ridley sea turtle (*Lepidochelys kempii*)	E	E	Ocean, sounds, nests on beaches	Yes[5]
Leatherback sea turtle (*Dermochelys coriacea*)	E	E	Ocean, nests on beaches	Yes[5]
Loggerhead sea turtle (*Caretta caretta*)	T	T	Ocean, sounds, nests on beaches	Yes
Northern diamondback terrapin (*Malaclemys terrapin terrapin*)[4]	FSC	SC	Sound-side marshes	Yes

Table 3-24 (concluded). State and Federal Protected Species Listed for Dare County

Species	Current Status[1] USFWS	Current Status[1] NCNHP	Habitat Type	Potential to Occur in the Project Area
Fish				
Shortnose sturgeon (*Acipenser brevirostrum*)	E	E	Brackish and freshwater rivers and estuaries	Yes[5]
Vascular Plants				
Blue witch grass (*Dichanthelium caerulescens*)	Not listed	E	Wet savannas with a calcareous influence	Yes
Carolina grasswort (*Lilaeopsis carolinensis*)	Not listed	T	Freshwater marshes and pond edges	Yes
"Dune bluecurls" (*Trichostema* sp. 1)	FSC	SR-L	Maritime grasslands behind foredunes; openings in maritime scrub	Yes
Saltmarsh spikerush (*Eleocharis halophila*)	Not listed	T	Salt and brackish marshes	Yes
Seabeach amaranth (*Amaranthus pumilus*)	T	T	Sand flats and low dunes	Yes[6]
Small-flowered hemicarpa (*Lipocarpha micrantha*)	Not listed	E	Drawdown zones of blackwater rivers, salt marshes	Yes
Snowy orchid (*Platanthera nivea*)	Not listed	T	Wet savannas	No
Invertebrates				
Hessel's hairstreak (*Callophrys hesseli*)	FSC	SR	Atlantic white cedar swamps	No

NOTES:

- Endangered – a taxon "in danger of extinction throughout all or a significant portion of its range."
- Threatened – a taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."
- FSC – A federal species of concern – a species that may or may not be listed in the future (formerly C2 candidate species or species under consideration for listing for which there is insufficient information to support listing).
- EXP – a taxon that is listed as experimental (either essential or nonessential). Experimental, nonessential endangered species (e.g., red wolf) are treated as threatened on public land, for consultation purposes, and as species proposed for listing on private land.
- The USFWS has jurisdiction over protected sea turtles when they are on land. When they are in the water, the NMFS has jurisdiction.

[1] Species as listed by the USFWS in January 2008 and the NCNHP in July 2007. E: Endangered; T: Threatened; FSC: federal species of concern; EXP: Experimental; SR: Significantly rare; SR-L: Significantly rare-limited; SR-T: Significantly rare-throughout range; SC: Special concern.
[2] Obscure record – date and location of observation uncertain.
[3] Listed because of similarity of appearance to American crocodile.
[4] The northern diamondback terrapin is a federal species of concern known to occur along the Outer Banks, but not on the USFWS protected species list for Dare County.
[5] Record from Pamlico Sound, Dare County in 2006 (personal communication, November 30, 2006, David Rabon, USFWS).
[6] The NCNHP has no records of the species within the project area, however, the NPS located a single seabeach amaranth on the Bodie Island flats (Latitude: 35° 46.790', Longitude: 75° 32.162') on July 6, 2004. (Personal communication, November 19, 2004, Marcia Lyons, Cape Hatteras National Seashore.)

The five federally-listed threatened species are:

1. Piping plover (*Charadrius melodus*);

2. Green sea turtle (*Chelonia mydas*);

3. Loggerhead sea turtle (*Caretta caretta*);

4. Seabeach amaranth (*Amaranthus pumilus*); and

5. American alligator (*Alligator mississippiensis*)—listed because of similarity of appearance to American crocodile (*Crocodylus acutus*).

According to the USFWS Red Wolf Recovery Team, the North Carolina red wolf experimental population only occurs on the mainland and therefore it is not discussed in this section. (Personal communication, December 1, 2006, Art Buyer, USFWS.)

Species descriptions, biological conclusions, potential for adverse impact, and the results of informal and formal consultation with USFWS and NMFS are presented in Section 4.7.7.

In addition to the federally-listed species listed above, bald eagles (*Haliaeetus leucocephalus*) were federally-listed. This species is now delisted; therefore, it is discussed under state-listed species in Section 3.7.7.4.

3.7.7.2 Federal Species of Concern

Seven species are identified by the USFWS as "species of concern" for Dare County. Table 3-25 lists the federal species of concern, their state status, and the existence of habitat within the project area. These species are not protected by federal law but may be elevated to protected status in the near future.

3.7.7.3 Federal Candidate Species

Seven species are identified by the USFWS as "candidate" species occurring in North Carolina. These species are not protected by federal law, but may be elevated to listed status in the near future:

1. Red knot (*Calidris canutus rufa*);

2. Sicklefin redhorse (*Moxostoma sp.*);

3. Bog asphodel (*Narthecium americanum*);

4. Georgia aster (*Symphyotrichum georgianum*);

5. Yadkin River goldenrod (*Solidago plumose*);

6. White fringeless orchid (*Platanthera integrilabia*); and

7. Hirsts' panic grass (*Dicanthelium hirstii*).

Table 3-25. Federal Species of Concern Known from Dare County, North Carolina

Common Name	Scientific Name	Federal Status	State Status	Habitat Requirements and Known Occurrences	Habitat Available in the Pamlico Sound Bridge Corridor?	Habitat Available in the Parallel Bridge Corridor?
Vertebrates						
American eel	*Anguilla rostrata*	FSC	NA[1]	Open oceans, large coastal tributaries, small freshwater streams, lakes and ponds.	Yes	Yes
Black rail	*Laterallus jamaicensis*	FSC	SR	Salt and brackish marshes amid juncus and cordgrasses, freshwater marshes, meadows, and grain fields. As of July 2003, the NCNHP database has a May 2000 record of a black rail[2].	Yes	Yes
Black-throated green warbler	*Dendroica virens waynei*	FSC	SR	Slow-moving headwaters of blackwater creeks and the swamps and swamp borders that feed blackwater rivers and their tributaries.	No	No
"Buxton Woods" white-footed mouse	*Peromyscus leucopus*	FSC	SR	Hardwood forests, field margins, myrtle thickets, marshes, canebrakes, and brushy fencerows.	No	No

Table 3-25 (concluded). Federal Species of Concern Known from Dare County, North Carolina

Common Name	Scientific Name	Federal Status	State Status	Habitat Requirements and Known Occurrences	Habitat Available in the Pamlico Sound Bridge Corridor?	Habitat Available in the Parallel Bridge Corridor?
Northern diamondback terrapin	*Malaclemys terrapin terrapin*	FSC	SC	Salt marshes and adjoining rivers, creeks, coves, and bays.	Yes	Yes
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	FSC	T	Dilapidated houses and buildings near permanent water, hollow trees, behind loose bark or at cave entrances.	No	No
Insects						
Hessel's hairstreak	*Callophrys hesseli*	FSC	SR	Atlantic white cedar swamps	No	No
Vascular Plants						
"Dune bluecurls"	*Trichostema* sp.1	FSC	SR-L	Between stable dunes, roadsides, thin woods and pinelands, and fields. The most northern occurrence of "Dune bluecurls" is near Buxton in southern Dare County[2].	Yes	Yes

NOTES:

- T – Threatened: A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
- FSC – Federal species of concern: A species that may or may not be listed in the future.
- SR – Significantly rare: A species that exists in the state in low numbers and requires monitoring, but exists in greater numbers elsewhere within its range.
- SC – Special Concern: A species that is native or once native to North Carolina that is determined by the WRC to require monitoring.
- L – Range of species is limited to North Carolina and adjacent states, with 20 – 50 populations within the state and fewer than 50 total throughout its range.
- T – Species are rare throughout their ranges (fewer than 100 populations).

[1] NCNHP, 2007.

[2] Personal communication, October 17, 1991, Alan Weakley, NCNHP.

Red knots are the only vertebrate candidate species that are likely to occur in the project area. This species uses ephemeral habitats similar to those frequented by other shorebirds, and is often found in coastal North Carolina during migrations. The only other candidate species that may occur in Dare County is Hirsts' panic grass; however, this species prefers habitats that are not present in the project area (pond-cypress savannahs and limesinks; UNC, 2008).

3.7.7.4 North Carolina-Listed Species

The State Endangered Species Act (GS 113-331 to 113-337) provides for the conservation, management, enhancement, and protection of rare fauna in North Carolina. This law makes it unlawful to possess or disturb, for any reason not approved by the NCWRC, any animal on the protected list.

State-listed plant species are protected under the State of North Carolina Plant Protection and Conservation Act of 1979 (GS 196 106-202.12 to 106-202.19). It is illegal to: 1) dig, otherwise disturb, or remove any protected species without written permission of the landowner; or 2) sell, barter, or trade for any purpose any plant on the protected list, unless approved and permitted by the North Carolina Department of Agriculture.

State-listed plant species that occur in Dare County (in addition to those described above under federal species) are:

- Blue witch grass (*Dichanthelium caerulescens*);
- Saltmarsh spikerush (*Eleocharis halophila*);
- Carolina grasswort (*Lilaeopsis carolinensis*);
- Small-flowered hemicarpha (*Lipocarpha micrantha*); and
- Snowy orchid (*Platanthera nivea*).

The state-listed plant species listed above were designated as threatened by the state, except for blue witch grass and small-flowered hemicarpha. Blue witch grass occurs in wet savannas with a calcareous influence. The last known element occurrence was in the Refuge in 2003 (NCNHP, 2008). The saltmarsh spikerush prefers brackish and freshwater marshes; therefore, potential habitat is available within the project area. The only saltmarsh spikerush record from Dare County is from the Bodie Island Lighthouse Pond in 1984 and it was not observed during field verification of biotic communities for this document. The Carolina grasswort has only been documented from Dare County in the vicinity of Buxton, Currituck Sound, and the Cape Hatteras Lighthouse Pond. It prefers freshwater marshes, pools, and tidal marshes, all of which occur within the project area. The small-flowered hemicarpha, which occurs in drawdown zones of blackwater rivers and salt marshes, was last recorded on Hatteras Island in 1953 (personal communication, December 4, 2006, Harry LeGrand, NCNHP). The snowy orchid occurs in wet savannas, which do not occur within the project area.

State-listed animal species that occur in Dare County (in addition to those described above under federal species) are:

- Star-nosed mole – Coastal Plain Population (*Condylura cristata* pop. 1);
- Timber rattlesnake (*Crotalus horridus*);

- Little blue heron (*Egretta caerulea*);
- Snowy egret (*Egretta thula*);
- Tricolored heron (*Egretta tricolor*);
- Peregrine falcon;
- Gull-billed tern;
- Bald eagle;
- Outer Banks kingsnake (*Lampropeltis getula sticticeps*);
- Carolina water snake (*Nerodia sipedon williamengelsi*);
- Glossy ibis (*Plegadis facinellus*);
- Black skimmer (*Rynchops niger*);
- Common tern (*Sterna hirundo*); and
- Least tern (*Sternula antillarum*).

The state-listed animal species listed above were designated as Special Concern by the state. This designation is determined by the NCWRC to require monitoring; however, three bird species—the peregrine falcon (endangered), bald eagle (threatened), and the gull-billed tern (threatened)—are state-listed as endangered or threatened. Peregrine falcons are fairly common fall migrants and uncommon winter residents over all communities in the project area. Bald eagles were a federally-listed (threatened) species; however, they were delisted in June of 2007. Eagles continue to be federally-protected by the Migratory Bird Treaty Act of 1918, and receive unique federal protection from the Bald and Golden Eagle Protection Act of 1940. However, this species no longer requires formal consultation under the Endangered Species Act. Bald eagles occur in Dare County, but typically only use mature forests (not present in the project area) for nesting. The gull-billed tern regularly occurs within the project area and can be expected to use most non-woody communities (NCNHP database, 2006).

There are no known records of the star-nosed mole, timber rattlesnake, and Outer Banks kingsnake within the project area. Potential habitat does occur for the Outer Banks kingsnake (dunes, dry habitat), however, the closest known record is from Cape Hatteras Village. The Carolina water snake has been known to occur in the northern portion of Pea Island, with the last record being from 1992 (personal communication, December 4, 2006, Harry LeGrand, NCNHP). All colonial wading birds listed are known to occur and nest within the project area (personal communication, December 4, 2006, Sue Cameron, NCWRC).

3.8 Mineral Resources

There are no known mineral resources of economic value within either of the replacement bridge corridor alternatives.

3.9 Air Quality

In accordance with the Clean Air Act of 1970 (42 USC 7609, as amended in 1990 and 1997) the US Environmental Protection Agency (USEPA) established National Ambient Air Quality Standards (NAAQS) for the protection of public health and welfare. The NAAQS address the following six major pollutants: Carbon Monoxide (CO), Ozone (O_3), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Particulate Matter (PM_{10} and $PM_{2.5}$) and Lead (Pb). Of these six pollutants, the FHWA requires a detailed evaluation of CO.

3.9.1 Carbon Monoxide

The primary pollutant emitted from automobiles is carbon monoxide (CO). Automobiles are considered the major source of CO in the project area. The state and federal ambient air quality standards for carbon monoxide are:

- 1-hour - 35 ppm or 40 milligrams per cubic meter (mg/m^3); not to be exceeded more than once per year; and
- 8-hour - 9 ppm or 10 mg/m^3; not to be exceeded more than once per year.

Any 1-hour concentration above 35 ppm or 8-hour concentration above 9 ppm is considered a violation of the standards.

In order to determine potential CO concentrations at receptors near a highway, two concentration components must be used: local and background. The local component takes into account CO emitted by cars operating on highways near receptors (i.e., within 300 feet [91.4 meters]). The background component takes into account CO emitted by cars operating on streets farther from receptor locations. The background CO concentration for the project area is estimated to be 1.8 ppm. Consultation with the Air Quality Section of NCDENR's Division of Environmental Management indicated that an ambient CO concentration of 1.8 ppm is applied to most rural areas.

3.9.2 Other Emissions

Automobiles also are sources of hydrocarbons and nitrogen oxides. Hydrocarbons and nitrogen oxides emitted from cars in an urban area are mixed together in the atmosphere where they react with sunlight to form ozone, nitrogen dioxide, and other photochemical oxidants. It is the photochemical oxidants that are of concern and not the precursor hydrocarbons and nitrogen oxides.

The photochemical reactions that form ozone and nitrogen dioxide require several hours to occur. For this reason, the peak levels of ozone generally occur 6 to 12 miles (10 to 20 kilometers) downwind of the source of pollutant emissions. Urban areas generally are regarded as sources of photochemical oxidants, not individual streets and highways. The best example of this type of air pollution is the smog that forms in Los Angeles, California.

Area-wide automotive emissions of hydrocarbons and nitrogen oxides are expected to decrease in the future because of the continued installation and maintenance of pollution control devices on new cars. No appreciable changes in these emissions are expected on the proposed project.

Automobiles are not significant sources of particulate matter and sulfur dioxide. Nationwide, highway sources account for less than 7 percent of particulate matter emissions and less than 2 percent of sulfur dioxide emissions. Particulate matter and sulfur dioxide emissions are predominantly the result of non-highway sources (e.g., industrial, commercial, and agricultural activities). Because emissions of particulate matter and sulfur dioxide from cars are very low, there is no reason to suspect that traffic on the proposed project would cause air quality standards for particulate matter and sulfur dioxide to be exceeded.

Automobiles emit lead as a result of burning gasoline containing tetraethyl lead, which is added by refineries to increase the octane rating of the fuel. New cars with catalytic converters burn unleaded gasoline and emit no lead. Also, the USEPA has required a reduction in the lead content of leaded gasoline. The overall average lead content of gasoline in 1974 was 2 grams per gallon (0.53 grams per liter). By 1989, this composite average had dropped to 0.01 grams per gallon (0.003 grams per liter).

In the future, lead emissions are expected to decrease as more cars use unleaded fuels and as the lead content of leaded gasoline is reduced. Because of these reasons, exceeding NAAQS for lead is not a concern on highway improvement projects.

3.9.3 Regional Air Quality Standard Compliance

The project is in Dare County, which has been determined to be in compliance with the National Ambient Air Quality Standards. 40 CFR Parts 51 and 93 (Title 40, Parts 51 and 93 of the *Code of Federal Regulations*) are not applicable because the proposed project is in an attainment area. This project is not anticipated to create any adverse effects on the air quality of this attainment area.

3.10 Noise

3.10.1 Fundamental Concepts of Roadway Noise

Sounds exist in the human and natural environment at all times. Some sounds are necessary or desirable for communication or pleasure, some are unnoticed, and some are unwanted or disturbing. By definition, unwanted sounds are called *noise*. The following sections provide background for some of the concepts and terminology of sound and noise.

3.10.1.1 Generation of Sound

Sound is a disturbance that propagates as a wave through air, causing air particles to vibrate. Although the generating motion and the resultant motion of the air particles are very small, a sound wave can propagate over several miles (kilometers).

Three basic parameters of environmental noise play major roles in determining human subjective response. These parameters are:

- Intensity or level;
- Frequency spectrum; and
- Time-varying character.

3.10.1.2 Intensity

The first parameter of environmental noise—intensity or level—is quantified in decibels (dB). The range of pressure variations that the human ear can detect is tremendous; however, to describe sound in terms of pressure variations would be very cumbersome because of the great range of amplitudes that is involved. Therefore, a compressed scale was devised based upon the logarithm of the mean square pressure. The decibel or dB is the unit of this compressed scale. By using these units, the range of normally encountered sounds can be expressed as 20 to 140 dB rather than as 1 to 1,000,000.

3.10.1.3 Frequency

The second parameter of environmental noise that can be quantified is frequency. As a sound wave passes a point, the air pressure alternately rises and falls. Each time the pressure rises and falls, it completes one cycle. The number of cycles per second (called Hertz, Hz) is the unit in which frequency is expressed.

Frequency is observed subjectively as the tone or pitch of a sound. The human ear can detect a wide range of frequencies: from about 20 to 17,000 Hz. The low frequencies (20 – 500 Hz) have a low-pitched, or bass, sound. The mid-frequencies range from roughly 500 to 3,000 Hz, where most speech information is carried. High frequencies are from 3,000 to 17,000 Hz.

3.10.1.4 A-Weighted Sound Level

The most commonly used measure of noise level is the A-weighted sound level (dBA). From many experiments with human listeners, scientists have found that the human ear is more sensitive to midrange frequencies than it is to either low or very high frequencies. At the same sound level, midrange frequencies therefore are heard as louder than low or very high frequencies. This characteristic of the human ear is taken into account by adjusting or weighting the spectrum of the measured sound level for the sensitivity of human hearing. The A-weighted sound level is a measure of sound intensity with frequency characteristics that correspond to human subjective response to noise. The A-weighted sound level is accepted by acousticians as a proper noise impact unit for traffic noise.

An understanding of these relationships is helpful in providing a subjective impression of changes in the A-weighted sound level:

- Except in carefully controlled laboratory experiments, an increase of only 1 dB in A-weighted level cannot be perceived;
- Outside of the laboratory, a 3 dB increase in A-weighted level is considered a just-noticeable difference;
- A change in A-weighted level of at least 5 dB is required before any significant change in the noise level in a community is perceived; and
- A 10 dB increase in A-weighted level is subjectively heard as approximately a doubling in loudness, independent of the existing noise level.

3.10.1.5 Sound Level Descriptors

The third basic parameter of environmental noise is its time-varying character. The sound level from any roadway fluctuates from moment to moment as time passes. These fluctuations constitute the time-varying properties of roadway noise.

The sound level descriptor used in this study is L_{eq}. L_{eq} is defined as the continuous A-weighted sound level that, in a given time period, contains the same energy as the actual time-varying sound during that period. L_{eq} has been shown to be a particularly stable descriptor for roadways with low traffic volumes. For traffic noise assessment, L_{eq} typically is evaluated over a 1-hour period of peak traffic. All noise levels determined in this study are L_{eq} over a 1-hour period.

3.10.2 Noise Abatement Criteria

In order to determine that highway noise levels are or are not compatible with various land uses, the FHWA has developed Noise Abatement Criteria (NAC) and procedures to be used in the planning and design of highways. A listing of the NAC for various land uses is presented in Table 3-26.

Table 3-26. Noise Abatement Criteria

Activity Category	L_{eq}	Hourly A- Weighted Sound Level – decibels (dBA) Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: Part 772 of Title 23 of the *Code of Federal Regulations*.

Traffic noise impacts occur when predicted traffic noise levels either:

- Approach or exceed the FHWA NAC or
- Substantially exceed the existing noise levels.

NCDOT *Traffic Noise Abatement Policy* (June 1996) defines “approaching or exceeding” as any activity category land use with a predicted noise level within 1 dBA of its criteria. Substantial increases are defined as 15 dBA or more where the existing L_{eq} is 50 dBA or less, or 10 dBA or more where the existing L_{eq} is greater than 50 dBA.

3.10.3 Ambient Noise Levels

A noise measurement survey was conducted in the project area on June 27, 2003, to document existing noise levels. Table 3-27 lists the four locations where measurements were taken, the date and times of measurement, the predominant surface, the average A-weighted noise levels (L_{eq}), and the FHWA noise abatement category that applies to the receptor. The locations are shown in Figure 3-1a and Figure 3-1c.

Table 3-27. Noise Measurement Results

Site Number	Location and Distance from NC12	Time (on June 27, 2003)	Predominant Surface	Measured L_{eq} (dBA)	FHWA Noise Abatement Criteria Category and L_{eq}
1	Oregon Inlet Campground 100 ft. (30.5 m) east of NC 12	2:15 – 2:35 PM	Grass	58	'B' 67 L_{eq}
2	Residence 1,150 ft. (350.5 m) west of NC 12	3:25 – 3:45 PM	Grass	48	'B' 67 L_{eq}
3	Residence 100 ft. (30.5 m) west of NC 12	4:05 – 4:25 PM	Grass	64	'B' 67 L_{eq}
4	Residence 500 ft. (152.4 m) west of NC 12	4:30 – 4:50 PM	Grass	52	'B' 67 L_{eq}

[1] Distance was measured from near edge of road to receptor. Sites are shown in Figure 3-1a and Figure 3-1c.

Traffic on NC 12 and Bonner Bridge was the dominant source of noise. There was little interruption or buffers between the roadway and receptors. Noise measurements were recorded for 20-minute periods. The noise meter used was a Larson Davis 820 sound level meter. Accessories included a Larson Davis CAL200 calibrator, a Larson Davis 2560 microphone, and a microphone windshield. The microphone was placed 5 feet (1.52 meters) above the ground. Simultaneous vehicle classification counts were recorded for nearby roadways, as applicable. The data were extrapolated to one-hour volumes for verification of the sample noise measurements and model calibration.

Chapter 4

Environmental Consequences

4.0 Environmental Consequences

The purpose of this chapter is to describe the anticipated community, cultural resource, natural resource, environmental quality, and other effects of the replacement bridge corridor alternatives described in Chapter 2. The two corridor alternatives are:

- Pamlico Sound Bridge Corridor with two possible termini design options in Rodanthe (Curved Rodanthe Terminus and Intersection Rodanthe Terminus), described in Section 2.9; and

- Parallel Bridge Corridor with NC 12 Maintenance Alternatives (Nourishment, Road North/Bridge South, All Bridge, Phased Approach/Rodanthe Bridge [Preferred], and Phased Approach Rodanthe Nourishment), described in Section 2.10.

Where appropriate, the text contrasts the replacement bridge corridor alternatives with the No-Action Alternative.

The chapter is divided into topical discussions in a manner similar to Chapter 3. These sections address the following issues:

- Relationship between Long-Term and Short-Term Uses/Benefits, beginning on page 4-181; and
- Irreversible and Irretrievable Commitments of Resources, beginning on page 4-181.

4.1 Community Impacts

This section discusses the impacts of the detailed study alternatives, as well as the No-Action Alternative (where appropriate) on various aspects of the project area community. It includes details on home and business relocations as well as impacts to area land use plans, the Coastal Barrier Resources System, community cohesion and accessibility, economics and community services, Oregon Inlet users, underground storage tanks and hazardous waste, and farmland.

4.1.1 Relocations

No relocation of residential or business land uses would occur with the No-Action Alternative. The replacement bridge corridor alternatives would require the relocations shown in Table 4-1.

Table 4-1. Relocations

	Homes	Businesses
Pamlico Sound Bridge Corridor		
• Curved Rodanthe Terminus	6	6
• Intersection Rodanthe Terminus	5	1
Parallel Bridge Corridor		
• With Nourishment	0	0
• With Road North/Bridge South	2	0
• With All Bridge	2	0
• With Phased Approach/Rodanthe Bridge (Preferred)	3	1
• With Phased Approach/Rodanthe Nourishment	0	0

No schools, churches or other community facilities would be displaced with any of the bridge replacement corridor alternatives. With the Parallel Bridge Corridor with Road North/Bridge South and All Bridge Alternatives, a service road would be built to connect traffic to the Rodanthe-Waves-Salvo Community Center (see Section 4.1.6.4).

The North Carolina Department of Transportation (NCDOT) prepared relocation reports (July 22, 2005 and February 5, 2007) reporting the number of homes and businesses displaced, the specific businesses displaced, the value of the displaced homes, the availability of decent, safe, and sanitary replacement housing, and the expected relocation needs (Appendix C). All of the homes and businesses displaced are owner-occupied, with the exception of a tenant-occupied residence displaced by the Parallel Bridge Corridor Phased Approach/Rodanthe Bridge Alternative (Preferred). This alternative also would remove the gas pumps from the gas station (Liberty) closest to NC 12 and also shorten the canopy of the service station. The gas pumps and canopy associated with another business also would be removed (North Beach Beach Mart). In the case of the North Beach Beach Mart, the structures affected are partially within what is believed to be the NCDOT's NC 12 right-of-way. Impacts to minorities, large families, disabled persons, or others who would have special problems being relocated are not anticipated. No special relocation services would be necessary.

The residential relocations would not cause a housing shortage. Based on coordination with Realtors in the project area, there is adequate decent, safe, and sanitary housing that is expected to be available during the relocation period. Suitable sites for relocating the displaced businesses are also available.

It is the policy of the NCDOT to ensure that comparable replacement housing will be available prior to the construction of state and federally-assisted projects. Furthermore, the North Carolina Board of Transportation has the following three programs to minimize the inconvenience of relocation:

- Relocation Assistance;
- Relocation Moving Payments; and
- Relocation Replacement Housing Payments or Rent Supplement.

With the Relocation Assistance Program, experienced NCDOT staff will be available to assist displacees with information such as availability and prices of homes, apartments, or businesses for sale or rent and financing or other housing programs. The Relocation Moving Payments Program, in general, provides for payment of actual moving expenses encountered in relocation. Where displacement will force an owner or tenant to purchase or rent property of higher cost or to lose a favorable financing arrangement (in cases of ownership), the Relocation Replacement Housing Payments or Rent Supplement Program will compensate up to $22,500 to owners who are eligible and qualify and up to $5,250 to tenants who are eligible and qualify.

The relocation program for the proposed action will be conducted in accordance with the Federal Uniform Relocation Assistance and Real Property Acquisitions Act of 1970 (Public Law 91-646), and the North Carolina Relocation Assistance Act (GS-133-5 through 133-18). The program is designed to provide assistance to displaced persons in relocating to a replacement site in which to live or do business. At least one relocation officer is assigned to each highway project for this purpose.

The relocation officer will determine the needs of the displaced families, individuals, businesses, non-profit organizations, and farm operations for relocation assistance advisory services without regard to race, color, religion, sex, or national origin. The NCDOT will schedule its work to allow ample time, prior to displacement, for negotiations and possession of replacement housing that meets decent, safe, and sanitary standards. The displacees are given at least a 90-day written notice after NCDOT purchases the property. Relocation of displaced persons will be offered in areas not generally less desirable in regard to public utilities and commercial facilities. Rent and sale prices of replacement property will be within the financial means of the families and individuals displaced, and will be reasonably accessible to their places of employment. The relocation officer will also assist owners of displaced businesses, non-profit organizations, and farm operations in searching for and moving to replacement property.

All tenant and owner residential occupants who may be displaced would receive an explanation regarding all available options, such as (1) purchase of replacement housing, (2) rental of replacement housing, either private or public, or (3) moving existing owner-occupant housing to another site (if possible). The relocation officer will also supply information concerning other state or federal programs offering assistance to displaced persons and will provide other advisory services as needed in order to minimize hardships to displaced persons in adjusting to a new location.

The Moving Expenses Payment Program is designed to compensate the displacee for the costs of moving personal property from homes, businesses, non-profit organizations, and farm operations acquired for a highway project. Under the Replacement Program for Owners, NCDOT will participate in reasonable incidental purchase payments for replacement dwellings, such as attorney's fees, surveys, appraisals, and other closing costs and, if applicable, make a payment for any increased interest expenses for replacement dwellings. Reimbursement to owner-occupants for replacement housing payments, increased interest payments, and incidental purchase expenses may not exceed $22,500 (combined total), except under the Last Resort Housing provision.

A displaced tenant may be eligible to receive payment, not to exceed $5,250, to rent a replacement dwelling or to make a down payment, including incidental expenses, on the purchase of a replacement dwelling. The down payment is based upon what the state determines is required when the rent supplement exceeds $5,250.

It is a policy of the state that no person will be displaced by NCDOT's state or federally-assisted construction projects unless and until comparable replacement housing has been offered or provided to each displacee within a reasonable period of time prior to displacement. No relocation payment received will be considered as income for the purposes of the Internal Revenue Code of 1954 or for the purposes of determining eligibility or the extent of eligibility of any person for assistance under the Social Security Act or any other federal law.

Last resort housing is a program used when comparable replacement housing is not available, or when it is unavailable within the displacee's financial means, and the replacement payment exceeds the federal/state legal limitation. The purpose of the program is to allow broad latitudes in methods of implementation by the state so that decent, safe, and sanitary replacement housing can be provided. This program would be implemented, if necessary, as mandated by state law.

4.1.2 Land Use Planning

The Pamlico Sound Bridge Corridor alternatives would be compatible with the *Dare County Land Use Plan* and zoning, the Coastal Area Management Act (CAMA), the *Pea Island National Wildlife Refuge Comprehensive Conservation Plan*, and National Park Service (NPS) plans. The Pamlico Sound Bridge Corridor, however, would likely result in the Pea Island National Wildlife Refuge (Refuge) providing some form of alternative access to the Refuge other than the paved road desired by some Dare County and local municipal officials.

The Parallel Bridge Corridor alternatives (including the Preferred Alternative) would be compatible with the *Dare County Land Use Plan* and zoning. However, the two Phased Approach alternatives (including the Preferred Alternative) may not be compatible with the principles of the CAMA because they require the construction of permanent bridges in locations that are projected to eventually be on the beach and in the ocean. The Parallel Bridge Corridor alternatives also may not be consistent with the *Pea Island National Wildlife Refuge Comprehensive Conservation Plan* or NPS plans. The relocation of NC 12 to the west with the

Road North/Bridge South and All Bridge alternatives would affect important wildlife habitat (see Section 4.7.3). The use of artificial dunes and/or beach nourishment associated primarily with the Nourishment Alternative would not support the natural processes of barrier island dynamics. However, the NPS and US Fish and Wildlife Service (USFWS) will be responsible for determining whether or not the Parallel Bridge Corridor alternatives (including the Preferred Alternative) are consistent with NPS plans and the *Pea Island National Wildlife Refuge Comprehensive Conservation Plan*, respectively. The Refuge's *Comprehensive Conservation Plan* assumes a bridge over Oregon Inlet and a maintained road in the existing NC 12 easement in the Refuge pending NCDOT's decisions on the replacement of Bonner Bridge and the long-term maintenance of NC 12.

The No-Action Alternative would not be consistent with the *Dare County Land Use Plan* and the CAMA. It would be consistent with NPS plans and the *Pea Island National Wildlife Refuge Comprehensive Conservation Plan.*

4.1.2.1 Coastal Area Management Act

As discussed in Section 4.1.2.2, the replacement bridge corridor alternatives would be compatible with the *Dare County Land Use Plan* (except for the preference of Dare County officials on how NC 12 access to Hatteras Island is maintained), so they also would meet the consistency requirement of the CAMA, which requires that any action affecting an area of environmental concern (AEC) be consistent with the local land use plans. However, the two Phased Approach alternatives (including the Preferred Alternative) may not be compatible with the principles of CAMA because they require the construction of permanent bridges in locations that are projected to eventually be on the beach and in the ocean. All of the oceanfront lands in the project area are included in the Ocean Hazard System AEC, which is comprised of three areas: the Ocean Erodible AEC (beaches and any other oceanfront lands that are subject to long-term erosion and significant shoreline changes); the High Hazard Flood AEC (lands subject to flooding, high waves, and heavy water currents during a major storm); and the Inlet Hazard AEC (lands next to ocean inlets). CAMA restrictions on development in Ocean Hazard AECs are found in 15A NCAC 7H.0300 (North Carolina Administrative Code). These restrictions include setback standards to address erosion, minimum elevations for first floor construction to allow for ocean overwash, and regulations to prevent unnecessary loss of oceanfront dunes. Because the Preferred Alternative is projected to eventually be in an Ocean Hazard AEC, a variance may have to be petitioned from the North Carolina Coastal Resources Commission (NCCRC) in order to obtain a CAMA permit (see Section 3.1.3.1). Although they would not involve a structure on the beach, a variance also could be needed for the other Parallel Bridge Corridor Alternatives.

The replacement bridge corridor alternatives also would affect coastal wetlands, and CAMA permits are required for those development activities that take place in coastal wetlands.

Since the No-Action Alternative would not be compatible with the *Dare County Land Use Plan* for the reasons described in Section 4.1.2.2, it also would not meet the consistency requirement of the CAMA.

4.1.2.2 Dare County Land Use Plan

Both the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor are compatible because neither alternative would generate unanticipated growth (either in terms of an increased rate or an increased intensity of development) nor affect the character of future growth. Such growth is not anticipated because:

- A bridge in either one of the replacement bridge corridors would replace an existing bridge, and current plans assume a continuation of road access between Bodie and Hatteras islands.

- The availability of undeveloped land considered environmentally suitable for development on Hatteras Island is limited.

- The type and intensity of future development is constrained by Dare County zoning and land use planning, the availability of water, and reliance on septic tanks.

In addition, both of the replacement bridge corridor alternatives would be compatible with the *Dare County Land Use Plan* because they would ensure that NC 12 continues to connect to Hatteras Island. Dare County officials have, however, indicated a desire to retain a paved NC 12 through the Refuge as a part of replacing Bonner Bridge. The Pamlico Sound Bridge Corridor would bypass the Refuge, and although Refuge officials intend to maintain access to the Refuge, it is unlikely to be a paved road.

Paved shoulders on bridges (8 feet [2.4 meters]) and on roadways (4 feet [1.2 meters]) would be a part of all the replacement bridge corridor alternatives, facilitating NC 12's use by bicycles.

The No-Action Alternative would not be consistent with the *Dare County Land Use Plan's* support of new transportation and economic development projects. The removal of bridge access to Hatteras Island and loss in travel capacity likely would diminish the expected future permanent population, as well as the number of visitors to Hatteras Island, the Cape Hatteras National Seashore (Seashore), and the Refuge.

4.1.2.3 National Park Service Plans

The Pamlico Sound Bridge Corridor would not affect existing NPS facilities or operations either directly by displacement or indirectly by visual impacts (see Section 4.3) or noise (see Section 4.10). No new facilities or activities are planned by the NPS near the Pamlico Sound Bridge Corridor. The Pamlico Sound Bridge Corridor, in the long-term, would be compatible with the NPS's desire of supporting the natural processes of barrier island dynamics, since NCDOT would no longer be required to maintain NC 12 on Hatteras Island within the Seashore and the Refuge in order to maintain traffic between Bodie and Hatteras islands.

Although the Pamlico Sound Bridge Corridor would bypass the portion of the Seashore and Refuge, the USFWS and NPS would maintain some type of access to this portion of the Seashore and the Refuge for recreational users.

The Parallel Bridge Corridor would not affect existing NPS facilities or operations on Bodie Island. Facilities within the Refuge and Seashore north of Rodanthe would be affected by the Parallel Bridge Corridor alternatives (including the Preferred Alternative), as described in Section 4.5. No new facilities or activities are planned by the NPS near the Parallel Bridge Corridor on Hatteras Island.

The Parallel Bridge Corridor with Nourishment, with Phased Approach/Rodanthe Nourishment, and with Road North/Bridge South alternatives would not be compatible with the NPS's desire of supporting the natural processes of barrier island dynamics. The Road North/Bridge South Alternative includes the construction of three new dunes as the shoreline continues to erode, the first being in year 2030. The Parallel Bridge Corridor with All Bridge and Phased Approach/Rodanthe Bridge (Preferred) alternatives would be compatible with this NPS desire.

The NPS will determine if the bridge replacement corridor alternatives would impair (harm) park resources or values under the terms of the National Park Service Organic Act (16 *United States Code* [USC] 1) and the 1978 amendment to the National Park System General Authorities Act of 1970 (16 USC 1a-1) (see Section 3.1.3.3). Also, NPS will be responsible for determining whether or not the detailed study alternatives (including the Preferred Alternative) are consistent with NPS plans.

The No-Action Alternative would be compatible with Seashore plans assuming the associated ferry service terminates at the emergency ferry terminal in Rodanthe and, like the Pamlico Sound Bridge Corridor, bypasses the Refuge. If the ferry terminal were placed at the north end of Hatteras Island, ongoing protection and maintenance of NC 12 would be required.

4.1.2.4 Pea Island National Wildlife Refuge Comprehensive Conservation Plan

The *Comprehensive Conservation Plan* for the Refuge was published in September 2006. The *Comprehensive Conservation Plan* discourages changes to the location of NC 12 within the Refuge as it would affect wildlife habitat. The Pamlico Sound Bridge Corridor would be compatible with the *Pea Island National Wildlife Refuge Comprehensive Conservation Plan*, even though the document reflects planning strategies with NC 12 and Bonner Bridge in their current positions. The Pamlico Sound Bridge Corridor would bypass the Refuge and, therefore, would not affect the Refuge's natural resources. The Refuge plan states that if paved road access to the Refuge is altered or eliminated as a result of NCDOT's replacement of Bonner Bridge, the plan may require revision to reflect new methods of access. The Pamlico Sound Bridge Corridor, however, would likely result in the Refuge providing some form of alternative access to the Refuge rather than the paved road desired by some Dare County and local municipal officials.

The USFWS will be responsible for determining whether or not the Parallel Bridge Corridor alternatives (including the Preferred Alternative) are consistent with USFWS plans; however, based on statements from the USFWS during their participation on the National Environmental Policy Act (NEPA)/Section 404 Merger Team and in written comments on the Supplemental Draft Environmental Impact Statement (SDEIS) and the Supplement to the SDEIS (SSDEIS), the Parallel Bridge Corridor may not be compatible with the *Pea Island National Wildlife Refuge Comprehensive Conservation Plan*. The Refuge's *Comprehensive Conservation Plan* assumes a bridge over Oregon Inlet and a maintained road in the existing NC 12 easement in the Refuge pending NCDOT's decisions on the replacement of Bonner Bridge and the long-term maintenance of NC 12. With the two Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative), as well as the Nourishment Alternative, NC 12 would be retained in its existing easement through the Refuge, as assumed in the *Comprehensive Conservation Plan*. With the All Bridge Alternative and the Road North/Bridge South Alternative, NC 12 would be on a new alignment west of NC 12's current location through the Refuge, affecting wildlife habitat managed by the Refuge as described in Section 4.6.8. The Nourishment Alternative may not be compatible with Refuge objectives. Although the alignment of NC 12 through the Refuge would not change, the nourishment and dunes that allow NC 12 to remain in place would maintain the shoreline artificially.

The two Phased Approach alternatives (including the Preferred Alignment) differ from the other Parallel Bridge Corridor alternatives in that they would stay within the existing NC 12 easement with one exception. The Phased Approach/Rodanthe Nourishment Alternative includes nourishment to maintain NC 12 in Rodanthe that would affect beaches at the southern end of the Refuge. The selected management alternative contained in the Refuge's *Comprehensive Conservation Plan* assumes that NC 12 remains within the existing easement in its current form pending a decision by the NCDOT on how to replace Bonner Bridge. The two Phased Approach alternatives (including the Preferred Alternative) are different from the existing road in that they are elevated, with the bottom of the superstructure at a height of 25 feet (7.6 meters) above mean high water. Also, ultimately as the shoreline erodes, most of the bridges associated with this alternative would no longer be in the Refuge, but rather would be in the ocean east of the Refuge.

Effects on Refuge facilities caused by the Parallel Bridge Corridor alternatives (including the Preferred Alternative) are described in Section 4.5. No new facilities or activities are planned by the Refuge near the Parallel Bridge Corridor on Hatteras Island.

As stated previously, the USFWS will be responsible for determining whether or not the Phased Approach/Rodanthe Bridge Alternative (Preferred) is consistent with both the Refuge's mission and plans, including the *Comprehensive Conservation Plan*, as well as the provisions of the National Wildlife Refuge System Improvement Act of 1997 (see Section 3.1.3). A compatibility determination is not required because the Preferred Alternative falls within the terms of the easement permit.

The No-Action Alternative would be compatible with Refuge plans assuming the associated ferry service terminates at the emergency ferry terminal in Rodanthe and, like the Pamlico Sound Bridge Corridor, bypasses the Refuge. If the ferry terminal were placed at the north end of Hatteras Island, ongoing protection and maintenance of NC 12 would be required.

4.1.3 Coastal Barrier Resources System

The replacement bridge corridor alternatives are not within an area included in the Coastal Barrier Resources System (CBRS). In addition, because the proposed project would consist of the replacement of an existing bridge, as well as an existing road in the case of the Parallel Bridge Corridor, project area development trends would not be altered; therefore, the project would not encourage development in a CBRS area.

4.1.4 Community Cohesion and Accessibility

4.1.4.1 Community Cohesion

Neither of the Pamlico Sound Bridge Corridor alternatives, as well as the Parallel Bridge Corridor with Nourishment, Road North/Bridge South, and All Bridge alternatives, would affect the cohesion of the seven communities on Hatteras Island. The existing relationships among the communities of Hatteras Island with Bodie Island and the mainland would be maintained. Access on and off the island, including access to jobs, community services, and the continued delivery of goods and services from the mainland, would be maintained.

Both of the Parallel Bridge Corridor with the Phased Approach alternatives would impact community cohesion as a result of the presence of bridges in Rodanthe. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would have the greatest affect on community cohesion of the two alternatives.

The Phased Approach/Rodanthe Nourishment Alternative would cause neighborhood impacts in Rodanthe. A permanent approach structure and fill would extend approximately 0.22 mile (0.35 kilometer) south of the Refuge boundary into Rodanthe to near Corbina Drive, creating a visual barrier between the homes on either side of NC 12. Vehicular access would be maintained to the homes along NC 12 in this area by one-lane, one-way frontage roads on either side of the NC 12 bridge with a cross-over just south of the Refuge boundary. Access for pedestrians would be provided under the NC 12 bridge, except for in the area of the approximately 600 feet (183 meters) of the approach roadway that would be on fill.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would have the greatest effect on the cohesion of the Rodanthe community. The introduction of an elevated structure, with frontage roads extended from north of Sudie Payne Road (see Figure 2-21) to the Refuge boundary, would cause substantial visual impacts (see Section 4.3) and essentially bisect the community, creating distinct and separate Pamlico Sound and Atlantic Ocean neighborhoods. Although frontage road motorists would be provided three crossover points at America Drive, Cross of Honor Way (near Seagull Street), and just south of the Refuge border to cross under the bridge, the bridge would still create an NC 12 bypass of the northern part of the Rodanthe community. Several businesses, including a gas station that relies on business from NC 12 traffic, would be bypassed. Traffic would have to travel a circuitous route to access properties on either side of the bridge. The crossover point at America Drive is just north of the sole area of commercial businesses in this part of Rodanthe. It was placed at this point, in part, to minimize circuitous travel by the customers of these businesses. Again, pedestrians would be able to walk under the NC 12 bridge, except for the area of the approach roadway that would be on fill.

The No-Action Alternative would not affect internal community cohesion on Hatteras Island, but the eventual loss of road access to Bodie Island across Oregon Inlet would isolate the communities on Hatteras Island from the larger community of Dare County. With the No-Action Alternative, two routes to the mainland would be available. The most direct route would be via the new ferry service incorporated into the No-Action Alternative. Use of this service, however, would add at least 80 minutes each way to a trip between Hatteras Island and the mainland. Eighty minutes was the approximate time required for loading, unloading, and travel for a one-way trip across Oregon Inlet via the emergency ferry service provided from October 1990 to February 1991 when Bonner Bridge was closed. It does not include waiting time prior to the start of loading.

A less desirable alternative would be via the existing ferry service at the south end of Hatteras Island. A one-way trip from Rodanthe, the northernmost community on Hatteras Island, to the mainland would require a 34-mile (54.4-kilometer) ride on NC 12, as well as two ferry trips lasting a total of three hours. The final ferry trip would terminate in Hyde County. Additional travel then would be required to reach mainland Dare County.

4.1.4.2 Accessibility

The replacement bridge corridor alternatives would maintain road access between Hatteras Island and Bodie Island and mainland Dare County. Access for visitors to the Refuge and the Hatteras Island portion of the Seashore would be maintained, but in the case of the Pamlico Sound Bridge Corridor, the access would not likely be on a paved road. Although the Pamlico Sound Bridge Corridor would bypass the portion of the Seashore north of Rodanthe and the Refuge, the USFWS and the NPS have indicated that they intend to maintain some type of access within the Refuge and this portion of the Seashore for recreational users. However, the method of access likely would be something different than a paved road between Rodanthe and Oregon Inlet.

The Parallel Bridge Corridor alternatives would maintain road access to the Refuge and its beaches. Refuge access would be slightly more limited with the Road North/Bridge South Alternative, but the All Bridge Alternative and the two Phased Approach alternatives (including the Preferred Alternative) would limit Refuge access to three points and two points, respectively. Access to homes and businesses in Rodanthe also would be maintained by all the Parallel Bridge

Corridor alternatives, although the two Phased Approach alternatives (including the Preferred Alternative) would change the existing access in Rodanthe. Vehicular access would be maintained to the homes along NC 12 in this area by one-lane, one-way frontage roads on either side of the NC 12 bridge with a cross-over just south of the Refuge boundary. Pedestrians would be able to walk under the NC 12 bridge, except in the area of the approximately 600 feet (183 meters) of the approach roadway that would be on fill.

Fishing catwalks would not be placed on a new bridge with either of the Pamlico Sound Bridge Corridor alternatives or the Parallel Bridge Corridor with Nourishment, Road North/Bridge South, and All Bridge alternatives. The NCDOT would work with USFWS, NPS, Dare County, and other appropriate agencies to decide how to restore some kind of fishing access at the north end of Hatteras Island. Options for retaining fishing opportunities offered by the catwalks include either maintaining a part of Bonner Bridge as a fishing pier or constructing a “boardwalk” on top of the terminal groin. To maintain a portion of Bonner Bridge as a fishing pier, some government body or nongovernmental organization would have to take responsibility for pier operation, maintenance, and liability.

Catwalks probably would not be placed on the new Oregon Inlet bridge for either of the Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative). However, fishing access could be provided by leaving the traffic maintenance bridge in place as a fishing pier. This opportunity also could be used with the Nourishment Alternative (see Section 4.5.3.2). A traffic maintenance bridge is not needed with the other alternatives, and thus leaving one in place is not an option with the other alternatives.

The No-Action Alternative would dramatically limit the accessibility of Hatteras Island to residents, visitors, workers, and off-island goods and services once Bonner Bridge reaches the end of its service life and is demolished. The limited ferry service that would be provided would offer space for 900 trips per day across Oregon Inlet. In addition, the No-Action Alternative would deliver travelers to a section of roadway that frequently is overwashed by the ocean and that requires expensive and repetitive maintenance. The 2002 annual average daily traffic across Bonner Bridge was 5,400 vehicles per day (vpd). It is expected that by 2025 annual average daily traffic would be 9,600 vpd with a replacement bridge in either replacement bridge corridor. Other than the disruption of travel across Oregon Inlet, routes from NC 12 to various Seashore and Refuge facilities and activities would not be affected with the No-Action Alternative.

4.1.5 Economics

Potential direct impacts of both the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor alternatives (including the Preferred Alternative) include the displacement of businesses, lost tax base for Dare County associated with the land for the project right-of-way in Rodanthe, the economic impact of changed access to the Refuge with the Pamlico Sound Bridge Corridor, and the risk of a new breach opening within the Refuge, as well as the economic impact of such a breach.

The No-Action Alternative would not displace any businesses nor directly affect the tax base for Dare County by moving private lands into the public domain. The No-Action Alternative would have several adverse impacts on the economy of the island. It would limit the variety of goods and services available to island residents and visitors and would increase travel time to and from the island, which could result in a decline in the tourism-related sectors of the area's economy.

Access to the Oregon Inlet Fishing Center and Marina would not be affected during construction of the project. The US Army Corps of Engineers’ (USACE) maintained channel used by boaters from the Marina would not be blocked. Thus the project is not expected to affect the use or annual sales of the facility.

4.1.5.1 Business Displacement

The Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus would displace six businesses. The Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus would displace one business.

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would displace a commercial building containing one business. In addition, the gas pumps closest to NC 12 at the Liberty service station would be removed, and the canopy of the station also would be shortened. The gas pumps and canopy at the North Beach Beach Mart also would be removed. A small amount of new right-of-way (approximately 7 feet [2.1 meters]) would be required along most of the length of both Phased Approach alternatives (including the Preferred Alternative) in Rodanthe (though no new right-of-way would be obtained within the historic district). Additional new right-of-way also is required for a short distance at the intersection of the frontage roads with existing NC 12 at the southern end of the NC 12 bridge.

The other Parallel Bridge Corridor alternatives and the No-Action Alternative would not displace any businesses.

All of the displacements for all of the alternatives would be in Rodanthe, and any business displaced would be relocated. According to the relocation reports, suitable sites are available to relocate the displaced businesses. Minor short-term impacts on business activity in Rodanthe might occur because of reduced access resulting from construction activity. Short-term increases in local employment and income earnings related to construction labor also could be anticipated.

Long-term changes in access and traffic flow at businesses would occur only with the Phased Approach/Rodanthe Bridge Alternative (Preferred). NC 12 would bypass approximately 13 businesses, including the following types of businesses that rely at least partially on tourists passing by for their customer base: restaurant; gas station/convenience store; gift shop; real estate office; surf shop; and seafood/produce market. Access would be provided via a frontage road. Rental properties along the Pamlico Sound near the Rodanthe terminus could be seen as less desirable by vacationers because of impacts to views with all alternatives.

4.1.5.2 Tax Base

With the exception of the Parallel Bridge Corridor with Nourishment Alternative, the tax base of Dare County would be reduced by all of the replacement bridge corridor alternatives, because the land and buildings purchased for the project right-of-way in Rodanthe would be removed from the county tax base. However, the tax base loss associated with any of the replacement bridge corridor alternatives would be a fraction of one percent of the county’s total tax base. The annual tax revenue loss to the Dare County general fund would be the highest with the two Phased Approach alternatives at approximately $182,700 for the Phased Approach/Rodanthe Bridge Alternative (Preferred) and $37,500 for the Phased Approach/Rodanthe Nourishment Alternative. The tax revenue loss would be lower for the other alternatives at approximately $14,100 for the Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus, $10,500 for the Intersection Rodanthe Terminus, and $1,500 for the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives. No private land would be purchased, so no tax base is lost with the Parallel Bridge Corridor with Nourishment Alternative.

4.1.5.3 *Effect of Changed Access*

The replacement bridge corridor alternatives would permit the continued use of the Hatteras Island portion of the Seashore, as well as associated commercial and tourism related services. The replacement bridge corridor alternatives also would allow for anticipated growth in Rodanthe. The Parallel Bridge Corridor would retain paved road access in the Refuge, although that access would be limited to three locations with the All Bridge Alternative and two locations with the two Phased Approach alternatives (including the Preferred Alternative) (see Section 4.5.3.1).

The Pamlico Sound Bridge Corridor would bypass the portion of the Seashore north of Rodanthe and the Refuge, but the USFWS and the NPS have indicated that they intend to maintain some type of access within the Refuge and this portion of the Seashore for recreational users. However, the method of access likely would be something different than a paved road between Rodanthe and Oregon Inlet. The NCDOT likely would seek and accept an invitation to participate in USFWS and NPS efforts to develop their own access program.

The potential economic impact of eliminating paved road access to the Seashore north of Rodanthe and Refuge with the Pamlico Sound Bridge Corridor on Dare County was assessed. On average, these losses are not likely to have a major economic impact on the Outer Banks/Dare County area. Some individual businesses, however, would be more directly affected, and could suffer serious losses. The basis for this finding is described in the paragraphs that follow. The assessment is also documented in *Bonner Bridge Replacement Economic Impact Report* (Parsons Brinckerhoff Quade & Douglas, Inc., July 2005). The analysis found that the loss of paved road access would cause 9 percent of Refuge visitors not to visit the Outer Banks. The 9 percent includes surveyed visitors that said they would not visit the Refuge without paved road access and had no other location on the Outer Banks to participate in the activity for which they currently use the Refuge. Of the visitors surveyed, 12.6 percent said they would still visit the Refuge with alternate access, but there were no other locations on the Outer Banks to participate in the activity for which they currently use the Refuge. This group makes up 51,600 to 67,100 (12.9 percent of the estimated 400,000 to 520,000) annual visitors to the Refuge. These visitors would need to be served by the USFWS/NPS's alternate access program, or the economic impact could be worse than described.

<u>Direct Impacts</u>

Direct economic impacts associated with the loss of paved road access can be measured as the loss of visitors' expenditures resulting from the change. The Travel Industry Association of America (TIA), which conducts extensive surveys of tourist travel behavior and expenditure patterns throughout the Unites States, has published estimates of average visitor expenditures and duration of tourist visits in North Carolina. The TIA's most recent visitor expenditure data for North Carolina (TIA, 2004) indicate that out-of-state tourists visiting North Carolina spend an average of $332 per visit; North Carolina resident tourists average $221 per visit. On average, 68 percent of North Carolina tourist trips involve at least one overnight stay, with 46 percent staying in hotels, motels, or other commercial lodgings. The average duration of a tourist visit in North Carolina is 2.3 nights. Using this information, a range of between 400,000 and 520,000 visitors per year to the Refuge (Parsons Brinckerhoff Quade & Douglas, Inc., July 2005), and the percent of in-state and out-of-state visitors to the Refuge derived from the Refuge visitors study (see Table 3-11) conducted for this assessment, it was estimated that Refuge visitor expenditures vary from $114 million to $149 million annually (see Table 4-2). Key results of the visitors study are presented in Section 3.5.2.4 and are documented in full in *Pea Island National Wildlife Refuge Visitors' Utilization Study* (Parsons Brinckerhoff Quade and Douglas, Inc., April 2005).

Table 4-2. Refuge Visitor Expenditures

Total Refuge Visitor Estimates	Estimated In-State Refuge Visitors		Estimated Out-of-State Refuge Visitors		Estimated Visitor Expenditures (millions)		
	%	Number	%	Number	In-State	Out-of-State	TOTAL
400,000	41.7	166,800	58.3	233,200	$36.9	$77.4	$114.3
520,000	41.7	216,840	58.3	303,160	$48.0	$100.7	$148.7

The expenditures in Table 4-2 do not reflect the exclusive economic impact of the Refuge. Most visitors to the Refuge come to the Outer Banks for multiple purposes, only one of which is to visit the Refuge. Moreover, Refuge visitors have, in many cases, alternatives to the Refuge in which to conduct their activities, which is reflected in the results of the Refuge visitors study conducted for this assessment. Also, the survey found that even without paved road access, the Refuge would be used. Expenditures most likely lost would be those of visitors who said in the survey that they would not return to the Refuge without paved road access (see Table 3-10) and do not have reasonable alternative places locally to pursue their activities (see Table 3-11).

To determine this share of total Refuge visitors, a cross tabulation of the results from the visitors study has been made as follows:

		Still would visit PINWR		
		Yes	No	
Other locations to conduct activity	Yes	47.56%	32.24%	79.8%
	No	12.04%	8.16%	20.2%
		59.60%	40.40%	

Note: Cell percentages assume independence between the row and column variables.

Approximately 9 percent of the Refuge visitors interviewed satisfy both criteria—that is, they would not visit the Refuge without paved road access, and they do not have alternative locations where they could engage in their activity. This result suggests that the percentage of lost visitor expenditures is about 9 percent of the total Refuge visitor expenditures. For purposes of this assessment, it was assumed that 10 percent of total Refuge visitor expenditures would be "lost" to the Outer Banks region. The slight upward rounding reflects a somewhat higher loss as alternative locations prove to be unsatisfactory for a small number of Refuge visitors over time, as well as the possibility that those who said they would continue to use the Refuge might do so at a lesser frequency.

Given the $114 million and $149 million estimate of total annual visitor expenditures at current levels of visitation and the 10 percent factor, lost visitor spending would range from $11.4 million to $14.9 million annually without paved road access (see Table 4-3). These visitor expenditure loss estimates may be assumed to comprise the direct economic impacts of Refuge visitors, measured in terms of additional final sales.

Table 4-3. Economic Loss from No Paved Road Access to the Pea Island National Wildlife Refuge

	Estimated lost direct Refuge spending (millions)	Multipliers			Economic Loss		
		Output (final sales) multiplier[1]	Earnings multiplier[2]	Employ-ment multiplier[3]	Total lost final sales (millions)	Total lost earnings (millions)	Total lost employ-ment
Eating and drinking places	$3.8-$5.0	1.4914	0.4016	25.5	$5.7-$7.5	$1.5-$2.0	97-128
Hotels and other lodgings	$3.8-$5.0	1.5306	0.3873	17.6	$5.8-$7.7	$1.5-$1.9	67-88
Other retail	$3.8-$5.0	1.4990	0.4193	20.6	$5.7-$7.5	$1.5-$1.9	78-103
TOTAL LOSS	**$11.4-$15.0**	**--**	**--**	**--**	**$17.2-$22.7**	**$4.5-$5.8**	**242-319**

Bureau of Economic Analysis (BEA) multiplier definitions:
[1] Total dollar change in output (final sales) for all industries that results from a $1 change in output delivered to final demand in the table row industry.
[2] Total dollar change in earnings of households employed for all industries that results from a $1 change in output delivered to final demand in the table row industry.
[3] Total change in number of jobs for all industries that results from a $1 million change in output delivered to final demand in the table row industry.

Secondary Impacts

Secondary, or multiplier impacts include indirect and induced effects. Indirect effects arise from the multiple rounds of purchases by businesses to supply needed customers. Induced effects arise from the additional rounds of consumer spending by workers who earn wages. Thus, every tourist dollar spent triggers additional rounds of expenditures. For example, a dollar spent on restaurant meals would generate spending by restaurant establishments on items or services (inputs) such as food, transportation, building maintenance and operation, and labor. Not all of these inputs would be obtained locally, however. Expenditures for items such as food would largely “leak out” to areas outside of the region, lessening the overall economic benefits from final demand spending, such as tourist spending.

Input-output analysis is typically used to evaluate these secondary impacts. For state and county level analyses, a commonly used methodology is the Regional Input-Output Modeling System (RIMS) II Methodology. RIMS II uses the US Department of Commerce, Bureau of Economic Analysis' (BEA) national Input-Output table to estimate these effects at small area levels. Adjustments are made to the national Input-Output tables to reflect the leakages characteristic of small, open economies. The RIMS II system provides industry specific multipliers, which when applied to direct impacts for that industry, generates estimates of the change across all industry sectors in total output (final demand sales), earnings, and employment resulting from a dollar increase (or decrease) in final demand sales.

Total economic losses resulting from the loss of paved road access to the Refuge may be measured as the sum of direct and indirect impacts.

Utilizing a typical RIMS II multiplier set for an ocean-front community (i.e., RIMS II multipliers for St. Lucie County, Florida), it is thus possible to estimate the total (direct and secondary) annual economic losses resulting from the estimated reductions in Refuge tourism spending. An additional assumption is that, of Refuge visitor expenditures, approximately one-third are for hotels and other lodging places, one-third for restaurants and other eating and drinking places, and one third for miscellaneous retail spending. The results of the RIMS II analysis for lost sales, earnings, and employment for the change in Refuge access is shown in Table 4-3.

An additional indicator of economic loss would include the fiscal impacts, i.e., the impact on Dare County and state tax revenues. Fiscal impacts are shown in Table 4-4.

Table 4-4. Fiscal Impacts from No Paved Road Access to the Pea Island National Wildlife Refuge

Tax type	Tax rate	Tax base	Reduction in tax base (millions)	Tax revenue loss
NC Sales tax	7%	Retail sales	$17.2-$22.7	$1.2-$1.6 million
Dare County Prepared Food and Beverage Tax	1%	Prepared food and beverages	$5.7-$7.5	$57-$75 thousand
Dare County Room Occupancy Tax	3%	Hotel and room lodging sales	$5.8-$7.7	$174-$231 thousand
Dare County Tourism Development Tax (general)	1%	Hotel and room lodging sales	$5.8-$7.7	$58-$77 thousand
Dare County Tourism Development Tax (for beach nourishment)	1%	Hotel and room lodging sales	$5.8-$7.7	$58-$77 thousand
TOTAL LOCAL	--	--	**--**	**$347-$460 thousand**
TOTAL STATE and LOCAL	--	--	**--**	**$1.5-$2.1 million**

On average, these losses are not likely to have a major economic impact on the Outer Banks/Dare County area. For example, total estimated lost employment (242 to 319 jobs) is approximately 2 percent of total private sector Dare County employment of 12,539 (2001), as reported by the Census Bureau. Paid employment, as defined by the Census Bureau, consists of full- and part-time employees, including salaried officers and executives of corporations, who are on the payroll in the pay period that includes March 12. Included are employees on paid sick leave, holidays, and vacations; not included are proprietors and partners of unincorporated businesses. Many of the lost jobs would likely be seasonal and are not included in the Census totals. Lost income would be about the same small percent. Tax revenue effects would be similarly small. Total Dare County Occupancy Tax Receipts were about $13 million in 2004. Lost tax receipts would comprise about 2.5 percent of the total for Dare County. Lost state sales taxes are a much smaller percentage—less than 0.03 percent of the $4.6 billion gross sales taxes collected in North Carolina in 2004.

Some individual businesses would be more directly affected, and could suffer serious losses. Such businesses would include shops closest to the Refuge, including in particular businesses that rent fishing, birding, or other beach recreational equipment.

No-Action Alternative

Bonner Bridge serves as a supply line for Hatteras Island. The No-Action Alternative would have several adverse impacts on the economy of the island. The variety of goods and services available to island residents and visitors would be more limited than at present, and the prices of available items would become more costly because of reduced accessibility. Commerce between Hatteras Island and the rest of Dare County—and even the region—would be reduced. Employment opportunities for Hatteras Island residents elsewhere in the county and region would be diminished, as would employment opportunities for nonresidents on Hatteras Island. Commercial and residential construction on the island would be curtailed.

The No-Action Alternative also would make travel more difficult for Dare County visitors to Hatteras Island, the entire Hatteras Island portion of the Seashore, and the Refuge. Visitor levels would be affected by both the lack of capacity and the additional time it would take to cross Oregon Inlet, and the increased travel time would discourage day trips. Potential visitors might choose to visit other attractions outside the county. This disruption, in turn, could result in a decline in the tourism-related sectors of the area's economy. Because of the area's economic dependence on tourism and its related service industries, the loss of access could adversely affect the general economic strength of the Hatteras Island communities and Dare County.

4.1.5.4 Effect of a Storm-Related Breach of NC 12

As indicated in Section 3.6.3.4, the potential exists for a storm-related breach to occur in Hatteras Island within the Refuge between now and 2060 (see Figure 2-21), with the storm with the right characteristics to create a breach occurring only once in that time period. Based on the opinions of the expert panel described in Section 3.6.3.4 of, the location most likely for a breach to occur would be at the southern end of the Refuge (Site 3). A breach at this location would only disrupt travel with the Parallel Bridge Corridor with Nourishment and with Phased Approach/Rodanthe Nourishment alternatives. There is also the potential for a deep breach near the terminal groin (Site 5). As discussed in Section 3.6.3.4, access to Hatteras Island would not likely be affected by a breach at this location with the Pamlico Sound Bridge Corridor and the two Phased Approach alternatives (including the Preferred Alternative) (unless a breach occurred prior to implementation of Phases II and III). However, access to the northern tip of Hatteras Island would be lost with the Pamlico Sound Bridge Corridor. It would take three to six months to close a breach at the southern end of the Refuge, during which time travel to Hatteras Island would be limited to an emergency ferry service provided by NCDOT between Hatteras Island at Rodanthe and the mainland at Stumpy Point. A deep breach near the terminal groin would be difficult to close with sand. The potential economic impact of a breach at this location was assessed.

Formation of a breach in the Refuge would temporarily cut off access (except for limited ferry service) to Hatteras Island, including to all the private and public tourism destinations on Hatteras Island (with the probable exception of the Refuge itself, given that the most likely breach location would be at the southern end of the Refuge). Given that a breach could occur at different times of the year, and could take three to six months to close, economic costs were estimated for a low, high, and medium tourism month.

The economic assessment found that direct and secondary impact (measured as a reduction in retail sales) of a breach open for three months would be $5.7, $46.3, and $146.7 million in the off-peak, middle, and peak seasons, respectively. A six month breach covering the middle and peak six months would result in reductions in retail sales of $193.0 million. The job loss with a breach in the peak three months was estimated to be 30,000 person months. The combined state income and sales tax loss, Dare County occupancy tax loss, and Dare County food and beverage sales loss was estimated to be $16.7 million for three months in the peak season and $21.1 million for six months over the six-month middle and peak seasons.

Methodology

The impact assessment in this section considers the impacts of several "breach scenarios." The scenarios reflect uncertainty in the time of year during which a breach might occur, and the expected duration to close a breach. The economic findings of the former—when the breach might occur—varies substantially because the seasonal variation in economic activity in Dare County—particularly on the Outer Banks—which more than Dare County in general, caters to tourist activity. The scenarios are as follows:

- Seasonal variation: peak, off peak, and middle seasons.
- Time to repair: one month; three months.

Direct Economic Impacts

The Outer Banks Chamber of Commerce estimates that approximately 25 percent of total Dare County economic activity is on Hatteras Island. The Chamber of Commerce also estimates that about 20 percent of Dare County restaurant receipts and 29 percent of the gross occupancy receipts (primarily from rental cottages, with some from hotels on the island) are earned on Hatteras Island.

Using these estimates, combined with total measures of Dare County economic activity provided by the Outer Banks Chamber of Commerce, Hatteras Island monthly economic activity across various measures is estimated in Table 4-5. The measures selected are those that likely would be substantially affected by a breach.

The next step is to estimate the amount of Hatteras Island economic activity that can be attributed to tourist activity, as distinct from the economic impacts that might be felt by the permanent population, in the form of increased transportation costs, for both personal and goods related transport.

A reasonable way to estimate this is to look at the difference between off-peak times and other times. The off-peak economic activity reflects the normal activities of residents and businesses, rather than the flow of tourists and visitors to the island. The increment can be assumed to be a reasonable approximation of the economic increment resulting from tourist and visitor activity.

The seasonal (i.e., tourism related) economic activity is estimated in Table 4-6. Incremental or seasonal impacts are measured relative to February, the lowest activity month.

Table 4-5. Hatteras Island Share of Retail, Occupancy, and Food and Beverage Sales

	Season	Gross Retail Sales (millions, 2004)		Gross Occupancy Receipts (millions, 2004)		Food and Beverage Sales (millions, 2004)	
		Dare County	Hatteras Island Share (25%)	Dare County	Hatteras Island Share (29%)	Dare County	Hatteras Island Share (20%)
January		$81.26	$20.32	$1.69	$0.49	$5.23	$1.05
February	Off	$55.11	$13.78	$1.43	$0.41	$5.54	$1.10
March	Off	$51.88	$12.97	$2.66	$0.77	$7.05	$1.41
April	Off	$72.16	$18.04	$8.13	$2.36	$11.34	$2.27
May		$88.34	$22.09	$15.57	$4.52	$14.45	$2.89
June		$108.17	$27.04	$43.77	$12.69	$23.19	$4.64
July	Peak	$173.40	$43.35	$77.49	$22.47	$28.90	$5.78
August	Peak	$237.98	$59.50	$68.65	$19.91	$25.89	$5.18
September	Peak	$218.15	$54.54	$22.89	$6.64	$16.84	$3.37
October	Mid	$135.90	$33.98	$10.93	$3.17	$12.75	$2.55
November	Mid	$91.00	$22.75	$5.06	$1.47	$8.04	$1.61
December	Mid	$77.25	$19.31	$1.34	$0.39	$6.84	$1.37
TOTAL		**$1,390.60**	**$347.67**	**$259.61**	**$75.29**	**$166.06**	**$33.22**

Source: Outer Banks Chamber of Commerce.

Table 4-6. Hatteras Island Seasonal Retail, Occupancy, and Food and Beverage Sales

	Incremental (Seasonal) Gross Retail Sales (millions)	Incremental (Seasonal) Gross Occupancy Receipts (lodging place receipts) (millions)	Incremental (Seasonal) Food and Beverage Sales (millions)
Peak Season	**$116.05**	**$47.79**	**$11.03**
• July	29.57	22.06	4.68
• August	45.72	19.50	4.08
• September	40.76	6.23	2.27
Mid-Season	**$34.70**	**$3.82**	**$2.23**
• October	20.20	2.76	1.45
• November	8.97	1.06	0.51
• December	5.53	0.00	0.27
Off-Peak Season	**$4.26**	**$0.44**	**$1.48**
• February	0.00	0.08	0.00
• March	0.00	0.00	0.31
• April	4.26	0.36	1.17

Note: Incremental impacts measured relative to February, the lowest activity month.

The information in Table 4-6 can be used to estimate the direct economic losses of a breach for the six scenarios considered. These estimates are presented in Table 4-7. Economic losses consist of reduced retail sales; gross occupancy receipts and food and beverage sales are a subset of gross retail sales – the three columns in Table 4-6 are thus not additive, but indicate sub-sector impacts.

Table 4-7. Breach Direct Economic Impact by Season

	Peak Season (millions, 2004 dollars)	Off-Peak Season (millions, 2004 dollars)	Mid-Season (millions, 2004 dollars)
1 month breach (average)	$38.68	$1.42	$11.57
3 month breach	$116.05	$4.26	$34.70

Secondary Economic Impacts

Multiplier and total effects (i.e., direct plus secondary impacts), can be estimated based on the direct reduction in retail sales. Multipliers must be applied carefully in this case; however, it is unclear to what extent Hatteras Island businesses can satisfy input requirements, as compared with those inputs being imported from off the island.

Assuming that Hatteras Island businesses must import a majority—say 75 percent—of all inputs from off-island, the multipliers would be less than those utilized in the assessment of the impact of no paved road access to Hatteras Island with the Pamlico Sound Bridge Corridor above. The multiplier, in this case, is estimated to equal 1.33.

In a very simple multiplier model, the value of the multiplier depends on the import or "leakage ratio", as follows: 1/1-(1-m) = multiplier, where m = the import leakage ratio. Assuming m = 0.75, the multiplier is calculated as 1.33. Overall secondary impact losses would be greater for the Outer Banks region and Dare County as a whole, as the multiplier is higher for the region than it is just for Hatteras Island, where import leakage is greater.

Using this multiplier, total economic losses on Hatteras Island, including direct and secondary impacts are shown in Table 4-8.

Table 4-8. Breach Direct and Secondary Economic Impact by Season

	Peak Season (millions, 2004 dollars)			Off-Peak Season (millions, 2004 dollars)			Mid-Season (millions, 2004 dollars)		
	Direct	Secon-dary	Total	Direct	Secon-dary	Total	Direct	Secon-dary	Total
1 month breach (average)	$36.68	$12.23	$48.91	$1.42	$0.47	$1.89	$11.57	$3.86	$15.43
3 month breach	$110.04	$36.69	$146.73	$4.26	$1.41	$5.67	$34.71	$11.58	$46.29

As seen in Table 4-8, the extent of the impact is highly variable, depending on the scenario considered. For example, a three month breach occurring at the height of the peak season could result in tourism-related economic losses on Hatteras Island of about $147 million. By contrast, a three month breach occurring during the off-peak season would entail relatively small tourism-related losses of around $6 million. The greatest potential impact would be a six-month breach occurring over the peak and mid-season time periods, which would result in a combined impact of $193.02 million ($146.73 plus $46.29).

Job Loss

Job losses were not estimated by breach scenario, because it is unclear whether and to what extent local seasonal employees would not be hired or permanent employees laid off as a result of the substantial but temporary reductions in activity. The likelihood is that temporary or seasonal employees would lose their jobs for breaches exceeding one month during the peak season; as discussed in Section 4.6.7, the minimum time to close a breach at the southern end of the Refuge would be three months.

A very rough estimate of the peak seasonal employment loss in the event of a breach over the full three months of the peak season is about 30,000 person-months (equivalent of 1 person working 30,000 months), assuming labor receives one third of the proceeds from retail sales in the form of wages, and that the average wage is $5,000 over a three month period.

Fiscal Impacts

Based on the losses estimated above, fiscal impacts for Dare County and North Carolina are estimated in Table 4-9. The greatest potential impact would be a six-month breach occurring over the peak and mid-season time periods, which would result in a combined impact of $21.13 million ($13.40 plus $3.34 plus $4.06 plus $0.33).

Table 4-9. Breach Fiscal Economic Impact by Season

	NC Sales Tax	NC Income Tax[1]	TOTAL STATE	Dare County Occupancy Tax (all occupancy taxes combined)	Dare County Food and Beverage Sales (millions)	TOTAL DARE COUNTY
Peak Season						
• 1 month breach	$3.60	$0.80	$4.40	$1.00	$0.05	$1.05
• 3 month breach	$10.90	$2.50	$13.40	$3.20	$0.14	$3.34
Mid-Season						
• 1 month breach	$1.10	$0.25	$1.35	$0.10	$0.01	$0.11
• 3 month breach	$3.30	$0.76	$4.06	$0.30	$0.03	$0.33
Off-Peak Season						
• 1 month breach	$0.10	$0.03	$0.13	$0.05	$0.01	$0.06
• 3 month breach	$0.40	$0.09	$0.49	$0.20	$0.02	$0.22

[1] Assumes a blended 6.5 percent state income tax rate. Also assumes that one-third of final retail sales are distributed as wages to employees.

Other Impacts

Other impacts could include the economic costs of time and inconvenience associated with the breach, for both passengers and goods. No analysis has been performed to assess the travel impacts of a breach for either category, but these effects would likely be substantial.

Frequency of Impacts

While the impacts are found to be substantial in any given year for peak season breach scenarios, the low probability of such a breach occurring in any given year greatly reduces the potential "life cycle" effect. As discussed in Section 3.6.3.4, the expert panel that was asked to assess the breach issue concluded that the storm event needed to create a breach likely would only occur once through 2060.

The size of the breach impact, particularly if the breach were to occur in the peak season, also makes it highly desirable to develop additional data that would help facilitate closing a breach. As discussed in Section 4.6.7, three months was considered the minimum time to close a breach with advance data gathering. Without advance data gathering, the time to close a breach would likely double to six months.

A breach, and its associated costs, would not be of concern with the Pamlico Sound Bridge Corridor, because the Refuge would be bypassed by the Pamlico Sound bridge. Except for accounting for the potential of such a breach in bridge location and foundation design, a breach and its economic impact also would not be a concern with the Parallel Bridge Corridor Alternatives, except for the two involving nourishment. The Rodanthe area bridges associated with all of Parallel Bridge Corridor alternatives (except those involving nourishment) would span the breach location. In the case of the Phased Approach/Rodanthe Bridge Alternative (Preferred), the breach location would be spanned in Phase II. The nourishment program associated with the Nourishment Alternative and the Phased Approach/Rodanthe Nourishment Alternative would reduce the risk of a breach occurring, but it would remain a possibility.

Other potential breach locations exist in the Refuge, as discussed in Section 3.6.3.4. The potential for a breach to occur at these locations between now and 2060 is considered minimal by expert panel members, with the potential being somewhat greater south of the Refuge's ponds at the location of the former New Inlet.

4.1.6 Community Services

The replacement bridge corridor alternatives would not substantially affect community services. The details of the potential effects of the replacement bridge corridor alternatives on emergency medical services, police and fire services, schools, the Rodanthe-Waves-Salvo Community Center, water and sewer services, solid waste disposal, telephone service, cable service, electric power service, and the emergency ferry dock are discussed in the following sections. The No-Action Alternative would have adverse impacts on emergency medical services, fire and police protection, schools, solid waste disposal, telephone services, and power.

4.1.6.1 Emergency Medical Services

With the replacement bridge corridor alternatives, ground transportation by ambulance would continue to use the bridge to reach the hospitals in Kitty Hawk, North Carolina; Norfolk, Virginia; Chesapeake, Virginia; and Elizabeth City, North Carolina. Replacing Bonner Bridge with a 17.5-mile (28.2-kilometer) long structure in the Pamlico Sound Bridge Corridor would increase emergency vehicle travel distance for the ground transport of critically ill or injured persons and others requiring immediate aid across Oregon Inlet by approximately 2 miles (3.2 kilometers). The distance from Rodanthe to Bodie Island is approximately 2 miles (3.2 kilometers) longer with the Pamlico Sound Bridge Corridor than on the existing road. With a design speed of 60 miles per hour (mph) (96 kilometers per hour [kph]) for the Pamlico Sound Bridge Corridor, this could result in an increase in travel time of approximately two minutes. With the Parallel Bridge Corridor there would be no noticeable change in travel distance or time for emergency vehicles as compared to existing conditions.

Helicopters used to evacuate seriously injured accident victims would be able to land on the 40-foot-wide (12.2-meter) clear roadway width associated with the proposed bridges for all of the replacement bridge corridor alternatives. (Personal communication, January 6, 2004, Larry Mimms, Dare County EMS.) In addition, the 40-foot (12.2-meter) clear roadway width of these bridges would provide adequate space for other emergency vehicles to turn around and return to their station after responding to an emergency on the proposed bridge. (Personal communication, January 6, 2004, John Jones, Dare County EMS.)

With the No-Action Alternative, the ground transportation time required to transport critically ill or injured persons, and others requiring immediate aid, across Oregon Inlet would be increased by at least 80 minutes (the amount of time required for ferry service across Oregon Inlet) when the ferry is operating. This additional time to cross Oregon Inlet would increase the travel time to the Nags Head hospital nearly 90 percent. The substantially longer transport time would put the patient at greater risk of permanent disability or death from injury or illness. The lack of road access and the lack of ferry service late at night would increase the demand for emergency medical transportation by the county's helicopter.

4.1.6.2 Police and Fire Service

Construction of a replacement bridge within the Pamlico Sound Bridge Corridor would require emergency services (police and fire) supplied off-island from the north to travel approximately 2 miles (3.2 kilometers) farther to get from the bridge terminus on Bodie Island to the terminus in Rodanthe than what is needed on existing NC 12. The 40-foot (12.2-meter) clear roadway width of bridges associated with all of the replacement bridge corridor alternatives would provide adequate space for fire trucks to turn around and return to the fire station after responding to an emergency on the proposed bridge. (Personal communication, December 17, 2003, Ryan Lehman, Nags Head Fire Department.) With the Parallel Bridge Corridor there would be no noticeable change in travel distance or time for these emergency vehicles as compared to existing conditions.

The No-Action Alternative would lessen the flexibility of the fire and police service on Hatteras Island to obtain timely assistance from other fire departments elsewhere in the county or in adjoining counties during large-scale emergencies. The removal of roadway access between Bodie and Hatteras islands would disrupt the current patrol routes of the NPS and could eliminate coverage of Hatteras Island by the North Carolina Highway Patrol because of the decreased access across Oregon Inlet.

4.1.6.3 Schools

The school-aged population of Hatteras Island is served by school facilities on the island. The No-Action Alternative would curtail or increase travel time to extracurricular activities, including sporting events that involve off-island travel. The replacement bridge corridor alternatives would have no impact on Hatteras Island schools.

4.1.6.4 Rodanthe-Waves-Salvo Community Center

The Pamlico Sound Bridge Corridor's terminus in Rodanthe is north of SR 1492 (Myrna Peters Road), so the Pamlico Sound Bridge Corridor would not affect the Rodanthe-Waves-Salvo Community Center. The Rodanthe area bridge's southern approach road (associated with the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives), however, would be in the same location as Myrna Peters Road. An alternate access to NC 12 would be provided immediately to the south of the community center.

For the Phased Approach alternatives (including the Preferred Alternative) , access would be altered at the north end of Rodanthe where two one-way frontage roads would be provided to maintain access to homes and businesses in the area where NC 12 is placed on a bridge. The Rodanthe-Waves-Salvo Community Center is in the area affected by the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) only. No other community facilities are along the portion of NC 12 that would be placed on a bridge. The one-way frontage roads, and limited number of crossovers between them, would create a slightly more circuitous route for emergency vehicles. Depending on the location of the home or business that they are trying to reach in relationship to the crossovers, they would likely have to go beyond the intended destination to make a U-turn either before or after making their stop. This effect would be least with the Phased Approach/Rodanthe Nourishment Alternative, which includes a shorter bridge in Rodanthe. With the Phased Approach/Rodanthe Bridge Alternative (Preferred), users of the Rodanthe-Waves-Salvo Community Center also would travel a more circuitous route.

4.1.6.5 Water

The replacement bridge corridor alternatives would not affect water service on Hatteras Island. There are separate water sources on Bodie Island, in the Refuge, and in Rodanthe. Existing water lines west of NC 12 in Rodanthe are for local distribution only, and alteration of these lines during construction of the bridge approach roads in Rodanthe would not affect overall service. (Personal communication, July 24, 2003, T.J. Ketterman, Dare County Water, Kill Devil Hills, NC.) The NCDOT would coordinate any construction activities with Dare County to minimize disruption of local service. The No-Action Alternative would have no impact on water service.

4.1.6.6 Sewer Service

The replacement bridge corridor alternatives would not affect sewer service, because there are no sewers in the project area.

4.1.6.7 Solid Waste Disposal

The replacement bridge corridor alternatives would not affect solid waste disposal. The No-Action Alternative would create a situation similar to that experienced when Bonner Bridge was damaged in October of 1990 and closed temporarily. The daily waste collections would have to be removed from the island via ferry for transport to the mainland landfill. Transport by ferry would double the daily operation time, thereby increasing operating costs. The time increase could be reduced by giving sanitation vehicles priority on the ferries or establishing a transfer station on Hatteras Island.

4.1.6.8 Telephone Service

The replacement bridge corridor alternatives would have no effect on telephone service provided to Hatteras Island. New telephone cables would be placed on or adjacent to the proposed replacement bridge with the Pamlico Sound Bridge Corridor and the bridge across Oregon Inlet with the Parallel Bridge Corridor, replacing those now on Bonner Bridge. Disruption of service, as it is switched from the existing lines to the replacement lines, would be minimal. It is the preference of Sprint Communications (the current service provider) that service lines be attached to a replacement bridge over Oregon Inlet or Pamlico Sound through the use of pre-fabricated inserts installed during construction. This method would help reduce costs, provide access for maintenance, and reduce construction scheduling conflicts that could delay the demolition and removal (which would occur under a separate contract) of Bonner Bridge.

Costs associated with relocating telephone cables currently on Bonner Bridge would be greatest with the Pamlico Sound Bridge Corridor Alternatives at approximately $262,500 (2006 dollars) for 17.5 miles (28.2 kilometers) of relocation, and least on the Parallel Bridge Corridor alternatives (including the Preferred Alternative) at $54,000 for 2.7 miles (4.4 kilometers) of relocation. With most of the Parallel Bridge Corridor Alternatives, the telephone company would need to relocate its telephone lines on Hatteras Island in the project area periodically as the shoreline erodes. Through 2060, NCDOT estimates the following telephone line relocation costs along NC 12 in 2006 dollars:

- Nourishment Alternative: $0.0 million
- Road North/Bridge South: $0.8 million
- All other Parallel Bridge Corridor alternatives (including the Preferred Alternative): $1.5 million

The No-Action Alternative would require the development of an alternative system for providing telephone services to Hatteras Island, such as placement of submarine cables under Oregon Inlet.

4.1.6.9 Cable Service

The replacement bridge corridor alternatives would provide a reasonable means for Charter Communications to provide improved cable services to Hatteras Island. A replacement bridge would provide the opportunity for cables to be attached to the structure. Like Sprint Communications, Charter Communications would like to utilize pre-installed inserts attached to the bridge.

The No-Action Alternative would eliminate the potential for improving cable services on Hatteras Island. Charter Communications indicated that it would not be feasible to develop an independent conveyance of cable lines to the Island. (Personal communication, October 3, 2003, George Weaver, Charter Communications, Nags Head, NC.) The No-Action Alternative would have no impact to the existing services since customers are supplied cable service via satellite.

4.1.6.10 Electric Power

The replacement bridge corridor alternatives would have no effect on the availability of electric service to Hatteras Island because new transmission lines would be built. Disruption of service as it is switched from the existing lines to the replacement lines would be minimal. Design of aerial lines would have to take into account the potential need for an emergency helicopter to land on the bridge.

Costs associated with relocating electrical lines currently on Bonner Bridge would be greatest with the Pamlico Sound Bridge Corridor Alternatives at approximately $53.6 million (2007 Cape Hatteras Electrical Cooperative estimate).

The impact of absorbing a project of $53.6 million would be enormous according to the cooperative. The total plant investment of the cooperative in facilities as of October 2005 was $34.6 million. This option almost triples the present plant investment of the cooperative. The impact of increasing plant investment by a $53.6 million project would require an increase in retail electric rates by approximately 42 percent. The cooperative already has the highest utility plant investment per meter served and retail rates among the highest of electric cooperatives in North Carolina.

Relocation of electric lines onto the new Oregon Inlet bridge with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would cost as much as $12 million (2007 Cape Hatteras Electrical Cooperative estimate). While this cost greatly exceeds typical cooperative electric system projects, the cooperative has indicated that it long expected the requirement. With most of the Parallel Bridge Corridor Alternatives, the cooperative would need to relocate its electrical lines on Hatteras Island periodically in the project area as the shoreline erodes. Through 2060, the NCDOT estimated the following electrical line relocation costs in 2006 dollars:

- Nourishment Alternative: $0.0 million
- Road North/Bridge South Alternative: $2.0 million
- All other Parallel Bridge Corridor alternatives (including the Preferred Alternative): $3.8 million

The No-Action Alternative would disrupt power service to Hatteras Island because Bonner Bridge would be demolished at the end of its service life and transmission lines are carried on the bridge. A representative of the electric cooperative indicated that there are two possibilities for the continuation of power service to Hatteras Island under the No-Action Alternative. (Personal communication, October 23, 2003, Jim Kinghorn, Cape Hatteras Electric Membership Association, Buxton, NC.) The two possibilities are:

1. Construction of large, independent towers to transmit the high-voltage aerial lines to the island; and

2. Construction of steam generators on Hatteras Island.

Each alternative would have economic and environmental consequences. Construction of towers to convey aerial lines would increase cost and risk for the electric cooperative. Line maintenance would be conducted from boats in Pamlico Sound. Construction and maintenance of supporting structures would face many of the same challenges as construction of foundations for a new Oregon Inlet bridge. The construction of primary-source steam generators on Hatteras Island would necessitate development of an oil terminal, and the fuel cost of supplying and running the generators would be high. The high construction costs and environmental impact potential of transmission towers or generators would involve a lengthy and difficult permitting process with no guarantee of success.

4.1.6.11 Emergency Ferry Dock

The Pamlico Sound Bridge Corridor is north of the NCDOT's emergency ferry dock in Rodanthe and the channel used by ferries to reach the dock. The Pamlico Sound Bridge Corridor's terminus in Rodanthe is north of the road connecting the dock to NC 12 and would not affect the dock or its operations. The Rodanthe area bridge's southern approach road (associated with the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives) would be in the same location as the current access road to the emergency ferry dock, and a new access road to the emergency ferry dock would be built with these alternatives. An alternate access to NC 12 would be provided immediately to the south of the Rodanthe-Waves-Salvo Community Center. Access to the emergency ferry dock would not change with the Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative. With the Phased Approach/Rodanthe Bridge Alternative (Preferred), users of the ferry dock, like those of the Rodanthe-Waves-Salvo Community Center, would travel a more circuitous route to get to and from the dock via the frontage roads that would parallel the new NC 12 bridge passing through Rodanthe and bypass the ferry terminal access road.

4.1.7 Oregon Inlet Users

The replacement bridge corridor alternatives would make navigation through Oregon Inlet safer by providing wider horizontal clearances than exists today between piers. The No-Action Alternative would eliminate any constraints that Bonner Bridge now places on Oregon Inlet users.

A bridge in either the Pamlico Sound Bridge Corridor or the Parallel Bridge Corridor would have a minimum navigation span horizontal clearance of 200 feet (60.1 meters). The vertical clearance at the navigation spans would be 75 feet (22.9 meters) above mean high water. With the Pamlico Sound Bridge Corridor, the navigation zone (area with spans of the navigation span height and width) would be 1,600 to 2,000 feet (488 to 610 meters) long. With the Parallel Bridge Corridor, the navigation zone across Oregon Inlet would include a series of navigation spans across the inlet for up to approximately 5,000 feet (1,524 meters), except with the two Phased Approach alternatives (including the Preferred Alternative) where the navigation zone would be 3,300 feet (1,006 meters). These dimensions would be adequate to provide for the navigation needs of current and anticipated future inlet users. The navigation zone with the Phased Approach alternatives (including the Preferred Alternative) would not affect channel use. The typical size of vessels using Oregon Inlet in the future is not expected to exceed that of the largest commercial fishing boats using the inlet today. The maximum size of vessels utilizing the inlet is not expected to increase, primarily because of the shallow authorized depth.

The replacement bridge corridor alternatives would make navigation through Oregon Inlet safer by providing wider horizontal clearances than exists today between piers. The potential threat of vessel collisions with the replacement bridge corridor alternatives would be less than with Bonner Bridge because of the proposed increase in horizontal clearance. This would allow fishing vessels to lower their outriggers as they pass beneath the bridge, and it would provide more room for error than exists now when a vessel passes under the bridge during storm conditions. The replacement bridge also would be designed to withstand the impact of dredging vessels.

Charter fishing boats operating out of the Seashore's Oregon Inlet Marina and Fishing Center use an unmarked natural channel known as Bridge to Old House Channel (or known more commonly as "the crack") to reach the navigation span of Bonner Bridge, rather than the Oregon Inlet Channel/Old House Channel maintained by the USACE. (Figure 3-7 shows the location of channels in the Oregon Inlet area.) On a peak day, approximately 130 charter vessels use "the crack." Use of "the crack" shortens the distance traveled by vessels operating between the fishing center and Bonner Bridge's navigation span from approximately 5 miles (8 kilometers) to about 2.5 miles (4.0 kilometers). As illustrated in Figure 3-7, a bridge in either the Pamlico Sound Bridge Corridor or the Parallel Bridge Corridor would cross "the crack" as the bridge moves southwest into Pamlico Sound. Since charter fishing boats require as much as 30 feet (9 meters) of clearance, a bridge in these corridors would block the channel's use by these vessels and increase the time it takes for these vessels to move from the fishing center to the ocean, since they would be required to use the Oregon Inlet Channel/Old House Channel maintained by the USACE. The travel time to the ocean from the fishing center would be approximately 30 minutes longer via the Oregon Inlet Channel/Old House Channel than via “the crack.” Crossing “the crack” by a bridge cannot be avoided with either replacement bridge corridor, since “the crack” runs adjacent and parallel to Bonner Bridge for part of its length.

Under the No-Action Alternative, removal of Bonner Bridge would eliminate any constraints that Bonner Bridge now places on Oregon Inlet users.

4.1.8 Underground Storage Tanks and Hazardous Waste

The Pamlico Sound Bridge Corridor with the Curved Rodanthe Terminus would affect a portion of the Liberty service station, but none of its current underground storage tanks (USTs) are within the area directly affected. Both Rodanthe terminus options for the Pamlico Sound Bridge Corridor would affect the Rodanthe junkyard in the project area, although junked cars were removed from a part of the area between 2003 and 2004. The preliminary site assessment conducted for these properties for the Pamlico Sound Bridge Corridor found minor concentrations of Diesel Range Organics (diesel fuel and associated compounds) in two soil samples (Catlin Engineers and Scientists, December 2003). The assessment concluded that these minor concentrations should not require further action for soils left in place. However, if soils were excavated in these areas during roadway construction, they would be handled as petroleum impacted waste. Contaminated soils would be removed and disposed as per state and federal requirements for transportation, treatment, storage, and disposal of such soils. Extra costs associated with handling contaminated soils would be taken into account when negotiating the purchase price of proposed right-of-way containing such soils.

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would displace the gas pumps closest to NC 12 at the Liberty service station, as well as the gas pumps at the North Beach Beach Mart and Campground convenience store in Rodanthe. Low monetary and scheduling impacts are anticipated from these sites. A full site investigation would have to be conducted to determine whether the USTs are affected and whether they have leaked into surrounding soils. If contaminated soils are present, they would be removed and disposed of as per state and federal requirements as noted in the previous paragraph.

No contaminated soils or USTs would be disturbed with the No-Action Alternative.

A replacement bridge within the Pamlico Sound Bridge Corridor would substantially increase the distance (17.5 miles [28.2 kilometers] versus the current 2.4 miles [3.9 kilometers]) that ground transport of hazardous materials between Bodie and Hatteras islands would be over water. The Rodanthe area bridge (associated with the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives) would include 1.8 miles (2.9 kilometers) over water in addition to the Oregon Inlet bridge. The length of the Oregon Inlet bridge in the Parallel Bridge Corridor would be similar in length to Bonner Bridge, so there would be no additional risk of spills associated with bridge length in this portion of the Parallel Bridge Corridor. In the event of hazardous waste or oil spills, emergency response procedures established under the Dare County 2001 Emergency Operations Plan would be followed. In addition, the requirements would apply to spills of oil and those chemicals listed in the Federal Clean Water Act, whether on the ground or in water bodies, including off-shore spills.

4.1.9 Farmland

There are no important farmland soils within the replacement bridge corridor alternatives.

4.2 Environmental Justice

Executive Orders 12898 and 13045 require federal agencies to identify and address, as appropriate, the potential for disproportionately adverse human health or environmental effects of federal programs, policies, and activities on minority and low-income populations. These requirements were met by analyzing environmental justice data in accordance with regulatory guidance from the Council on Environmental Quality (CEQ) (CEQ, 1997), US Environmental Protection Agency (USEPA) (USEPA, 1998), and US Department of Transportation (USDOT) guidelines for assessing environmental justice impacts (USDOT, 1997).

Three criteria must be met for impacts to minority and low-income communities or children to be considered significant: 1) there must be one or more populations within the region of comparison (ROC); 2) there must be adverse (or substantial) impacts from the proposed action; and 3) the environmental justice populations within the ROC must bear a disproportionate burden of those adverse impacts. If any of these criteria are not met, then impacts with respect to environmental justice or protection of children would not be substantial. The analysis contained in this Final Environmental Impact Statement (FEIS) is consistent with Executive Orders 12898 and 13045.

As documented in Section 3.2, there are no concentrations of any minority group or low-income populations within the project area. Thus, there is no evidence that the replacement bridge corridor alternatives or the No-Action Alternative would disproportionately affect low-income or minority households.

4.3 Visual Impacts

The following sections discuss the nature of the visual impacts for the Pamlico Sound Bridge Corridor and Parallel Bridge Corridor alternatives (including the Preferred Alternative) from the perspectives of Rodanthe, the Refuge, and Oregon Inlet, all of which are consistent parts of the Seashore in the project area.

4.3.1 Rodanthe

With both bridge corridors, a new bridge would be introduced to Rodanthe views, although the views affected differ between the alternatives. The No-Action Alternative would not affect views at Rodanthe.

4.3.1.1 Pamlico Sound Bridge Corridor

Views of the Pamlico Sound from homes along the sound's shoreline (and second-story homes farther away from the Sound) in Rodanthe are panoramic and unobstructed. A bridge in the Pamlico Sound Bridge Corridor would result in substantial changes to these views. The intactness and unity of the landscape would be reduced by the introduction of project features. The location of the Pamlico Sound Bridge Corridor minimizes impacts to views by maintaining a predominantly straight and perpendicular final approach to land that extends for approximately 3 miles (4.8 kilometers) of the southernmost portion of the structure. With this location, the proposed bridge would not obscure the full panorama of the views of Pamlico Sound from homes along the shoreline.

The bridge generally would obscure approximately one-third of the panorama as the bridge moves west into the Sound. For the rest of the panorama, the bridge would appear as a thin line on the horizon in the day. At night, the lights of motor vehicles would be visible, off in the distance for much of the panorama and closer as the proposed bridge approaches the shore. Roadway lighting is not planned for the proposed bridge.

Visual impacts would be greatest for homes closest to the proposed Pamlico Sound bridge. With the Curved Rodanthe Terminus Option, more than half of the panoramic view of the Sound would be obscured at the home immediately north of the terminus option.

The Rodanthe approach road within the Pamlico Sound Bridge Corridor would change landforms and vegetation, as well as displace several existing buildings, and part of an automobile junkyard. None of these features contribute to views of high quality. Thus, their replacement by the Pamlico Sound bridge and its approach road would not adversely affect the area's visual quality. The Pamlico Sound bridge and its Rodanthe approach road would be visible from the watchtower that is a part of the historic Chicamacomico Life Saving Station building. The current viewshed is occupied by modern commercial and residential development and the junkyard. Therefore, the change would not affect the integrity of this view.

4.3.1.2 Parallel Bridge Corridor with NC 12 Maintenance

The Parallel Bridge Corridor with Nourishment would not affect the Rodanthe area. A bridge would be built west of Rodanthe with the Road North/Bridge South and the All Bridge alternatives. Again, views of the Pamlico Sound from homes along the shoreline (and second-story homes further away from the Sound) in Rodanthe are panoramic and unobstructed. A bridge in this corridor would result in substantial changes to these views. The Rodanthe area bridge would be closer (1,400 to 1,700 feet [427 to 518 meters]) to the shore over its full length than the Pamlico Sound Bridge Corridor bridge, which would be roughly perpendicular to the shore. The intactness and unity of the view would be split by the line of the Rodanthe area bridge across the full 180 degrees of the view. At night, the lights of motor vehicles would be visible. Roadway lighting is not planned for the proposed bridge.

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would substantially affect the Rodanthe area, introducing an elevated roadway into the community for a distance of 1.1 miles (1.8 kilometers) beginning at the Refuge boundary. A bridge would be built with a one-lane/one-way frontage road on either side of the bridge at-grade to maintain access to adjoining properties. On either side of NC 12, pavement would be approximately 34.5 feet (10.5 meters) closer to adjoining homes and businesses. The bridge would be at its full height of approximately 33.5 feet (10.2 meters) above mean sea level (approximately 30 feet [9.1 meters] above ground) as it enters Rodanthe from the north (see Figure 2-24). The bridge would remain at its full height for 0.8 miles (1.3 kilometers) and then begin to descend to ground level. The final 400 feet (122.0 meters) of the elevated roadway would be on fill contained by retaining walls.

Within the area of effect described for the Phased Approach/Rodanthe Bridge Alternative (Preferred), approximately 90 residential and/or business structures are along NC 12 and would be within 100 feet of the new bridge. The elevated structure would impede the viewshed of the primary viewers looking east towards the Atlantic Ocean and ocean-side viewers looking west.

Views could be blocked by the elevated structure as high as the third or fourth story. At an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (approximately 30 feet [9.1 meters] above ground), the bridge would be a dominating presence at ground level, particularly for those 90 homes and businesses close to the bridge (see Figure 2-24). The combination of the bridge's height, length, structural characteristics, and materials would present a structure not in keeping with the existing character of the area.

The bridge with the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be a sizable man-made addition to views from homes in Rodanthe into the Refuge at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (approximately 30 feet [9.1 meters] above ground). It would present a stark contrast with the natural character of the Refuge and would be the tallest feature in the Refuge, since existing dunes are generally no more than 20 feet (6.1 meters) high. The bridge's presence in views would be most prominent near the Refuge border and would diminish as the bridge continues north away from Rodanthe.

The potential for beach erosion is severe in the Rodanthe area. By 2060, as a result of the beach eroding under the bridge, the majority of the bridge would be in the ocean (as far as 930 feet [283.5 meters] offshore) and would be a presence within ocean views except for at its southern end (where the bridge will approach its terminus at NC 12 right-of-way that will not erode away but will remain in 2060). Most of the homes with views of the Phased Approach/Rodanthe Bridge Alternative (Preferred) bridge would be lost to beach erosion.

Views of the Pamlico Sound from homes along the sound shoreline in Rodanthe are panoramic and unobstructed. A bridge with the Phased Approach/Rodanthe Bridge Alternative (Preferred) would not affect views of the Sound, but would obscure the view for soundside homes with a view of the Atlantic Ocean.

The Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative would affect the Rodanthe area, introducing an elevated roadway into the community for a distance of 0.3 mile (0.5 kilometer). Within this distance, about 30 residential or business structures along the existing roadway would be within 100 feet of the new bridge. Visual impacts would be the same as described for the Phased Approach/Rodanthe Bridge Alternative (Preferred) but less severe overall because of the shorter bridge length in Rodanthe.

4.3.2 Pea Island National Wildlife Refuge

The Pamlico Sound Bridge Corridor is not within the Refuge and is far enough from the Refuge to have no adverse visual effect.

In the Parallel Bridge Corridor, the Nourishment Alternative would be within the same right of way as existing NC 12. The visual effect of this alternative is minimal, as beach nourishment and dune placement would be the only action. Views of the ocean from the road would be obscured by new dunes, but dunes are already an almost constant presence along NC 12 within the Refuge. New dunes would not represent a substantial visual change.

The Parallel Bridge Corridor with Road North/Bridge South Alternative would include the start of the Rodanthe area bridge, whose visual impacts are described in Section 4.3.1.2, and the relocation of NC 12 as a road at the same elevation as existing NC 12. The horizontal shift of the road west would change the appearance of the surrounding terrain, changing wetland to road and narrowing the ponds as much as 700 feet (213.4 meters). From the perspective of its impact on the historic landscape of the naturalized setting in the Refuge, as enhanced by the Civilian

Conservation Corps in the 1930s, this alternative was found to have an Adverse Effect (see Section 4.4.1.2) under the requirements of Section 106 of the Historic Preservation Act of 1966. From the perspective of general visual change for visitors to the Refuge, no long distance views would be blocked or altered, and the vegetation in the immediate area of existing NC 12 and the new road would be restored. Thus, the long-term visual impact of this alternative would be low and no greater than the natural changes in the current landscape resulting from beach erosion and ocean overwash.

The Parallel Bridge Corridor with All Bridge Alternative would represent a sizeable intrusion into the landscape of the Refuge. The All Bridge Alternative would introduce a sizeable new linear man-made feature for approximately 7.5 miles (12.1 kilometers) through the Refuge. The bridge through the Refuge with this alternative would be built as much as 900 feet (274.4 meters) west of the existing road, following a straighter alignment than the Road North/Bridge South Alternative. The bridge would be approximately 28 feet (8.5 meters) above the existing ground line, allowing for the bottom of the superstructure (bridge spans) to be a minimum of 10 feet (3 meters) above mean high water. This height is similar to the height of the tallest of the dunes that line much of the shoreline in the Refuge. Bridge foundations probably would be built every 100 feet (30.5 meters). The bridge structure would pass above the wildlife trails on top of the dikes associated with the northernmost pond and over the ponds. The bridge would present a contrast with the natural character of the Refuge. The bridge would dominate views from the dunes lining the beach and, as the dunes disappear over time, it would also dominate views from the beach. It would also dominate views from the wildlife trails along the Refuge's ponds, interrupting the undeveloped and protected character of the Refuge that makes it rare along the eastern US seaboard in terms of views and a setting for recreation activities.

Like the All Bridge Alternative, the Phased Approach alternatives (including the Preferred Alternative) would represent a sizeable intrusion into the landscape of the Refuge. The Phased Approach alternatives (including the Preferred Alternative) would introduce a sizeable new linear man-made feature for approximately 10 miles (16.1 kilometers) through the Refuge, intrude approximately 700-feet into the existing dikes and ponds, and alter the naturalized setting enhanced by the Civilian Conservation Corps in the 1930s. NC 12 through most of the Refuge would be elevated to a bridge within the existing easement. The bridge would be at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (approximately 30 feet [9.1 meters] above ground), allowing for the bottom of the superstructure to be a minimum of 25 feet (7.6 meters) above mean high water (see Figure 2-24). This is 15 feet (4.6 meters) higher than the height assumed for the All Bridge Alternative.

Like the All Bridge Alternative, the bridge would present a contrast with the natural character of the Refuge. The bridge would dominate views from the dunes lining the beach and, as the dunes disappear over time, it also would dominate views of the beach and ultimately the ocean. It would not be characteristic of the undeveloped and protected character of the Refuge that makes it rare along the eastern US seaboard in terms of views and a setting for recreation activities.

With the No-Action Alternative, views in the Refuge would not be changed except by natural shoreline erosion.

4.3.3 Oregon Inlet

Three viewpoints occur in the Oregon Inlet area: the northern end of Hatteras Island, the spit and the southern end of Bodie Island, and the Oregon Inlet Marina and Oregon Inlet Campground area. The Parallel Bridge Corridor would be present in all three of these viewpoints. The Pamlico Sound Bridge Corridor would be a notable visual presence only in the Oregon Inlet Marina and Oregon Inlet Campground area.

With the No-Action Alternative, Bonner Bridge would be removed and not replaced. Thus, Bonner Bridge would no longer be in view at the three viewpoints. A clearer view of Oregon Inlet and Pamlico Sound would be introduced from viewpoints on the south end of Bodie Island and the north end of Hatteras Island with the No-Action Alternative.

4.3.3.1 Northern End of Hatteras Island

At its Hatteras Island terminus, the Oregon Inlet bridge associated with the Parallel Bridge Corridor alternatives would be taller than Bonner Bridge, which enters Hatteras Island at an elevation of approximately 15 feet (4.6 meters). The new Oregon Inlet bridge would include navigation spans over Oregon Inlet, and it would eventually reach Hatteras Island at a higher elevation than the current bridge. The new bridge would enter Hatteras Island at an elevation of approximately 70 feet (21.3 meters) with the Nourishment Alternative. The elevation would be 57 feet (17.4 meters) with the Road North/Bridge South and All Bridge alternatives. With the Phased Approach alternatives (including the Preferred Alternative), the new bridge would enter Hatteras Island at an elevation of approximately 33.5 feet (10.2 meters) and would remain at that height in the vicinity of the historic (former) Oregon Inlet US Coast Guard Station and as the bridge continues south. The bridge and its roadway approach for the other Parallel Bridge Corridor alternatives would drop to the existing grade over the course of approximately 2,700 feet (823.1 meters). The Phased Approach alternatives' bridges would be a more dominant component of views from the (former) Oregon Inlet US Coast Guard Station and other viewpoints on the northern end of Hatteras Island than the existing bridge.

Thus, a new Oregon Inlet bridge would be a more dominant component of views from the (former) US Coast Guard Station and other viewpoints on the northern end of Hatteras Island.

In addition to the new bridge, the Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) would include three additional visual features:

1. In the interval between the completion of Phase I (the bridge over Oregon Inlet) and the completion of Phase II (assumed to be about three years), drivers would enter and leave the bridge over Oregon Inlet via two ramps, and the bridge structure would end at its full height;

2. Four ramps ultimately would be built from the bridge to the ground to provide access to the (former) Oregon Inlet US Coast Guard Station and the existing parking lot in the area; and

3. The traffic maintenance bridge that would be built east of the new bridge in the existing easement could possibly be retained as a fishing pier.

A bridge within the Pamlico Sound Bridge Corridor would be farther (e.g., more than 1.5 miles [2.4 kilometers]) from the northern end of Hatteras Island than Bonner Bridge. Thus, the scale of a replacement bridge in the Pamlico Sound Bridge Corridor in relation to viewers at the (former) US Coast Guard Station and other viewers in this area would be far less than that of Bonner Bridge. A replacement bridge in the Pamlico Sound Bridge Corridor would be visible for a greater distance than Bonner Bridge given the proposed bridge's longer length and height. However, it would appear as a thin line on the horizon when visible because the proposed bridge would be several miles farther offshore.

4.3.3.2 Bodie Island Spit

A new Oregon Inlet bridge (in the Parallel Bridge Corridor) would not affect views from the Bodie Island spit. No substantial change would occur in the quality of resource components. The scale and dominance of the Oregon Inlet crossing would not be substantially changed. An Oregon Inlet crossing would continue to be the predominant visual element. The new Oregon Inlet bridge would be slightly farther away, and would present a less complex or cleaner appearance than Bonner Bridge. The Pamlico Sound Bridge Corridor bridge would be approximately 4,000 feet (1,220 meters) from the spit and not a notable visual feature. Bonner Bridge would be removed from spit views, so there would no longer be an Oregon Inlet bridge visible from the spit with the Pamlico Sound Bridge Corridor.

4.3.3.3 Oregon Inlet Marina and Oregon Inlet Campground Area

No substantial visual impact would result in the Oregon Inlet Marina and Oregon Inlet Campground area with a replacement bridge in the Pamlico Sound Bridge Corridor. The Pamlico Sound Bridge Corridor's disturbance to landforms and vegetation would be limited to the bridge approach on Bodie Island. Lands formerly used for the Bonner Bridge approach would be restored in a manner in keeping with the surrounding landforms and vegetation after Bonner Bridge is demolished. The Pamlico Sound Bridge Corridor would be slightly closer to the Oregon Inlet Marina than Bonner Bridge. Thus, the scale of the proposed bridge in relation to the marina would be somewhat greater than that of Bonner Bridge. The Pamlico Sound Bridge Corridor would be slightly farther from the Oregon Inlet Campground on Bodie Island. The visual impact in the area of the Oregon Inlet Marina and Oregon Inlet Campground would be the same with the Parallel Bridge Corridor as it currently is with Bonner Bridge.

4.4 Cultural Resources

This section describes the effects of the replacement bridge corridor alternatives on historic and archaeological resources, in accordance with Section 106 of the National Historic Preservation Act of 1966 (36 *Code of Federal Regulations* [CFR] Part 800).

4.4.1 Architectural and Landscape Resources

Figure 3-3 shows the Area of Potential Effects for the replacement bridge corridor alternatives. The historic resources within the Area of Potential Effects are:

- Pea Island National Wildlife Refuge (determined eligible);
- The (former) Oregon Inlet US Coast Guard Station building (National Register) at the northern end of Hatteras Island;
- Rodanthe Historic District (determined eligible) at the southern end of the project area; and
- The Chicamacomico Life Saving Station (National Register), which stands within the Rodanthe Historic District.

An Adverse Effect is defined in the regulations of the Advisory Council on Historic Preservation that implement Section 106 of the National Historic Preservation Act of 1966 (36 CFR Part 800.5(a)(1)) as:

> An Adverse Effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.

The regulations also give the following examples of adverse effects:

> (i) Physical destruction of or damage to all or part of the property;
>
> (ii) Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary's standards for the treatment of historic properties (36 CFR Part 68) and applicable guidelines;
>
> (iii) Removal of the property from its historic location;
>
> (iv) Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;
>
> (v) Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features;
>
> (vi) Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and
>
> (vii) Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

The following sections present the Section 106 determination of effect for the three historic resources in the areas of potential effects (APE). These determinations of effect were made at meetings between representatives of the NCDOT, the Federal Highway Administration (FHWA), and the State Historic Preservation Officer (SHPO) on November 25, 2003 for the Pamlico Sound Bridge Corridor and June 28, 2005 and December 1, 2006 for the Parallel Bridge Corridor. The concurrence forms are included in Appendix B. Reasons for the eligibility of these resources are presented in Section 3.4.1.

4.4.1.1 Pamlico Sound Bridge Corridor

Pea Island National Wildlife Refuge

The Pamlico Sound Bridge Corridor is not within the Refuge and there will be no construction activities within the Refuge. Thus, a bridge in the Pamlico Sound Bridge Corridor would have No Effect on the Refuge.

(Former) Oregon Inlet US Coast Guard Station

A replacement bridge in the Pamlico Sound Bridge Corridor would not directly affect the (former) US Coast Guard Station. As indicated in the previous section, however, efforts required to maintain NC 12 are not consistent with the management goals of the Refuge. Thus, although the USFWS and the NPS have indicated that they intend to maintain some type of access within the Refuge and this portion of the Seashore, the method of access could be something different than a paved road between Rodanthe and Oregon Inlet. The (former) US Coast Guard Station is at the northern end of Hatteras Island. Thus, a change in the access strategy could affect the accessibility of the (former) US Coast Guard Station and, therefore, its value for an alternative use on its current site. This change could cause continued neglect of the property.

The continued migration of Oregon Inlet threatened the southern terminus of Bonner Bridge and the north end of Hatteras Island in the late 1980s. Thus, the NCDOT built a terminal groin to protect the bridge. With the construction of the terminal groin, Hatteras Island migration to the south was halted. As such, the terminal groin also now protects the (former) US Coast Guard Station. The NCDOT has no current plans to remove the terminal groin on Hatteras Island after Bonner Bridge is demolished. The terminal groin is not needed in order to build and maintain a bridge in the Pamlico Sound Bridge Corridor, and neither is its removal. The performance of the terminal groin would not be affected by the construction of a bridge in the Pamlico Sound Bridge Corridor. The terminal groin could serve parties other than NCDOT and other immediate needs besides protecting Bonner Bridge. It is conceivable, however, that circumstances could change at some time in the future such that it could prove prudent to remove the terminal groin. In addition, the permit from the Refuge that allowed the construction of the terminal groin states that the purpose of the terminal groin is to "…protect the southern segment of the existing Herbert C. Bonner Bridge and its southern approach of North Carolina Highway 12." The permit also states that the NCDOT can use the lands and waters occupied by the terminal groin for as long as they "are used for the purpose granted." If the groin is removed, the north end of Hatteras Island would continue its movement south (see Section 3.6.3.5) and, unless relocated, the (former) US Coast Guard Station would be washed away.

Therefore, because of the potential loss of access and the potential removal of the terminal groin, a replacement bridge in the Pamlico Sound Bridge Corridor would have an Adverse Effect on this resource.

The Refuge and the Seashore plan to conduct an access study. The NCDOT would seek and accept an invitation to participate in the development of alternate access plans if a Pamlico Sound Bridge Corridor Alternative is selected for construction, and it would suggest that the SHPO be invited to participate. If the alternate access provided is found by the SHPO to contribute potentially to the further neglect of the (former) US Coast Guard Station, the NCDOT would help ensure this potential impact is adequately mitigated. Such mitigation would not include retaining NC 12 in the Refuge. If mitigation would include relocating the (former) US Coast Guard Station to a site north of Oregon Inlet, the NCDOT currently expects not to demolish Bonner Bridge until that relocation occurred or until a process for taking the building across Oregon Inlet on a barge is developed. However, given the current condition of Bonner Bridge, consideration would have to be given to whether the weight of the (former) US Coast Guard Station could be safely borne by Bonner Bridge before relocation across the bridge could take place.

If NCDOT is required to remove the groin following completion of the demolition and removal of Bonner Bridge, the NCDOT and representatives of the USFWS would assess the impacts of groin removal in a separate environmental study, as needed, prior to any final decision to remove the terminal groin. Such a study would assess impacts to the (former) US Coast Guard Station.

Chicamacomico Life Saving Station and Rodanthe Historic District

In the Rodanthe portion of the APE, the National Register-listed Chicamacomico Life Saving Station and several nearby houses form the National Register-eligible Rodanthe Historic District. The Pamlico Sound Bridge Corridor is outside of the boundaries of these resources.

The proposed bridge within the Pamlico Sound Bridge Corridor would be visible from the watchtower that is a part of the Life Saving Station building. However, the viewshed currently is occupied by modern commercial and residential development and an automobile junkyard (partially removed between 2003 and 2004). Thus, the integrity of the view has already been compromised.

At one house within the district, peak-hour noise levels in 2025 would approach or exceed the FHWA's Noise Abatement Criteria (NAC) with the Pamlico Sound Bridge Corridor. However, this noise level is associated more with the forecast growth in traffic than the implementation of a bridge within the Pamlico Sound Bridge Corridor. There would be no difference at the affected site between 2025 noise levels assuming Bonner Bridge remains in place and 2025 noise levels with the Pamlico Sound Bridge Corridor. In addition, 2025 noise levels with the Pamlico Sound Bridge Corridor would only be 2 dBA (A-weighted sound level in decibels) above existing conditions, an imperceptible difference.

Since the Pamlico Sound Bridge Corridor ends north of the eligible district, the proposed bridge would not affect traffic volumes that pass through the district on NC 12. Because of the lack of direct or substantial indirect affects on the district, there is no reason to believe that a bridge in the Pamlico Sound Bridge Corridor would lead to neglect of the properties within the district. The Chicamacomico Life Saving Station would not leave control of its owners.

Given these findings, the Pamlico Sound Bridge Corridor would have No Adverse Effect on the Chicamacomico Life Saving Station and the associated historic district.

4.4.1.2 Parallel Bridge Corridor Alternatives

Pea Island National Wildlife Refuge

With the Nourishment Alternative, the NC 12 roadway would remain within its existing easement, although two features would be introduced to the Refuge. The first would be a taller Oregon Inlet bridge southern terminus. Bonner Bridge currently enters Hatteras Island at an elevation of approximately 15 feet (4.6 meters). The new bridge would enter Hatteras Island at an elevation of approximately 70 feet (21.3 meters). The new bridge would have a navigation span that spans Oregon Inlet, thus it would reach Hatteras Island at a higher elevation than the current bridge. The bridge and its roadway approach would drop to the existing grade over the course of approximately 2,700 feet (823.1 meters). Second, several dunes approximately 10 feet (3 meters) high would be constructed in the area of the dikes and ponds created by the Civilian Conservation Corps (CCC) in the 1930s. Ten feet (3 meters) is the approximate height of the original dunes also built by the CCC. Two additional dunes approximately 20 feet (6.1 meters) high would be built at the south end of the Refuge. The dikes and ponds created by the CCC would remain in their current state, protected from further island erosion by the nourishment program. The Nourishment Alternative would have No Adverse Effect on the Refuge since the new dunes would be on the east side of NC 12, and the existing dikes and ponds would remain in place.

With the Road North/Bridge South Alternative, NC 12 would be moved west on a new roadway in association with the taller Oregon Inlet bridge described above. Three short, 10-foot (3-meter) high new dunes would be built as needed beginning in 2030. The road component would be built approximately 230 feet (70.1 meters) west of the 2060 high erosion shoreline, narrowing the width of the ponds built by the CCC by as much as 700 feet (213.4 meters). This is the minimum relocation possible if NC 12 is to be maintained without additional relocations under high erosion conditions until 2060. The relocated road would be at the same elevation as the existing road. South of the ponds, NC 12 would veer west to be relocated on a bridge just west of the Refuge. The relocation would begin approximately 1.9 miles (3.1 kilometers) north of the southern boundary of the Refuge and approximately 3.8 miles (6.1 kilometers) south of the southernmost pond. The bridge would be approximately 28 feet (8.5 meters) above the surface of Pamlico Sound. The Road North/Bridge South Alternative would have an Adverse Effect on the Refuge, because the relocation of NC 12 would intrude into the existing dikes and ponds for approximately 3.5 miles (5.6 kilometers) (i.e., the entire length of the three ponds from north to south) at a distance of up to 700 feet (213 meters) to the west of existing NC 12. The Refuge was found to be eligible for the NRHP under Criterion A of the National Historic Preservation Act of 1966, as amended, in the areas of conservation and social history (see Section 3.4.1.1). A letter dated September 17, 2003 from the North Carolina SHPO that affirms this finding is contained in Appendix A.

With the <u>All Bridge Alternative</u>, NC 12 would be moved west mostly on a bridge in association with the taller Oregon Inlet bridge described above. No dunes would be built. The bridge component would be built as much as 900 feet (274.4 meters) west of the existing road, following a straighter alignment than the road alternative. The bridge would be approximately 28 feet (8.5 meters) above the existing ground line, allowing for the bottom of the superstructure (bridge spans) to be a minimum of 10 feet (3 meters) above mean high water. This height is similar to the height of the tallest of the dunes that line much of the shoreline in the Refuge. Bridge foundations probably would be built every 100 feet (30.5 meters). The bridge structure would pass above the wildlife trails on top of the dikes associated with the northernmost pond and over the ponds. The All Bridge Alternative would introduce a sizable new linear visual feature for approximately 7.5 miles (12.1 kilometers) through the Refuge. The All Bridge Alternative would have an Adverse Effect on the Refuge because the elevation of NC 12 on a bridge would place NC 12 over the existing dikes and ponds. The Refuge was found to be eligible for the NRHP under Criterion A of the National Historic Preservation Act of 1966, as amended, in the areas of conservation and social history (see Section 3.4.1.1). A letter dated September 17, 2003 from the North Carolina SHPO that affirms this finding is contained in Appendix A.

With the <u>Parallel Bridge with Phased Approach alternatives</u> (which are identical through the PINWR and including the Preferred Alternative), the nature of the Adverse Effect would be the visual impact of this alternative on this historic landscape and loss of access to Refuge features. As discussed in Section 4.3.2, the Phased Approach Alternative would introduce a sizable new linear man-made feature for approximately 10 miles (16.1 kilometers) through the Refuge. NC 12 through most of the Refuge would be elevated to a bridge in the existing NC 12 easement. The bridge would be at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level allowing for the bottom of the superstructure to be a minimum of 25 feet (7.6 meters) above mean high water (see Figure 2-24).

Like the All Bridge Alternative, the bridge with the Phased Approach alternatives (including the Preferred Alternative) would present a stark contrast with the natural character of the Refuge. In addition, at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (30 feet [9.1 meters] above ground), the Phased Approach bridges would be 15 feet (4.6 meters) higher than the height assumed for the All Bridge Alternative. The bridge would dominate views from the dunes lining the beach and, as the dunes disappear over time, it would also dominate views of the beach and ultimately the ocean. It would be uncharacteristic of the existing undeveloped and protected setting of the Refuge that makes it rare along the eastern US seaboard in terms of views and a resource for recreation activities.

The bridge with the Phased Approach alternatives (including the Preferred Alternative) would not directly affect existing facilities and activities shown in Figure 3-1b, but once built, direct access to the nature trails and the ponds area (built by the Civilian Conservation Corps in 1933) would no longer be available from NC 12. Access to the Refuge would only be at the north end via the ramps (described in Section 2.10) and south of the ponds where existing NC 12 is not threatened by shoreline erosion in the next 50 years. (See Section 4.5.3 for a further discussion of recreation impacts in the Refuge.)

(Former) Oregon Inlet US Coast Guard Station

Land within the National Register boundary of the (former) Oregon Inlet US Coast Guard Station would not be used with any of the Parallel Bridge Corridor alternatives.

With the Nourishment Alternative, the nourishment component would occur south of the (former) US Coast Guard Station. The new Oregon Inlet bridge would introduce two changes to the setting of the (former) US Coast Guard Station. First, as indicated in the discussion of impacts to the Refuge as an historic resource, the new bridge would be higher than Bonner Bridge. The current bridge enters Hatteras Island at an elevation of approximately 15 feet (4.6 meters). The new bridge would enter Hatteras Island at an elevation of approximately 70 feet (21.3 meters). The bridge and its roadway approach would drop to the existing grade over the course of approximately 2,700 feet (823.1 meters). The higher bridge structure would be introduced to views from the US Coast Guard Station towards Pamlico Sound. The second change with the Nourishment Alternative would be the construction of an access road to the parking lot that serves people fishing on Bonner Bridge's catwalks. It would go past (approximately 80 feet [24.4 meters] away) the Station building. If the (former) US Coast Guard Station is restored for reuse at its current site, this access road would provide convenient access to the Station. The Nourishment Alternative would have an Adverse Effect on the station because the greater height of the new Oregon Inlet bridge would alter the historic view and function of the station. Guards could watch 360 degrees for ships when the Station was built. The higher bridge also would alter the setting.

With the Road North/Bridge South Alternative, the changes in the setting of the (former) US Coast Guard Station would be similar to those for the Nourishment Alternative. The new Oregon Inlet bridge terminus would be approximately 120 to 250 feet (36.6 to 76.2 meters) west of the current bridge terminus on Hatteras Island. Again, the new bridge would be higher than Bonner Bridge as it enters Hatteras Island, in this case approximately 57 feet (17.4 meters) versus the current 15 feet (4.6 meters). The location of the terminus further west lengthens the distance from the end of the navigation zone to Hatteras Island; thus the bridge is lower when it reaches Hatteras Island than with the Nourishment Alternative. Access to the fishing parking lot and the station would be identical to that for the Nourishment Alternative. For the same reasons as the Nourishment Alternative, the Road North/Bridge South Alternative would have an Adverse Effect on the Station.

With the All Bridge Alternative, again the changes in the setting of the (former) US Coast Guard Station would be similar to those for the Nourishment Alternative. The new Oregon Inlet bridge terminus would be approximately 350 to 420 feet (107 to 128 meters) west of the current bridge terminus on Hatteras Island. Again, the new bridge would be higher than the old bridge as it enters Hatteras Island, in this case approximately 57 feet (17.4 meters) versus the current 15 feet (4.6 meters). The Oregon Inlet bridge would connect to the proposed 28-foot-high (8.5-meter) NC 12 maintenance bridge. Existing NC 12 and the existing road to the (former) US Coast Guard Station would provide access to the fishing parking lot and the station, respectively. A new access road would not be introduced. For the same reasons as the Nourishment Alternative, the All Bridge Alternative would have an Adverse Effect on the station.

With the Phased Approach alternatives (including the Preferred Alternative), the new Oregon Inlet bridge would introduce changes to the setting of the (former) Oregon Inlet US Coast Guard Station. The new bridge would be higher than Bonner Bridge as it enters the Refuge and longer in the vicinity of the station. It would not come down to grade like the existing bridge but continue south. Bonner Bridge currently enters Hatteras Island at an elevation of approximately 15 feet (4.6 meters). The new bridge would enter Hatteras Island at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (see Figure 2-24).

With the Phased Approach alternatives (including the Preferred Alternative), the project would be phased in this area. In Phase I, the Oregon Inlet Bridge would be built and would end as a stub on Hatteras Island in the existing easement and adjacent to the station. Ramps would be built on either side of the bridge to bring traffic down to the existing road. During Phase II, expected to be built only a few years after Phase I, the bridge would be extended south and a second set of ramps would be built. The ramps would function as a highway interchange to bring NC 12 traffic down to the existing parking lot adjacent to the station. By the time Phase IV construction is complete, the bridge would not end until south of the Refuge ponds, well outside the viewshed of the station.

If it was considered desirable in the future to move the (former) Oregon Inlet US Coast Guard Station from its current site to a site north of Oregon Inlet, it would be more difficult to move the building across the Oregon Inlet bridge with the Phased Approach alternatives (including the Preferred Alternative) than with the other Parallel Bridge Corridor alternatives. With the other Parallel Bridge Corridor alternatives, the building could be moved from ground level to the bridge via the bridge travel lanes and shoulders (40 feet [12.2 meters] clear roadway width) with a grade of approximately 3.5 percent. With the Phased Approach alternatives, a narrower (18 feet [5.5 meters] including lane and shoulder) and steeper (approximately 5.3 percent grade) access ramp would need to be used. As with all alternatives, however, the building also could be moved across Oregon Inlet on a barge.

Like the other Parallel Bridge alternatives, these changes in visual setting with the Phased Approach alternatives (including the Preferred Alternative) would be an Adverse Effect on the (former) Oregon Inlet US Coast Guard Station from the perspective of its status as an historic resource. The Phased Approach alternatives would alter its setting and historic views from the station that were a part of its function. Guards could watch 360 degrees for ships when the station was built.

Chicamacomico Life Saving Station and Rodanthe Historic District

In the Rodanthe portion of the APE, the National Register-listed Chicamacomico Life Saving Station and several nearby houses form the National Register-eligible Rodanthe Historic District. Shoreline erosion modeling predicts that if high erosion trends continue, the Chicamacomico Life Saving Station and much of the associated historic district would be in the ocean in 2060. The first building in the Life Saving Station complex would be at the eroded shoreline in 2030. The Life Saving Station itself would be at the shoreline between 2050 and 2060 under high erosion conditions. None of the NC 12 maintenance alternatives are designed to affect this trend. They are only designed to maintain NC 12 in place or on a bridge. While the Road North/Bridge South and All Bridge alternatives are identical in their relationship to these two National Register-listed or -eligible resources, the relationship of the other Parallel Bridge Corridor alternatives would be different.

The Nourishment Alternative would involve nourishment to protect NC 12 north of the Life Saving Station and historic district. No dunes would be built in proximity to the Life Saving Station or historic district. The alternative would have No Effect on these historic resources.

The Road North/Bridge South and the All Bridge alternatives would be identical in the vicinity of the Life Saving Station and other historic district features. The alternatives would have an Adverse Effect on the Life Saving Station and the Rodanthe Historic District, as they would both pass through the district. These alternatives would approach Rodanthe on a bridge approximately 28 feet (8.5 meters) high through Pamlico Sound, and would enter the historic district at an elevation of approximately 18 feet (5.5 meters). Bridge foundations probably would be built every 100 feet (30.5 meters). The bridge component would end and the final fill leading down to an intersection at NC 12 would begin within the historic district. The alternatives would terminate at NC 12 across from the existing NC 12/Midgett Drive intersection, just to the south of the Chicamacomico Life Saving Station. The Road North/Bridge South and the All Bridge alternatives would both use land from non-contributing properties within the historic district, and would pass 14 feet (4.3 meters) and 320 feet (97.5 meters), respectively, from two contributing structures – the J. Frank Meekins Fish House and Levene W. Midgett House. These alternatives would be visible from the watchtower that is a part of the Life Saving Station building. Myrna Peters Road would be separated from NC 12. An alternative access road to NC 12 immediately south of the (former) Rodanthe School would be provided to the J. Frank Meekins Fish House and (former) Rodanthe School because their current access to NC 12 is via Myrna Peters Road. The Chicamacomico Life Saving Station would not leave control of its owners.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would involve building a bridge in the existing right-of-way with a one-lane/one-way frontage road on either side of the bridge substructure at grade to maintain access to adjoining properties. These features would fit into the existing right-of-way in the historic district, but would use the entire right-of-way width. NC 12 would remain on bridge until a point on NC 12 is reached that is 230 feet (70.1 meters) from the 2060 high erosion shoreline. This point occurs south of the historic district and, thus, the bridge would pass through the historic district. The bridge would be at its full height of 33.5 feet (10.2 meters) above mean high sea level (approximately 30 feet [9.1 meters] above ground) as it enters the district from the north (see Figure 2-24). It would begin to drop down to grade within the district and would be approximately 12.5 feet (4.0 meters) above ground at the southernmost point of the district. It would still be 30 feet (9.1 meters) above ground in front of the Chicamacomico Life Saving Station. Direct vehicle access across the right-of-way would be eliminated in the district. Connections between the frontage roads would be 963 feet (294.0 meters) south of the southern district boundary and 734 feet (224.0 meters) north of the northern district boundary. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would have an Adverse Effect on the Chicamacomico Life Saving Station and the district because of the change in the visual setting. The bridge would be a feature not in keeping with the historic setting of the structures contained within the district in terms of its height and structural components, and it would impede views across NC 12.

Like the Parallel Bridge Corridor with Nourishment Alternative, the Phased Approach/Rodanthe Nourishment Alternative would maintain NC 12 in Rodanthe using beach nourishment, so it would have No Effect on the Life Saving Station and historic district.

4.4.2 Archaeological Resources

There are no archaeological sites in the project area. In addition, underwater archaeological surveys identified no potentially significant submerged cultural resources within the project area.

(See Section 3.4.2.2 for a discussion of how this finding was made.) Letters from the SHPO concurring with this finding are included in Appendix A. Anomalies identified by remote sensing found buried in the sand appear to be modern debris (Krivor, 2004). If any archaeological resources (e.g., historic watercraft) are encountered during construction in areas with anomalies, construction work affecting the resource will cease immediately until the resource can be identified and assessed for National Register of Historic Places eligibility.

4.5 Parks and Recreation

This section addresses the land use impacts to the Seashore on Bodie Island and the Refuge. It also addresses the recreational use impacts to the Seashore and Refuge, as well as the Pamlico Sound. The No-Action Alternative, and the associated demolition and removal of Bonner Bridge, would result in the demolition of the fishing catwalks on Bonner Bridge. In addition, a ferry dock would need to be constructed within the Seashore with the No-Action Alternative; however, no other parks or recreation resources would be affected with the No-Action Alternative.

4.5.1 Cape Hatteras National Seashore Land Use Impacts on Bodie Island

These paragraphs summarize key components of impacts to the Seashore; a more detailed description of impacts is presented in the Section 4(f) evaluation in Chapter 5, as well as under other impact types presented throughout this chapter.

Activities, features, or attributes of the Seashore on Bodie Island would not be impaired substantially by a Pamlico Sound or Oregon Inlet (Parallel) bridge in the replacement bridge corridors, since NC 12 and Bonner Bridge were developed and planned to serve the Seashore. The replacement bridge corridors on Bodie Island are in the same general area as Bonner Bridge where it affects Seashore lands. No existing NPS facilities would be displaced.

The Pamlico Sound Bridge Corridor would require the permanent use of 7.3 acres (3.0 hectares) of the Seashore at Bodie Island for permanent fill and right-of-way over land. The Parallel Bridge Corridor would require the permanent use of 6.3 acres (2.6 hectares). All of this use would be on Bodie Island, where 6.3 acres (2.6 hectares) of Seashore land is currently used by Bonner Bridge. However, land within the Seashore currently occupied by Bonner Bridge would be returned to the Seashore after Bonner Bridge is demolished. All of the area filled to build the proposed bridge in the Pamlico Sound Bridge Corridor would be upland. No wetlands would be filled. The amount of wetland filled on Bodie Island to build the proposed bridge in the Parallel Bridge Corridor would be approximately 2.1 acres (1.8 hectares). Although NC 12 would be relocated slightly further to the west in the vicinity of the driveways to the Oregon Inlet Marina and the Oregon Inlet Campground, both driveways will remain in their current locations and access to these facilities would not be affected. There is a septic system leach field used by the Oregon Inlet Marina adjacent to the west side of NC 12 to the south of the Oregon Inlet Marina driveway. The exact location of this leach field is not known, but if it is determined during final design that the proposed project would impact the leach field, it will be moved to an appropriate adjacent location so that Oregon Inlet Marina operations would not be affected.

With either a Pamlico Sound Bridge or an Oregon Inlet bridge, charter fishing boats operating out of the Seashore's Oregon Inlet Marina and Fishing Center no longer would be able to use a natural channel known as "the crack" (Bridge to Old House Channel) to reach the navigation span of the Bonner Bridge instead of the Oregon Inlet Channel/Old House Channel maintained by the

USACE. The travel time to the ocean from the fishing center would be approximately 30 minutes longer via Oregon Inlet Channel/Old House Channel than via “the crack.”

The dredging activity required to erect portions of a proposed bridge in the shallow portions of the Pamlico Sound Bridge Corridor would result in temporary changes in estuarine sediments and topography. Dredging the Pamlico Sound bottom would likely be needed for approximately 600 feet (183 meters) within the Seashore. With the Parallel Bridge Corridor behind Bodie Island, a temporary haul road could be built for erection of the Oregon Inlet bridge. The haul road and alternatives to the use of a haul road are described in Section 2.10.1.3. Approximately 2,400 feet (732 meters) of the temporary haul road would be within the Seashore; the haul road would be removed following construction. Dredging or a work bridge are alternatives to a haul road. Dredging of the Oregon Inlet bottom near Oregon Inlet Shoal and within the boundaries of the Refuge would likely be needed to float construction barges. The channel would be 120 feet (36.6 meters) wide and approximately 2,000 feet (610 meters) long. Elsewhere where the Seashore’s boundaries are over water, the water depth is expected to be deep enough to float a construction barge without dredging. Dredging would be short-term and likely would refill to near pre-construction contours in areas of active, high-energy currents.

Separate contracts would be issued for construction of the proposed project in the Pamlico Sound Bridge Corridor and demolition and removal of Bonner Bridge. With an Oregon Inlet bridge, demolition could be within the same contract as construction.

With any of the replacement bridge corridor alternatives, construction activities within the Seashore would directly affect less than 1 acre (0.4 hectare) of potential nesting or foraging habitat for the piping plover (*Charadrius melodus*), which is federally-listed as a threatened species. According to the *Biological Assessment* (FHWA and NCDOT, 2008), up to 0.05 acre (0.02 hectare) of piping plover proposed critical habitat would be lost to fill and pile placement with the Phased Approach/Rodanthe Bridge Alternative (Preferred). With any of the alternatives, construction activities could potentially disrupt piping plovers that nest in the vicinity of the Oregon Inlet.

The Pamlico Sound Bridge Corridor’s only impacts within the Seashore great enough to warrant mitigation would be those related to piping plover nesting areas and construction dredging and/or construction access (haul road, dredging, and/or work bridge) impacts just west of Bodie Island. On Bodie Island, this conclusion also would be true for the Parallel Bridge Corridor. The approach to mitigation for these impacts is described in Sections 4.7.10 and 4.13.6.

The land use impacts to the Seashore on Bodie Island of the No-Action Alternative would involve the impacts associated with the demolition and removal of Bonner Bridge, as well as the construction and operation of small-scale ferry service to maintain some access to Hatteras Island. (See Section 2.2.6.3 for a description of potential impacts.) Without a bridge, there would be no impediments to navigation for boats operating out of the Oregon Inlet Marina and Fishing Center.

4.5.2 Pea Island National Wildlife Refuge Land Use Impacts on Hatteras Island

The replacement bridge corridor alternatives would vary in their effect on the activities, features, and attributes of the Refuge (in an area held in common with the Seashore) on Hatteras Island.

The Pamlico Sound Bridge Corridor would not use land from the Refuge. The Parallel Bridge Corridor, including the two Phased Approach alternatives (including the Preferred Alternative), would be within the Refuge (in an area held in common with the Seashore) on Hatteras Island. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would be built and maintained within the existing NC 12 easement. Thus, no new Refuge lands would be used by this alternative. The Parallel Bridge Corridor alternatives would affect land from the Refuge as follows:

- Nourishment. 19.7 acres (8.0 hectares) associated with new dunes plus nourishment of 6.3 miles (10.1 kilometers) of the seashore within the Refuge. NC 12 would remain in its current easement. A new access road to the Oregon Inlet area parking lot would involve 0.2 acre (0.07 hectare) of new right-of-way.

- Road North/Bridge South. 90.3 acres (36.6 hectares) of new 100-foot (30.5-meter) wide right-of-way would be used for the relocated NC 12 as a roadway and bridge. Approximately 2,961 feet (903 meters) of new bridge would be built over Refuge lands. A new access road to the Oregon Inlet area parking lot would involve 0.2 acre (0.07 hectare) of new right-of-way. Ultimately, 2.9 acres (1.2 hectares) of area would be used by three new dunes, with the earliest built in 2030.

- All Bridge. 89.6 acres (36.2 hectares) of new 100-foot (30.5-meter) wide right-of-way would be used for the relocated NC 12 as a roadway and bridge. Approximately 7.6 miles (12.2 kilometers) of new bridge would be built over Refuge lands. A new access road to the Oregon Inlet area parking lot would involve 2.6 acres (1.1 hectare) of new right-of-way.

- Phased Approach Alternatives (including the Preferred Alternative). The total area of disturbance within the existing easement in the Refuge would be 3.7 acres (1.5 hectares) permanent and 48.5 acres (19.6 hectares) temporary. With the Phased Approach/Rodanthe Nourishment Alternative, nourishment would occur on 1,500 feet (457.2 meters) of seashore within the Refuge.

The above areas include fill in USACE jurisdictional wetland as follows:

- Nourishment. 1.2 acres (0.5 hectare);

- Road North/Bridge South. 48.7 acres (19.7 hectares);

- All Bridge. 5.9 acres (2.4 hectares); and

- Phased Approach Alternatives (including the Preferred Alternative). 3.1 acres (1.3 hectares) permanent and 6.5 acres (2.6 hectares) temporary.

The Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor with All Bridge Alternative (with the exception of the continued presence of the terminal groin at the north end of Hatteras Island) would support the desire of officials responsible for the Refuge and the Seashore to not stabilize the Outer Banks artificially, but rather to let natural processes take their course. The two Phased Approach alternatives (including the Preferred Alternative) likewise would support this desire, with two exceptions: 1) the continued presence of the terminal groin and 2) the 1,500 feet of nourishment on Refuge beaches at the south end of the Refuge in association with Phased Approach/ Rodanthe Nourishment Alternative.

The Parallel Bridge Corridor with Road North/Bridge South Alternative would generally support the desire of officials responsible for the Refuge and the Seashore to not stabilize the Outer Banks artificially, but rather to let natural processes take their course. Exceptions would be the continued presence of the terminal groin, the three dunes that would eventually be built, and were a breach to occur in the Refuge that would need to be closed to maintain NC 12. The Parallel Bridge Corridor with Nourishment Alternative would not support this desire since it would maintain NC 12 by stabilizing the shoreline with nourishment and protecting NC 12 with dunes.

Protected species within the Refuge also could be affected, including sea turtles, the piping plover, and the seabeach amaranth, as discussed in Section 4.7.9.

The approach to mitigation for these impacts is described in Section 4.6.8.

4.5.3 Cape Hatteras National Seashore/Pea Island National Wildlife Refuge Recreational Use Impacts

As described in Section 3.5, visitors rely on NC 12 to reach various recreational activities within the Seashore and Refuge. These activities include fishing, cycling, hiking, walking, and birding. Neither replacement bridge corridor alternative would affect recreational use in the Seashore on Bodie Island. The NPS and the USFWS share management duties where the boundaries of the Seashore overlap with those of the Refuge at the northern end of Hatteras Island. The NPS is responsible for visitors and visitor facilities, while the USFWS is responsible for wildlife management. Because the NPS has recreation management responsibilities on both sides of Oregon Inlet, the discussion of the recreational use impacts for this area is combined in this section.

4.5.3.1 Pea Island National Wildlife Refuge Access

The replacement bridge corridor alternatives would maintain access by road from Hatteras Island to Bodie Island and mainland Dare County. Access for visitors to the Refuge would be maintained, but in the case of the Pamlico Sound Bridge Corridor, the access north of Rodanthe would not likely be on a paved road. Road access to the Refuge would change, but not be completely eliminated, with most of the Parallel Bridge Corridor alternatives (including the Preferred Alternative).

Pamlico Sound Bridge Corridor

With the Pamlico Sound Bridge Corridor, highway access from Bodie Island to Hatteras Island no longer would pass through the Seashore and Refuge, but the USFWS and the NPS have indicated that they intend to maintain some type of access within the Refuge and the portion of the Seashore north of Rodanthe for recreational users. However, the method of access likely would be something different than a paved road between Rodanthe and Oregon Inlet.

The loss of paved road access with the Pamlico Sound Bridge Corridor would inconvenience the Refuge's visitors, create economic impacts for Dare County (although not likely to be major), and cause an Adverse Effect to the National Register-listed (former) US Coast Guard Station. When considering these impacts, it is important to keep in mind that recreation is not defined as the primary purpose of the Refuge. Executive Order 7864 that created the Refuge reserved the area for migratory birds and other wildlife to advance the purposes of the Migratory Bird Conservation Act of 1929. The primary purpose of the Refuge is to be a refuge and breeding ground for migratory birds and other wildlife.

Participants in all types of visitor activities would be affected by the loss of paved road. The nearest paved road would be where NC 12 would terminate at the southern boundary of the Refuge at Rodanthe. The distance from the new south terminus of NC 12 (Refuge boundary) to various Refuge facilities would be:

- Boat ramp: 4.7 miles (7.6 kilometers);
- North Pond Wildlife Trail and Visitor Center: 7.7 miles (12.4 kilometers);
- Salt Flats Wildlife Trail: 9.3 miles (15.0 kilometers); and
- Fishing parking lot at Oregon Inlet: 11.8 miles (19.0 kilometers).

The distance to beach access would range from beach access being immediately adjacent to the terminus of NC 12 at the southern boundary of the Refuge, to 11.8 miles (19.0 kilometers) to the beach at the Oregon Inlet area. As described in Section 4.1.5.3, how this inconvenience would affect decisions of whether to visit the Refuge depends on the activity, as well as the availability of a similar experience elsewhere on the Outer Banks.

Parallel Bridge Corridor

Paved road access would continue in the Refuge with the Parallel Bridge Corridor. The Nourishment Alternative would change the location of the access to the fishing parking lot near Oregon Inlet, but all other access to recreational facilities within the Refuge would be unchanged. The Road North/Bridge South Alternative would alter trail and beach access slightly for most of the Refuge by moving NC 12 further west. At the south end of the Refuge, the Rodanthe area bridge would bypass the southern 1.6 miles (2.6 kilometers) of the Refuge. The bridges associated with the All Bridge Alternative would reduce Refuge access the second most of the five Parallel Bridge Corridor alternatives. Three access points would be provided in the Refuge: at the north end of the Refuge near the fishing parking lot, at the start of the Salt Flats Wildlife Trail (i.e., at the north end of the ponds), and south of the ponds (for a distance of approximately 2 miles [3.2 kilometers]). The All Bridge Alternative would bypass the Refuge Visitor Center, the North Pond Trail, the Refuge's headquarters, and the boat ramp. The Refuge Visitor Center and headquarters would be threatened by beach erosion by 2020 with all but the Nourishment Alternative and would need to be relocated.

The bridges associated with the two Phased Approach alternatives (including the Preferred Alternative) would reduce Refuge access the most of the various Parallel Bridge Corridor alternatives. Once complete, two access points would be provided within the Refuge: at the north end of the Refuge at the fishing parking lot and south of the ponds (for a distance of approximately 2.1 miles [3.4 kilometers]). The Phased Approach alternatives (including the Preferred Alternative) would bypass the Refuge Visitor Center, the Salt Flats Wildlife Trail, the North Pond Trail, the Refuge's headquarters, and the boat ramp. The two trails are the Refuge's primary opportunities for bird watching. Opportunities to stop and park for access to the ocean and beach for surfing and fishing would be limited to the two locations indicated.

Access to recreation use would be unchanged after the completion of Phase I of the Phased Approach alternatives (including the Preferred Alternative). Upon completion of Phase II, the length of the remaining NC 12 at-grade would be approximately 6.8 miles (10.9 kilometers). The at-grade portion would include the Refuge's headquarters and the boat ramp. Upon completion of Phase III, the length of NC 12 remaining at-grade would be approximately 4.6 miles (7.4 kilometers), and would no longer serve any of the existing Refuge facilities. Upon completion of Phase IV, the length of NC 12 at-grade would be approximately 2.1 miles (3.4 kilometers). Access to various facilities in the Refuge would change with the various phases of the Phased Approach as follows:

	Approximate Distance from Nearest NC 12 Access Point to these Facilities in miles (kilometers)			
	Phase I	*Phase II*	*Phase III*	*Phase IV*
• Refuge Visitor Center	Adjacent	0.3 (0.5)	0.3 (0.5)	3.6 (5.8)
• Salt Flats Wildlife Trail	Adjacent	0.1 (0.2)	0.1 (0.2)	2.5 (4.0)
• North Pond Trail	Adjacent	0.2 (0.3)	0.2 (0.3)	3.5 (5.6)
• Refuge's headquarters	Adjacent	Adjacent	0.6 (1.0)	1.6 (2.6)
• Boat ramp	Adjacent	Adjacent	0.8 (1.3)	0.8 (1.3)

Given that the Refuge Visitor Center and headquarters would be threatened by beach erosion by 2020, the Refuge could choose to move these facilities to a more convenient location.

The No-Action Alternative would remove roadway access across Oregon Inlet to Hatteras Island. This change would dramatically lessen the ability of visitors to reach recreational resources throughout the Refuge.

4.5.3.2 Fishing at Oregon Inlet

Bonner Bridge has catwalks that are used by fishermen. The catwalks are maintained by the NCDOT. Catwalks at Oregon Inlet likely would not be included on a replacement bridge in the Pamlico Sound Bridge Corridor because the new bridge would not terminate at the northern end of Hatteras Island.

The Oregon Inlet bridge with the Parallel Bridge Corridor would terminate at the northern end of Hatteras Island. For safety reasons, however, access via catwalks on a bridge in this corridor is not likely. Because of the height of the new bridge, those fishing locations would be approximately 40 feet (12.2 meters) above the water at the shoreline and approximately 65 feet (19.8 meters) above the water by the end of the first span (approximately 400 feet [122.0 meters] offshore) with all but the Phased Approach alternatives (including the Preferred Alternative). The Phased Approach alternatives would be at an elevation of approximately 33.5 feet (10.2 meters). The height of such a catwalk increases the likelihood of serious, if not fatal, injuries as a result of falls.

Opposition to not replacing fishing access was expressed at the public hearings. Fishing is a popular tourist recreational activity on this part of Hatteras Island. The NCDOT would work with the USFWS, the NPS, Dare County, and other appropriate agencies to decide how to restore some kind of fishing access. The USFWS and NPS have indicated that their objective is that fishing access be provided at the north end of Hatteras Island at Oregon Inlet, although fishing does not have to be provided from catwalks mounted on the new bridge.

At this time, one viable approach for the Pamlico Sound Bridge Corridor, Parallel Bridge Corridor with Road North/Bridge South, and Parallel Bridge Corridor with All Bridge alternatives appears to be leaving a portion of the existing Bonner Bridge for fishing. This cannot be done with the other three alternatives, which assume the new bridge terminates at Hatteras Island within the existing NC 12 easement. To maintain a portion of Bonner Bridge as a fishing pier, some government body or non-governmental organization would have to take responsibility for pier operation, maintenance, and liability. Construction of a "boardwalk" on top of the riprap that currently blankets the northern shore of Hatteras Island is another option. Accommodating fishing from the terminal groin is not considered a viable option. Fishing from the groin is considered very dangerous because of the rapid currents adjacent to the groin and the uneven surface of the groin.

When Phase I of the two Phased Approach alternatives (including the Preferred Alternative) – the new Oregon Inlet bridge – is complete, the temporary traffic detour bridge could be left in place to be used as a fishing pier, replacing the catwalks. This also could occur with the Nourishment Alternative, which also would involve replacing the bridge in the existing right-of-way. A traffic maintenance bridge is not needed with the other replacement bridge corridors. As is the case with maintaining a portion of Bonner Bridge as a fishing pier, some government body or non-governmental organization would have to take responsibility for fishing pier operation, maintenance, and liability. The Design-Build Contractor also may propose other options to provide for public fishing access.

If the temporary detour bridge is left in place as a fishing pier, it would be approximately five feet (1.5 meters) higher than the current catwalks on Bonner Bridge. According to Larry Hardham, President of the Cape Hatteras Anglers Club (personal communication, November 16, 2006), being closer to the water is better for fishing. Mr. Hardham also indicated that fishing is better the further out on the catwalk one stands. The fishing pier would be approximately the same distance into Oregon Inlet as the current catwalks. The pier would be much wider than the catwalks (4.5 feet [1.4 meters] versus 26 feet [7.9 meters]), providing fishermen with more room to move about than on the current catwalks. There also would be some shade where the fishing pier would be under one of the exit ramps to the existing parking lot at the north end of Hatteras Island.

With the No-Action Alternative, the fishing catwalks would be removed with the demolition and removal of Bonner Bridge at the end of its service life.

4.5.3.3 Other Recreational Activities

The Parallel Bridge Corridor with Nourishment Alternative would maintain NC 12 within in its existing right-of-way. Refuge facilities would thus be unaffected and would be protected from loss resulting from future shoreline erosion. The Road North/Bridge South Alternative would cross the Salt Flats Wildlife and North Ponds trails near their respective starting points. In the case of the North Pond Trail, which originates at the Visitor Center, users starting at the Visitor Center would have to cross the relocated NC 12. Warning signs and markers would be placed at the crossing. For the Salt Flats Wildlife Trail, the starting point and associated parking on NC 12 would be moved to the new NC 12 location approximately 270 feet (82.3 meters) to the west. A new driveway would be built to the Visitor Center, which would be approximately 550 feet (167.6 meters) east of the relocated NC 12. As described above in Section 4.5.3.1, the All Bridge Alternative would bypass the Refuge Visitor Center, the North Pond Trail, the Refuge's headquarters, and the boat ramp. The Refuge Visitor Center and headquarters would thus be relocated approximately a decade earlier than they would be as a result of an approaching shoreline. Access to the North Pond Trail would remain via the Salt Flats Wildlife Trail, but the two trails would not meet until approximately 2 miles (3.2 kilometers) away from the start of the Salt Flats Wildlife Trail.

Several recreation activities that occur on Hatteras Island, including fishing, hiking, surfing, wind surfing, kite boarding, swimming, ocean kayaking, birding, use of the Visitor Center and Refuge headquarters, would be affected by the two Phased Approach alternatives (including the Preferred Alternative). The effects on birding and use of the Visitor Center and Refuge headquarters would be limited to access impacts, which are discussed in the paragraphs above. Other activities would be directly affected.

The nature of the impacts to other recreation activities would vary over time, since while initially on land, the bridges associated with the Phased Approach alternatives (including the Preferred

Alternative) ultimately would move to the shoreline and then offshore in the Atlantic Ocean as the shoreline erodes underneath the bridges. Thus, unlike the other Parallel Bridge Corridor alternatives, the Phased Approach alternatives (including the Preferred Alternative) would directly affect activities on the beach front, including all of the beach and water activities listed in the previous paragraph.

Discussions with Larry Hardham, President of the Cape Hatteras Anglers Club (personal communication, November 16, 2006), yielded the conclusion that where access remains, the bridges themselves could affect fishing from the beach from the perspective of the type of fish present. Once bridge foundations are in the ocean, the types of fish that congregate around the shore could change in response to the presence of the structure. Certain types of fish that are prevalent today could move to other locations, while other types of fish could be attracted to the structure in the ocean. This could attract some fishermen looking for the kind of fish attracted to the new structure. Striper fishing, for example, which is very popular among fishermen in the fall, could be better when the bridge is in the ocean, as stripers are more prevalent near structures. Fishermen looking for the kind of fish that would move because of the structure would need to look for other places to fish from the shoreline, according to Mr. Hardham.

As noted in Section 4.5.3.1, the Phased Approach alternatives (including the Preferred Alternative) would ultimately eliminate access to Refuge hiking trails and reduce beach access. As the shoreline erodes and the Phased Approach bridges move onto the beach, hiking and other beach activities on the shoreline could still take place, but they would not occur in today's undisturbed natural setting. As the shoreline continues to erode, the structure would move further into the ocean and beach activities would return to their original unimpeded state, except that the structure would be visible in the ocean as it parallels the shoreline at varying distances from the beach (up to 930 feet [283.5 meters] offshore). To the extent that certain sections of the bridged roadway still would be on land or on the beach, beach activities would be affected, but not precluded.

The impacts to surfing would be more severe. Surfers choose their location to surf based upon where the waves break. As the shoreline changes, so too will the location of the best waves on the Refuge for surfing. Like the All Bridge Alternative, the reduction of access associated with the Phased Approach alternatives (including the Preferred Alternative) would increase the distance to access the best waves for surfing or perhaps take them out of a reasonable walking range. This change would be gradual with the Phased Approach alternatives as noted in the section on access above.

Once the Phased Approach alternatives' bridges (including the Preferred Alternative) are in the ocean, the ability to surf in a particular area would be eliminated. According to Julie Leavel of the Outer Banks District of the Eastern Surfers Association (personal communication, November 21, 2006), surfers usually go 50 to 75 feet (15.2 to 22.9 meters) into the ocean and sometimes up to 150 feet (45.7 meters) to find the best waves for surfing. How far out surfers travel into the ocean depends upon where the waves break. The introduction of a bridge structure to the ocean would change how and where the waves break, which would interfere with the swells in such a way that the waves would no longer be conducive for good surfing as is found in certain areas of the Refuge today. This would essentially eliminate surfing in this area. In addition, the presence of bridge piles every 120 feet (36.6 meters) in areas where the bridges would be less than 150 feet (45.7 meters) from shore would be a safety hazard.

4.5.4 Pamlico Sound Recreational Use Impacts

For recreational users of the Pamlico Sound, such as wind surfers, kayakers, and kite boarders, the Pamlico Sound Bridge Corridor would place an obstruction in the Sound as the bridge moves from shore at Rodanthe to a point approximately 5 miles (8 kilometers) west of Hatteras Island where the bridge corridor then would proceed north. The ability of recreational users to pass from one side of the bridge approach to the other, particularly for wind surfers and kite boarders, would be limited by its 140- to 150-foot (42.7- to 45.7-meter) span length between piers and vertical clearance of approximately 10.0 feet (3.1 meters) above mean high water (outside the navigation zone).

The Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives also would place an obstruction in the Sound as the Rodanthe area bridge moves out from shore in the Refuge to a point about 1,500 feet (480 meters) west of Hatteras Island. This bridge would have a 100-foot (30.5- meter) span length between piers and vertical clearance of approximately 10.0 feet (3.1 meters) above mean high water. Because of this bridge's close proximity to the shore, the impacts to recreational users would be more substantial. The Nourishment Alternative and the two Phased Approach alternatives (including the Preferred Alternative) would not affect the use of Pamlico Sound.

Numerous additional opportunities exist for these activities, however. Near the project area, these activities occur primarily south of the replacement bridge corridor alternatives.

Near the northern end of the Pamlico Sound Bridge Corridor, activities such as windsurfing, kayaking, and kite boarding are not common; the Pamlico Sound Bridge Corridor would not affect these non-motorized watercraft activities in this area. This area of the Pamlico Sound is used primarily for fishing and by other commercial and recreational vessels (see Section 4.1.7).

The No-Action Alternative would not affect the use of Pamlico Sound but would remove roadway access across Oregon Inlet to Hatteras Island. This change would dramatically lessen the ability of visitors to reach all recreational resources on Hatteras Island.

4.6 Coastal Conditions

This section discusses the impact of the detailed study alternatives on coastal conditions from the perspective of: inlet migration, profile, and gorge alignment; flooding during major storms; performance of the terminal groin; navigation channel dredging operations; natural overwash; island breach in the Refuge; and off-shore coastal processes (with the Phased Approach alternatives [including the Preferred Alternative]).

4.6.1 Inlet Migration, Profile, and Gorge Alignment

A bridge within the replacement bridge corridor alternatives would have a negligible effect on Oregon Inlet migration, profile, and gorge alignment other than the continued effect of the presence of the terminal groin with the Parallel Bridge Corridor alternatives (including the Preferred Alternative). These processes are driven by the movement of sediment along the ocean shoreline and tidal hydraulics processes within Oregon Inlet. A bridge within the replacement bridge corridor alternatives would represent a very minor additional component in the Oregon Inlet system, especially considering there is already a bridge within the inlet. In any case, storm events that typically cause the major adjustments to the inlet through increased wave activity and water flows would vastly overshadow any minor effects the proposed bridge in Pamlico Sound or across Oregon Inlet might have on inlet processes.

4.6.2 Flooding During Major Storms

All of the replacement bridge corridor alternatives, as well as the existing Bonner Bridge and NC 12, are within the floodplain discussed in Section 3.6.1. In addition, all of the replacement bridge corridor alternatives, as well as the existing Bonner Bridge and NC 12, are partially within coastal flood zones with a velocity hazard because of wave action. According to Federal Emergency Management (FEMA) floodplain maps (Figure 3-4), all of the Parallel Bridge Corridor alternatives would be subjected to wave heights as high as 11 feet (3.4 meters) over Oregon Inlet and in several other locations along the corridor, but could be subjected to wave heights as high as 13 feet (4.0 meters) near the southern end of South Pond. Existing Bonner Bridge and NC 12 also are subject to the same wave heights. The Pamlico Sound Bridge Corridor alternatives would be subjected to wave heights as high as 10 feet (3.0 meters) in Pamlico Sound near their southern terminus in Rodanthe.

4.6.2.1 Significant Encroachment

FHWA policies and procedures for the location and hydraulic design of highway encroachments on floodplains are defined in 23 CFR 650, Subpart A (Location and Hydraulic Design of Encroachments on Floodplains). With respect to floodplain highway encroachments, it is the policy of the FHWA "to avoid significant encroachments, where practicable." According to 23 CFR 650, Subpart A:

> "*Significant encroachment* shall mean a highway encroachment and any direct support of likely base floodplain development that would involve one or more of the following construction or flood-related impacts:
>
> – A significant potential for interruption or termination of a transportation facility which is needed for emergency vehicles or provides a community's only evacuation route;
>
> – A significant risk, or;
>
> – A significant adverse impact on natural and beneficial floodplain values."

<u>*Transportation Facility Interruption*</u>

All of the proposed replacement bridge corridor alternatives, as well as existing NC 12 through the project area, meet the definition of "significant encroachment" in that they include a road at an elevation below the storm surge. This also is true for the balance of Hatteras Island and the development served by NC 12. However, all of the proposed replacement bridge corridor alternatives would reduce the risk of NC 12 overwash and temporary closure within the project area in comparison to the risk that exists today through (depending on the alternative) beach nourishment, road relocation back from the shoreline, and bridging. The use of a bridge to replace parts of the existing NC 12 road with the Pamlico Sound Bridge Corridor, All Bridge, and Phased Approach alternatives (including the Preferred Alternative) would raise those parts of NC 12 above the storm surge. They also would either bypass or bridge potential Hatteras Island breach locations within the project area. All of the bridges, however, ultimately end at existing NC 12 below the storm surge, including the ends of the bridges on Bodie Island and Hatteras Island, and the 2.1- to 2.3-mile (3.3- to 3.7-kilometer) segment of NC 12 unchanged by the Parallel Bridge Corridor alternatives.

Dare County recognizes the risks associated with the storm surge and has an emergency management program that tracks storms and orders the voluntary evacuation of Hatteras Island and the entire Outer Banks prior to a storm surge. Dare County also has a helicopter to transport patients to area hospitals if NC 12 is severed as a result of a storm. NCDOT maintains emergency ferry docks and a channel across Pamlico Sound between Rodanthe and Stumpy Point to provide an alternate route of travel if NC 12 is severed between Rodanthe and Oregon Inlet. NCDOT has the capability and does mobilize equipment needed to begin re-opening NC 12 immediately after a storm passes.

Significant Risk

None of the alternatives would create a significant risk beyond risks associated with development on the Outer Banks that exist today. Risks on the Outer Banks are associated with storms and their consequences. All of the alternatives (including the Preferred Alternative) were developed taking into account the presence of storms and their potential impact on island change and the integrity and operation of the alternatives. The bridge superstructure associated with the replacement bridge corridor alternatives (including the Preferred Alternative) would be elevated above the highest potential water level.

The alternatives do vary in terms of their mitigation of the risk of NC 12 being closed as a result of an island breach. The Pamlico Sound Bridge Corridor alternatives would bypass potential breach locations. The Parallel Bridge Corridor with All Bridge and Phased Approach Rodanthe Bridge (Preferred) alternatives both bridge potential breach locations. Section 4.6.7 discusses in detail the relationship between all of the alternatives and the potential breach locations.

Impact to Beneficial Floodplain Values

Beneficial floodplain values were described in Section 3.6.1. The replacement bridge corridor alternatives would not have a significant adverse impact on natural and beneficial floodplain values.

The piles of the bridge substructure would not affect existing hydraulics, since the size of Pamlico Sound and the low water velocities would combine to create a situation where the small area blocked by the alternatives would not create backwater or adverse hydraulic conditions.

From the perspective of the beneficial floodplain values associated with natural barrier island evolution, as well as the ecological change and habitat creation associated with barrier island evolution, most of the alternatives (including the Preferred Alternative) would benefit these values. Except for the alternatives that involve the retention of the artificial dunes (Parallel Bridge Corridor with Nourishment and to a limited extent the Road North/Bridge South and Phased Approach/Rodanthe Nourishment alternatives), the project alternatives would restore natural shoreline overwash, as discussed in Section 4.7.7.

4.6.2.2 Only Practicable Alternative Finding

According to 23 CFR 650, Subpart A, a proposed action which includes a significant encroachment shall not be approved unless the FHWA finds that the proposed significant encroachment is the only practicable alternative. Practicable replacement bridge corridor alternatives must be within the floodplain because the area to be served, as specified in the project's Statement of Purpose and Need in Chapter 1, is within the floodplain. As such, alternatives that do not involve a significant encroachment were not considered. The replacement bridge corridor alternatives conform to applicable State and local floodplain protection standards because they would not affect the storm surge elevation.

4.6.3 Performance of the Terminal Groin

The performance of the terminal groin would not be affected by any of the replacement bridge corridor alternatives or the No-Action Alternative. With the Pamlico Sound Bridge Corridor and the No-Action Alternative, there would no longer be a bridge landing on the north end of Hatteras Island, so the terminal groin no longer would be needed (the stated purpose for the groin in the USFWS permit that allowed the groin's construction is to protect the south end of Bonner Bridge). If USFWS officials ask the NCDOT to remove the groin following completion of the demolition and removal of Bonner Bridge, the NCDOT and representatives of the USFWS would assess the impacts of groin removal in a separate environmental study, as needed, prior to any final decision to remove the terminal groin.

With the Parallel Bridge Corridor, the terminal groin would need to be retained to protect the road south of the southern terminus of the new Oregon Inlet bridge. The NCDOT would apply for a new permit for any of the Parallel Bridge Corridor alternatives (including the Preferred Alternative). Hydraulic analyses associated with the design of the Parallel Bridge Corridors alternatives that include bridges through the northern part of Hatteras Island would incorporate the potential for either the eventual terminal groin removal or the groin's flanking. The potential affect of groin removal or flanking on Hatteras Island is addressed in Section 3.6.3.5.

4.6.4 Navigation Channel Dredging Operations

A replacement bridge within either of the replacement bridge corridors would make navigation channel dredging operations easier to undertake by reducing the frequency and size of dredging operations from what is required today.

The proposed bridge in either corridor would have one navigation zone (see Section 2.9.2) for boats passing through Oregon Inlet.

The proposed bridge in the Pamlico Sound Bridge Corridor and its navigation zone would be west of Oregon Inlet in Pamlico Sound, where sand movement is less. This change alone could reduce the amount of dredging required to maintain a channel through Oregon Inlet compared to the existing situation with Bonner Bridge. The location of the zone would be determined in coordination with the USACE. The USACE currently maintains the Oregon Inlet Channel/Old House Channel. As discussed in Section 3.6.3, movement of Oregon Inlet over the life of the proposed bridge could shift the natural channel gorge to the Davis Channel area. This eventuality would be addressed in conversations with the USACE. The NCDOT's goal would be to place the navigation zone of a bridge in the Pamlico Sound Bridge Corridor in a location that facilitates channel maintenance over the full life of the bridge.

A bridge across Oregon Inlet in the Parallel Bridge Corridor would have a series of navigation spans (or zone) with a minimum 200 feet (61 meters) of horizontal clearance. The main navigation span of Bonner Bridge has 130 feet (39.6 meters) of navigation clearance. The navigation zone on Bonner Bridge is 504 feet (153.6 meters). With the two Phased Approach alternatives (including the Preferred Alternative), that navigation zone would be 3,300 feet (1,006 meters) long. With the other Parallel Bridge Corridor alternatives, the zone would extend across the width of the inlet (up to 5,000 feet [1,524 meters]). The shorter distance with the Phased Approach alternatives is necessitated by the inclusion of ramps accessing the north end of Hatteras Island from the alternative's bridges. Bonner Bridge is limited to three navigation spans. A longer navigation zone provided by the Parallel Bridge Corridor alternatives would allow the dredged navigation channel to be placed more readily at the natural inlet gorge and likely would reduce the amount of dredging at both the bridge and within the throat of the inlet, where a natural gorge exists. This benefit would be greater with the longer navigation zone associated with the Nourishment, Road North/Bridge South, and All Bridge alternatives.

With all alternatives, some additional dredging west of existing Bonner Bridge could be required to connect the natural inlet gorge to the channels maintained within Pamlico Sound in cases where the natural inlet gorge moves well beyond the location of Bonner Bridge navigation spans. In those cases, the USACE would have to determine, based on experience, whether it would be easier or more efficient to extend the back channels by dredging to meet the natural inlet gorge, or to force the inlet channel to take a different path than it might otherwise take on its own. The best strategy to be followed at any given time would depend on the complex and ever changing variation in shoal and channel locations that will naturally occur on the soundside of the Parallel Bridge Corridor. The greater latitude in potential channel locations that the Parallel Bridge Corridor would allow, however, would result in a net decrease in the dredging effort within the inlet.

The ocean bar channel dredging, which accounts for the majority of the dredging at Oregon Inlet, would not be affected by either of the replacement bridge corridor alternatives or the No-Action Alternative.

4.6.5 Natural Overwash

Overwash is the natural landward transport of sand and water. The deposit is called a washover fan. Overwash is a storm generated process that serves a critical function in barrier island evolution, as it is the source of sand for the soundside of the island. In this way, sand is removed from the beach and dune system and builds up on the soundside. The length of penetration of a washover fan is a function of the sediment supply, storm characteristics, and topography. Overwash occurs where the island is low relative to the storm surge/wave run-up and/or where breaks in the dune system create conduits for flow to be funneled from the oceanside landward. The dune breaks may be present before the storm or may develop during the storm as the dune erodes from the oceanside. The washover fan provides not only elevation through sediment deposition, but it creates new habitat by covering existing habitat and providing a bare sand flat for new populations. Removing sand from the washover interrupts the process of barrier island rollover by putting the sand back in the dune system.

As is evident in NC 12 maintenance activity data from NCDOT, overwash has become a substantial factor in determining the need for maintenance. Twelve cleanup projects since 2003 have been attributed to overwash, primarily in the Canal Zone, Sandbag, and Rodanthe ‘S’ Curves hot spots. In order to minimize the impact of NC 12 on overwash processes, the road could either be moved landward beyond the point of expected washover or elevated. The following alternatives would minimize the affect on overwash fans through at least 2060:

- Pamlico Sound Bridge Corridor alternatives, since they remove NC 12 from Hatteras Island north of Rodanthe.
- Parallel Bridge Corridor with Road North/Bridge South, since it moves NC 12 beyond the 2060 high erosion shoreline at the north end of Hatteras Island and places NC 12 on a bridge at the south end of the project area, with the exception of three locations where dunes are proposed late in the project’s design life.

- Parallel Bridge Corridor with All Bridge and Phased Approach alternatives (including the Preferred Alternative) (in bridging areas) by placing NC 12 on a bridge through most of the project area. In the case of the Phased Approach, interruption of overwash fans could occur until each Phase is implemented, as discussed in Section 4.6.8.6.

With NC 12 on bridges, the piles supporting the structure would interfere locally with the overwash; however, the overall structure would be very porous, and the overall impact should be restricted to the areas around the piles. The overwash would be streamlined between the pilings in a group where the velocities would be slightly greater than the velocities away from the group because of flow constriction. This might serve to create points of greater landward penetration resulting from higher flow velocities, which would correspond to each bridge foundation. There also would be some local scour around the piles providing an additional source of sand for the washover fan. Once the road is elevated, there would be no need to remove the sand from the washover and rebuild the dune.

The alternatives that would involve nourishment and extensive dune building also would interrupt the overwash process. When overwash occurs, the replacement of sand on the dunes would interrupt the overwash process; the impact could be reduced by removing the sand from the road (defined to be pavement and easement), but leaving the washover fan created landward of the NC 12 right-of-way. Not as much sand then would be available for post storm dune repairs, thereby leaving the road more vulnerable to overwash in the next event. The road could then require more extensive post storm repairs as a result of the weir flow damage, in which the pavement acts like a weir (dam), and the high velocities scour the sand on the landward side of the highway.

4.6.6 Accelerated Sea Level Rise

Section 3.6.3.3 noted that historic sea level rise is accounted for in the project's shoreline forecasts and described in two potential scenarios for accelerated sea level rise (scenarios 2 and 3). As a result of recently published research on global climate change and sea level rise, FHWA wanted to consider how the new information on global climate change may affect the development and implementation of this project. FHWA hosted a Peer Exchange workshop on May 14 to 15, 2008, in Raleigh, North Carolina. The peer exchange included a panel of coastal engineering and geology experts with knowledge of the local area, as well as experts with knowledge of recent research on global climate change. The objectives of the workshop were to identify recent scientific research on global climate change effects and to relate how that research can help inform the development of the Bonner Bridge Replacement project. The outcome of the workshop was to identify whether or not any analytical gaps exist between the NC 12 vulnerability analysis and shoreline erosion forecast conducted for the project (described in Section 3.6.3.1) compared to recent and relevant research on global climate change. The workshop included presentations on the following: the overall project; the technical report *Bonner Bridge Replacement – Parallel Bridge Corridor with NC 12 Maintenance – Shoreline Change and Stabilization Analysis* (Overton and Fisher, June 2005); relevant vulnerability studies for NC 12; and potential impacts of climate change for both the entire US Transportation System and the specific project area.

The analysis conducted for the project in the technical report *Bonner Bridge Replacement – Parallel Bridge Corridor with NC 12 Maintenance – Shoreline Change and Stabilization Analysis* (Overton and Fisher, June 2005) and described in Section 3.6.3.1 predicts future changes in the shoreline based on the historical record. Panelists generally agreed that the analysis's high erosion results of shoreline position may account for a portion of sea level rise caused by future changes in climate. In addition to this analysis, past sea level rise in one location and a range of potential future sea level rise scenarios for the mid-Atlantic coast were also considered. There was consensus that the current global sea level rise analytical models are not fully developed to predict local effects. The wide range of future sea level rise information considered illustrates the uncertainty associated with estimating future sea levels and shoreline locations. Panelists generally agreed that the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) with the island monitoring program outlined in Section 2.10.2.5 is the most practical method for carrying out the project with the given constraints, in part because it provides the opportunity to review and incorporate new analysis prior to commencement of each phase.

The Pamlico Sound Bridge Corridor would bypass the northern part of Hatteras Island and would likely be unaffected by accelerated shoreline erosion or breaches resulting from accelerated sea level rise. However, if Hatteras Island were to be fragmented, the existing hydrodynamics in Pamlico Sound could change, including the location of the natural navigation channel.

Accelerated sea level rise under scenario 2 would affect the Parallel Bridge Corridor alternatives as follows:

- <u>With Nourishment</u>. Increased demand for nourishment material (larger and/or more frequent projects). Erosion rates could increase such that beach nourishment would be practicably ineffective.

- <u>With Road North/Bridge South</u>. Possible shorter design life in the roadway section if the shoreline erodes faster than the project's high erosion forecast. The bridge component would bridge two of the three potential island breach areas.

- <u>With All Bridge</u>. It is possible that the bridges expected to remain over land would be in the ocean prior to 2060 if the shoreline migrates faster than the project's high erosion forecast. All five potential breach locations would be bridged.

- <u>With Phased Approach/Rodanthe Bridge (Preferred)</u>. The uncertainties in determining exact location and timing of shoreline change would be addressed by designing an appropriate monitoring plan, as described in Section 2.10.2.5. This alternative would bridge the five potential breach locations. Four of the five potential breach locations would be bridged in Phase II and the fifth would be bridged in Phase III. So while the shoreline predictions do not incorporate the increase in sea level rise used in scenario 2, the overall approach of the Phased Approach/Rodanthe Bridge Alternative (Preferred) plans for conditions that will occur under scenario 2.

- <u>With Phased Approach/Rodanthe Nourishment</u>. The effects of the Phased Approach/Rodanthe Bridge Alternative (Preferred) are still applicable, except in the nourishment area, where the effects would be similar to the Nourishment Alternative. This alternative would bridge three of the five potential breach locations, but would not bridge the location in the Rodanthe area where a breach is considered most likely to occur.

If scenario 3 occurs, it could be argued that the processes reflected in the shoreline change rates used in project planning will change substantially, and past shoreline trends cannot predict future behavior. Since future monitoring is planned with the Phased Approach/Rodanthe Bridge Alternative (Preferred), one outcome of the monitoring could be to assess the predictions and develop new indicators as new information allows. The monitoring plan associated with the

Phased Approach/Rodanthe Bridge Alternative (Preferred) would provide important information since data collection would be in the projected period of accelerated sea level rise. Indicators of change could potentially be developed from the monitoring information and be used to modify Phase II-IV and allow adaptation in the design to accommodate the new information. Both the extent of bridging and timing could need to be modified. Monitoring of areas currently considered stable would be necessary because of the potential for changing processes.

Worst-case imagined scenarios, such as scenario 3 described in Section 3.6.3.3, suggest substantial island disintegration with substantial change in the hydrodynamics (the hydraulic exchange) between sound and ocean. Thus, it is important to keep in mind that this dramatic change in trends would affect not just the project area but the entire barrier island system.

4.6.7 Island Breach in the Pea Island National Wildlife Refuge

As indicated in Section 3.6.3.4, the potential exists in five locations for a breach to occur in Hatteras Island as a result of a storm between now and 2060 (though only the Rodanthe breach is likely). The word “breach” is used in this discussion rather than the word “inlet” because if a breach were to occur, it would likely close eventually (although not necessarily immediately) and likely would not become a long-term phenomenon like Oregon Inlet.

4.6.7.1 Island Breach at Site 3

Based on the opinions of the expert panel described in Section 3.6.3.2, the location most likely for a breach to occur would be at the southern end of the Refuge just north of Rodanthe (Site 3 shown on Figure E-1 in Appendix E). A breach at this location would not be of concern with the Pamlico Sound Bridge Corridor because the area would be bypassed by the bridge. Though the potential for such a breach would have to be taken into account in bridge location and foundation design, a breach at this location also would not be a concern with the Road North/Bridge South and All Bridge alternatives with the Parallel Bridge Corridor. The Rodanthe area bridge associated with these alternatives would span the potential breach location. The nourishment program associated with the Parallel Bridge Corridor with Nourishment Alternative would reduce the risk of a breach occurring, but it still would remain a possibility. The Phased Approach/Rodanthe Bridge Alternative (Preferred) also would bridge Site 3. The Phased Approach/Rodanthe Nourishment Alternative would bridge approximately 65 percent of Site 3, while nourishment would occur within the remaining 35 percent. Again, nourishment would reduce the risk of a breach occurring. However, the design of the nourishment program for the Phased Approach/Rodanthe Nourishment Alternative is not intended to provide protection throughout the potential breach location; thus breaching remains a possibility with this alternative.

With the Parallel Bridge Corridor with Nourishment or Phased Approach/Rodanthe Nourishment alternative, it is assumed the State of North Carolina would close a breach in the Rodanthe area to maintain the continuity of NC 12. Using the experience of closing the breach that formed just north of Hatteras Village near the southern end of Hatteras Island in 2003, it is estimated that between 400,000 and 500,000 cubic yards (306,000 and 382,000 cubic meters) of sand would be required to close a breach at the Rodanthe site. This estimate was not based upon specific dimensions for this potential breach, but rather it was based on the assumption that the breach would be similar to, but somewhat larger than, the Hatteras Village breach. A breach also could be bridged.

The expert panel considered two potential borrow areas for the sand to close a breach at the south end of the Refuge: offshore of Rodanthe and the outer bar at Oregon Inlet. Information available related to the ocean bar indicates that sand from that location is likely to be acceptable in terms of its characteristics and volume to use to close a breach. The borrow site offshore of Rodanthe needs additional field work, including sediment cores, to confirm there is sand of acceptable characteristics and volume to be used to close a breach.

Based upon the 2003 experience at the Hatteras Village breach, the expert panel agreed that $10.00 per cubic yard ($7.60 per cubic meter) is a reasonable estimate for sand taken from the offshore borrow site at Rodanthe. For sand taken from the outer bar, because of the longer pumping distance, $15.00 per cubic yard ($11.50 per cubic meter) was the suggested unit cost estimate. Assuming 500,000 cubic yards (382,000 cubic meters) to fill a breach, an additional 30 percent of over fill (150,000 cubic yards [115,000 cubic meters]) because of multiple uncertainties, design and environmental assessment costs of $500,000, and an additional four percent for construction supervision, the total cost for closing a breach is estimated to range between:

- $7.28 million if the sand comes from the offshore site at Rodanthe, and
- $10.66 million if the sand comes from the ocean bar near Oregon Inlet.

The Hatteras Village breach was closed in approximately 60 days. This short time was in large part because of the declared emergency status of the project. While the expert panel agreed that a breach at Rodanthe would also be an emergency, the generally higher wave climate and the logistics of moving sand from either of the two potential borrow sites could result in a longer time to achieve closure. The expert panel considered two scenarios: 1) where no prior work had been done before the breach opened, and 2) where most of the design, permitting, and borrow material determination had been done in advance.

For the first scenario, where there was no advance preparation, the expert panel concluded that it might take as long as six months to close the breach. Several factors account for this longer time than for the Hatteras Village breach. Both the offshore borrow site and the inlet borrow site would be logistically more difficult to use than the borrow site at Hatteras Village. The dredges (probably two hopper dredges) would be working in the ocean (as opposed to Pamlico Sound), and weather delays would be likely. If the inlet borrow site were used, one or perhaps two booster pumps would be needed to move the material the approximately 12-mile (19.3-kilometer) distance to the breach. Substantial fieldwork would be required to map the borrow site and identify an adequate quantity of compatible material. Again, this fieldwork would take place at an offshore location during tropical storm season. Because the breach would be in the Refuge, additional environmental issues would potentially cause delays. All of these factors, plus other unforeseen problems, would probably lead to the longer time required to close the breach.

For the second scenario, with most of the preparation done in advance, the expert panel estimated that it would take up to three months to close the breach. This 90-day estimate is still a month longer than the recent experience at Hatteras Village. This is largely due to the expert panel's concern about the additional difficulties of using either an inlet source or an offshore borrow site, as well as the higher wave and storm exposure for this portion of the Outer Banks.

The expert panel suggested that advanced data gathering for the closure of a breach at the southern end of the Refuge would be prudent. This would be the case both in the near-term, until the proposed replacement project could be completed, or as a part of long-term planning if the Parallel Bridge Corridor with Nourishment or Phased Approach/Rodanthe Nourishment Alternative were implemented. Such advanced data gathering also should include the source of funding and a decision on whether the work should simply close the breach or use a wider configuration. The post-closure island cross-section (width) at the Hatteras Village breach is smaller than the island cross-section prior to Hurricane Isabel. Thus, the Hatteras site is more vulnerable now than it was prior to the breach. This smaller cross-section is in part related to the source of funding to close the breach. A substantial portion of the cost for closing the breach was covered by the FHWA, which included limits that precluded building up the cross-section of the island to make it less vulnerable.

4.6.7.2 Island Breaches at Sites 1, 2, and 4

The potential for a breach to occur at these three locations between now and 2060 is considered minimal (see Section 3.6.3.4), with the potential being somewhat greater south of the Refuge's ponds at the location of the former New Inlet. The Pamlico Sound Bridge Corridor would bypass all of these sites. The Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) and with All Bridge Alternative would also bridge these sites. The Parallel Bridge Corridor with Road North/Bridge South Alternative would bridge only Site 1. The nourishment program associated with the Parallel Bridge Corridor with Nourishment Alternative would reduce the risk of a breach occurring, but it still would remain a possibility.

4.6.7.3 Island Breach at Site 5

Section 3.6.3.4 contains information related to the potential for a breach to occur near Oregon Inlet (potential breach Site 5). It describes the potential effect of soundside shoreline erosion, the presence of the Davis Slough channel behind Hatteras Island, and oceanside accretion. It is stated that a breach at Site 5 that isolates the terminal groin could cause substantial changes in the geomorphology (development of the land forms) around Oregon Inlet. It is assumed for this study that no mitigating activity will occur to prevent continued "inner bank" erosion. Therefore, the potential for soundside erosion to contribute to the formation of an inlet near the terminal groin that is deeper and more permanent than might occur elsewhere in the project area was taken into consideration during the development of the two Phased Approach alternatives (including the Preferred Alternative) by assuming larger and deeper bridge piles. This approach also could be taken with the Parallel Bridge Corridor with All Bridge Alternative. The discussion of the Site 5 breach relates to the various bridge alternatives evaluated in this FEIS in the following ways:

- <u>Pamlico Sound Bridge Corridor</u>. This corridor would bypass the north end of Hatteras Island; therefore, a breach near Oregon Inlet would not affect the bridge.

- <u>Parallel Bridge Corridor with Nourishment Alternative</u>. As noted in Section 3.6.3.4, nourishment reduces the vulnerability of this location to a breach because of ocean overwash. However, nourishment would not mitigate the risk from soundside erosion. If a breach were to occur, even though the likelihood is minimal, NC 12 would be severed with this alternative. In addition, as noted in Section 3.6.3.4, a breach that completely isolates the terminal groin would be difficult to fill with sand and keep closed. The Oregon Inlet bridge would need to be extended in order to keep NC 12 open.

- <u>Parallel Bridge Corridor with Road North/Bridge South Alternative</u>. Like the Nourishment Alternative, this alternative would involve maintaining a road at the north end of Hatteras Island. Thus, the outcome of a breach for this alternative, however minimal the risk, would be similar to the Nourishment Alternative. The additional reduction in the potential for a breach offered by nourishment to reduce the vulnerability of this location to a breach would not occur with this alternative because the Road North/Bridge South Alternative includes no nourishment or dune maintenance.

- Parallel Bridge Corridor with All Bridge Alternative. This alternative would generally bridge the potential breach location at the north end of Hatteras Island. The design assumptions for the alternative presented in this FEIS would have two limitations in terms of the impact of a breach. First, the foundation assumptions included in the cost estimates for this alternative are lighter and shallower than those for the Phased Approach alternatives (including the Preferred Alternative), since they presume that the bridge would cross land and not be subjected to a breach, particularly one that would be deep and permanent as it competes hydraulically with Oregon Inlet. The same foundation currently assumed for the Phased Approach alternatives (including the Preferred Alternative), however, could be assumed for this alternative at additional cost. Second, this alternative assumes that access to the Refuge at the north end of Hatteras Island would be via a surface road. Such a road could be affected by a breach, however minimal the risk, with the same effects as described for the Nourishment Alternative. Again, the same access strategy assumed for the Phased Approach alternatives (including the Preferred Alternative) (i.e., bridge with ramps to the ground) could be assumed for this alternative at additional cost.

- Parallel Bridge Corridor with Phased Approach Alternatives (including the Preferred Alternative). This alternative would be the best suited to accommodate a breach at the north end of Hatteras Island, in that larger and deeper bridge foundations are presumed and the potential breach location would be fully bridged. Thus, in terms of the Parallel Bridge Corridor alternatives, this alternative would be best suited to accommodate a breach, however minimal the risk, should one occur at the north end of Hatteras Island. This alternative would not, however, be at navigation height. Thus, if Davis Slough became the more-preferred flow pattern between the ocean and Pamlico Sound, as it could if the terminal groin were removed (see Section 3.6.3.5 under "Long-Term Impacts of the Removal of the Terminal Groin"), dredging the Oregon Inlet channel could become more challenging since the dredged channel would have to remain in Oregon Inlet. The channel could not be moved to a location south of the terminal groin because of the presence of the bridge.

Physical modeling of the hydraulics of the Oregon Inlet area could provide additional insight into the degree to which waves and/or current control the erosion processes and the risk of inlet formation. Modeling also would be useful in developing mechanisms for mitigating that risk, particularly as it relates to the design of the bridges associated with the All Bridge and Phased Approach alternatives (including the Preferred Alternative). Such modeling would be conducted as a part of design development for the Phased Approach/Rodanthe Bridge Alternative (Preferred), as discussed in Section 2.10.1.2 under "Wave Energy, Storm Surge, and Scour."

4.6.8 Off-Shore Coastal Processes with the Phased Approach Alternatives

The two Phased Approach alternatives (including the Preferred Alternative) add several additional considerations related to coastal processes that are addressed in this section. They relate to the effect of bridge piles in the ocean on scour, longshore sediment transport, wave climate, beach erosion, breach formation, and short-term NC 12 maintenance needs until Phases II to IV are implemented.

The coastal zone potentially affected by the two Phased Approach alternatives (including the Preferred Alternative) is generally depicted as being made up of four distinct regions. Using nomenclature defined in the USACE *Coastal Engineering Manual*, (USACE, 2002) these zones are referred to as upland, shore, shoreface, and offshore. The upland zone is landward of the toe of the dune, inclusive of the dune. The shore extends from the mean low water (MLW) to the upper extent of storm damage (toe of the dune) and is divided into the backshore and the foreshore. The backshore is from the MHW to the toe of the dune and the foreshore is between the MHW and MLW. The shoreface extends from MLW to the flattened slope seaward of the offshore (sand) bar and is referred to as the nearshore. The offshore is seaward of the nearshore.

The upland area includes the dune field. The dune (in the absence of human intervention) is built, enlarged, or altered by wind-blown sand transport. Onshore winds provide the fuel for transport, and a wide dry beach supplies the source. The presence of obstructions to the wind (vegetation, topographic change, man made structures) lowers the wind energy available for transport and "traps the sand," resulting in the formation, growth, and migration of sand dunes. The upland area also is affected by larger storms in which water overwash of the dune field occurs. The characteristics of sediment (e.g., sand) transport during these events is a function of the hydraulics (water movement) of the event. Sediment can be transported landward, creating overwash fans of sediment. If however, the water level on the Pamlico Sound side is elevated, the flow of water from the soundside to the ocean side can sweep quantities of sand seaward. This latter phenomena is associated with inlet breaching.

The backshore, characterized as being landward of the MHW, is typically the dry beach. Therefore, the backshore also is subjected to wind blown transport. It is expected that the backshore loses sand to the dune when onshore winds dry the beach and move sand landward. In addition, the backshore is affected by wave action during high water events or storms. Sand can either be transported onto the backshore or eroded from the backshore, depending on the wave characteristics. The upward limit of transport is related to the wave run-up limit, that is, typically long period waves transport sand landward and short period waves erode the backshore.

The foreshore is subjected to the action of swash (water movement associated with waves and the tide) on a daily basis and thus substantial volumes of sand are transported onshore and offshore daily. Sediment is continually reworked and transport is dependent on the rising and falling of the tide and the wave conditions.

The nearshore zone extends from the “breaker zone” of the shore, through the surf zone and seaward of the offshore (sand) bar. Waves initially break over the offshore bar, reform, and break again just offshore of the MLW (breaker zone). This is a zone of high energy dissipation (because of wave breaking) and potentially a zone of substantial modification of the beach profile during storm events.

The offshore zone is assumed to be seaward of the wave breakers, and while transport can occur, much less modification of the profile is observed during storm events.

Nearshore currents act to transport sand in the longshore direction, generally from north to south. Waves breaking obliquely (neither perpendicular nor parallel) to the shoreline create a momentum flux (change) that drives longshore currents. Wind also can contribute to the development of these currents. These currents flow parallel to the shore and are strongest in the surf zone, decaying substantially once seaward of the breakers.

4.6.8.1 Effect of Bridge Piles on Scour

The extent of scour in the ocean bottom associated with the bridges built as a part of Phases II to IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be dependent on:

- The length of bridge in the ocean by year;
- Whether or not bridge is in or out of the area where the ocean waves break (breaker area); and
- The size and proximity of the individual piles that make up the bridge's foundation.

The portions of Phased Approach/Rodanthe Bridge Alternative (Preferred) in the ocean would create a total scour area on the ocean bottom as large as approximately 15.6 acres (6.3 hectares) by 2060. The displaced volume of sand in 2060 would be as large as approximately 152,678 cubic yards (116,714 cubic meters). The following paragraphs describe how these findings were reached.

Length of Bridge in Ocean (Phases II to IV)

Assuming both the high erosion shoreline (shown in Figure E-1 of Appendix E) modeled for the development and assessment Bonner Bridge project alternatives and the estimated completion of Phase II in 2015, Phase III in 2020, and Phase IV in 2030, the length of the bridge in the ocean would be:

- 2020: 1.6 miles (2.6 kilometers);
- 2030: 2.8 miles (4.5 kilometers);
- 2040: 4.2 miles (6.8 kilometers);
- 2050: 5.2 miles (8.4 kilometers); and
- 2060: 5.9 miles (9.5 kilometers).

Breaker Area

Scour depth in breaking waves has been studied in the lab and observed in the field at two research piers (USACE Field Research Facility at Duck, North Carolina and by Bayram and Laursen using data from a research pier in Japan). These studies found that, in the breaker area, scour occurred around piles, but that the high turbulence produced by breaking waves and the subsequent large volumes of sediment transport acted to fill in these holes landward of the breaking point. Thus, scour holes are expected to occur in association with Phases II to IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred) only once they are seaward of the wave breaking point. Landward of the breaker, the piles could alter the development of a "barred" profile and contribute to the formation of rip currents, features that occur naturally along the coast but have been noted occurring in relationship to piers.

To determine the depth at which the waves break (depth of breaking), two conditions were investigated: 1) the yearly average conditions (average of the depth at breaking for January through December) and 2) the average depth of breaking during the primary fish transport season (February through May). These depths were applied to offshore profiles taken in 2004 at 89 locations in the project area. For each station, the distance from mean high water (the shoreline) to the depth of breaking was determined. In the case of an offshore (sand) bar that was higher than the depth of breaking, the depth of breaking on the seaward side of the bar was taken. In these locations, waves will likely reform and break again closer to shore. In general the distance to the breaking depth from the shoreline is greater in the northern part of the project area (450 to 500 feet or 137 to 152 meters). These distances decrease to 200 to 300 feet (61 to 91 meters) further south with the exception of the hot spot in the Rodanthe area. The distance offshore in the Rodanthe area is controlled by the steep foreshore and the presence of an offshore bar.

In addition, the zone of impact of the wave generated longshore current was delineated relative to the depth of breaking. The longshore current is a function of the breaking wave height and the wave breaker angle to the shore. The distance to breaking described in the paragraph above was multiplied by 2 as a conservative estimate of this type of influence.

An overlay of the position of Phases II to IV, projected high erosion shoreline positions, and the width of the breaker zone resulted in the characterization of the project in relation to the breaker zone shown in Table 4-10 from 2020 to 2060.

Table 4-10. Bridge Length Inside and Outside the Breaker by Year

Location	Phase	in feet (meters)									
		2020		2030		2040		2050		2060	
Inside the Breaker											
Rodanthe/'S' Curves Hot Spot	II	4,625 1,445	(1,410) (441)	6,450	(1,966)	4,750	(1,448)	3,749	(1,143)	1,575	(480)
New Inlet/South Ponds	III/IV					2,173	(663)	3,208	(978)	3,779	(1,152)
Visitor Center	II			2,328	(710)	3,939	(1,201)	5,553	(1,693)	5,221	(1,592)
North Ponds	IV			262	(80)	1,925 431	(587) (131)	3,878	(1,182)	4,287	(1,307)
Canal Zone and Sandbag Hot Spots	II	2,120	(646)	2,649	(808)	3,632	(1,107)	3,554	(1,084)	2,851	(869)
TOTAL		8,190	(2,497)	11,689	(3,564)	16,850	(5,137)	19,942	(6,080)	17,713	(5,400)
Outside the Breaker											
Rodanthe/'S' Curves Hot Spot	II			2,874	(876)	5,230	(1,595)	6,791	(2,070)	9,471	(2,888)
New Inlet/South Ponds	III/IV										
Visitor Center	II									2,316	(706)
North Ponds	IV										
Canal Zone and Sandbag Hot Spots	II							741	(226)	1,860	(567)
TOTAL				2,874	(876)	5,230	(1,595)	7,532	(2,296)	13,647	(4,161)

Note: Where two numbers are shown in a single location, it indicates that two separate bridge segments are in the water inside the breaker area.

Pier Assumptions

The scour analysis assumed that the pier configuration in the Sandbag and Canal Zone hot spot areas (beginning approximately at the north end of the Refuge's ponds and included in Phase II) would consist of eight piles each arranged in a 2x4 configuration. The piles were assumed to be 54-inch (137-centimeter) cylinder piles (circular cross-sections). The piles for each pier would be placed within a 21-foot x 48-foot (6.4-meter to 14.6-meter) area. For the rest of the project, four pier configurations were considered:

1. Eight piles each arranged in a 2x4 configuration using 30-inch (76.2 centimeter) square piles in an area 15 feet x 48 feet (4.6 meters x 14.6 meters);

2. Three groups of four 20-inch (50.8 centimeter) square piles arranged in a 2x8 configuration in an area 10 feet x 36 feet (3.0 meters x 11.0 meters);

3. Four 6-foot (1.8-meter) cylindrical piles arranged in a linear (1x4) configuration in an area 10 feet x 36 feet (3.0 meters x 11.0 meters); and

4. Eight 4-foot (1.2-meter) cylindrical piles arranged in a 2x4 configuration in an area 10 feet x 36 feet (3.0 meters x 11.0 meters).

The configuration at the northern end of Hatteras Island and the configuration for the rest of the project reflect the representative description of the Phased Approach/Rodanthe Bridge Alternative (Preferred) presented in Section 2.10.2.4. Alternate configurations are considered to determine if scour holes would be substantially different in area with different configurations. It was assumed that the material scoured was sand.

Scour Analysis

When a vertical cylinder (pile) is placed in a uniform flow field (waves and current), the flow will be modified as the water and the pile interact, which can result in scour of the ocean bottom. The scour analysis looked at the potential depth and area of scour around both individual piles in a pier and the groups of piles that make up the pier.

Scour depths were calculated in three locations along Phase II to IV: the Canal Zone Hot Spot area (north end of the project on Hatteras Island), the Refuge Visitor Center area (middle of the project area), and in the 'S' Curves Hot Spot area (south end of the project area). Three locations were examined to determine if scour depths would substantially vary across the project area. Scour also was calculated by month to determine if there was substantial seasonal variation. The scour depths in each case were similar.

The seasonal range of individual pile scour depth for the three locations is:

- 'S' Curves: 3.9 to 4.3 feet (1.2 to 1.3 meters);
- Visitor Center: 4.1 to 4.7 feet (1.2 to 1.4 meters); and
- Canal Zone: 3.9 to 5.0 feet (1.2 to 1.5 meters).

The deepest holes all occurred in September.

Increased scour around an entire group of piles has been observed to be a general lowering of the bed around the group to depths greater than for individual piles. This group scour is a function of the increase in velocity between the piles within the gap and the turbulence generated by the piles. When analyzing scour depths of groups, seasonal depth ranges found were:

- 'S' Curves: 7.3 to 8.7 feet (2.2 to 2.7 meters);
- Visitor Center: 8.2 to 9.4 feet (2.5 to 2.9 meters); and
- Canal Zone: 7.9 to 9.9 feet (2.4 to 3.0 meters).

Again, the deepest holes all occurred in September. Given that group scour results in greater depth of scour, the rest of the scour analysis focused on group scour.

The area affected by group scour was determined for two scenarios. In the first, the long side of the area scoured is aligned in the long shore direction (roughly parallel with the project). Under this scenario, the group scour associated with one pier (group of piles) would overlap with the next with an assumed pier spacing of 120 feet. In the second scenario, it was assumed that the area scoured was not aligned such that the group scour holes overlap. Scenario two would result in the larger area of effect. Volume is computed for the non-overlapping case so that the maximum impact for each pier assumption is reported.

Results

For the foundations south of the Canal Zone Hot Spot, Foundation Alternatives 1 and 2 above would result in the maximum and minimum scour holes impact, respectively, of the four alternative pile designs considered. Scour area and volume estimates for these alternatives and the Canal Zone area foundation are presented in Table 4-11 and Table 4-12, respectively.

The smaller pile size (20 inches [50.8 centimeters]) and smaller footprint (10 feet x 36 feet [3.0 meters x 11.0 meters]) of Foundation Alternative 2 would yield the smallest scour areas, as would be expected for the smallest pile size and smaller footprint area.

Table 4-11. Area Affected by Scour by Location and Year[1]

	Canal Zone Hot Spot in acres (hectares)		Visitor Center Area in acres (hectares)		'S' Curves Hot Spot in acres (hectares)	
	Overlap	No Overlap	Overlap	No Overlap	Overlap	No Overlap
			Visitor Center/'S' Foundation Alternative 1			
2030	0.0	0.0	0.0	0.0	4.1 (1.7)	4.6 (1.9)
2040	0.0	0.0	0.0	0.0	7.6 (3.1)	8.6 (3.5)
2050	1.3 (0.5)	1.5 (0.6)	0.0	0.0	9.9 (4.0)	11.2 (4.5)
2060	3.1 (1.3)	3.8 (1.5)	3.6 (1.5)	4.3 (1.7)	13.8 (5.6)	15.6 (6.3)
			Visitor Center/'S' Foundation Alternative 2			
2030	0.0	0.0	0.0	0.0	3.1 (1.3)	3.1 (1.3)
2040	0.0	0.0	0.0	0.0	5.7 (2.3)	5.9 (2.4)
2050	1.3 (0.5)	1.5 (0.6)	0.0	0.0	7.5 (3.0)	7.6 (3.1)
2060	3.1 (1.3)	3.8 (1.5)	2.7 (1.1)	2.8 (1.1)	10.4 (4.2)	10.6 (4.3)

[1] The area affected by group scour was determined for two scenarios. In the first, the long side of the area scoured is aligned in the long shore direction (roughly parallel with the project). Under this scenario, the group scour associated with one pier (group of piles) would overlap with the next with an assumed pier spacing of 120 feet (36.6 meters). In the second scenario, it was assumed that the area scoured was not aligned such that the group scour holes overlap. Scenario two would result in the larger area of effect.

Table 4-12. Volumes of Sand Displaced by Scour

	in cubic yards (cubic meters)			
	Canal Zone Hot Spot	Visitor Center Area	'S' Curves Hot Spot	Total
		Visitor Center/'S' Foundation Alternative 1		
2030	0.0	0.0	29,083 (22,236)	29,083 (22,236)
2040	0.0	0.0	54,372 (41,570)	54,372 (41,570)
2050	10,126 (7,742)	0.0	70,810 (54,138)	80,937 (61,881)
2060	25,315 (19,355)	28,733 (21,968)	98,629 (75,407)	152,678 (116,731)
		Visitor Center/'S' Foundation Alternative 2		
2030	0.0	0.0	16,862 (12,892)	16,862 (12,892)
2040	0.0	0.0	31,525 (24,103)	31,525 (24,103)
2050	10,126 (7,741)	0.0	41,055 (31,389)	51,182 (39,131)
2060	25,315 (19,355)	15,618 (11,941)	57,184 (43,720)	98,118 (75,017)

The volume of sand displaced in the areas is approximated based on the assumed geometry of the hole and is shown in Table 4-12. The higher no overlap acres are assumed. The total volume of sand displaced by scour by 2060 would be between 100,000 cubic yards (76,455 cubic meters) and 153, 000 cubic yards (116,977 cubic meters). This is roughly 50 to 75 percent of the 200,000 cubic yards (159,911 cubic meters) of sand that NCDOT plans to remove from the terminal groin fillet in 2008 to replenish the beach berm in the 'S' Curves Hot Spot area. The net littoral sand transport to the south around Oregon Inlet is estimated to be about 862,000 cubic yards (659,046 cubic meters) per year.

The area that is projected to have the largest areal extent of scour holes is the 'S' Curves Hot Spot. The holes could develop earlier in the timeline of the project because of the steep offshore slopes in this area. Because more pile groups would be affected, more total area (and volume) would be removed. The volume removed would stay within the littoral system, initially deposited downdrift of the piles, and then subjected to the local background cross shore and/or longshore sediment transport patterns. The holes would shift in size and shape with change in wave height and direction and could contribute to localized changes in the nearshore wave characteristics given the alongshore length expected to be affected. Perhaps more important, however, to the projection of impacts to coastal processes for the 'S' Curves Hot Spot is that this is the area determined to have the highest "breach" potential (see Section 3.6.3.4).

In the event of a breach, the hydrodynamics and sediment transport in and around the pilings would be dominated by inlet processes (not wave and longshore currents) and the scour holes that would develop would be in the inlet throat, not offshore. The dynamics of scour would be similar to that found in inlets (for example, Oregon Inlet), but the magnitude of the scour holes would depend on the characteristics of the new inlet (i.e., width, depth, volume of flow, and sediment size), as well as the bridge pier design. The characteristics of the scour in the new inlet should be similar to that found in inlets of comparable flow velocity, sediment characteristics, and bridge pier design. However, because of the uncertainty of the characteristics of a potential new breach (see Section 3.6.3.4), this potential scour is not determined.

4.6.8.2 Effect of Bridge Piles on Wave Climate

Wave climate is generally defined as the long-term statistical characterization of waves in the ocean. The presence of the bridge piles is not expected to change the wave climate seaward of the bridge pile vicinity.

The potential for the bridge piles to impact the wave climate in the vicinity of the bridge piles and landward is first delineated by considering the pile diameter to wavelength ratio. Large pile diameters combined with short wavelengths have the greatest potential for wider spread wave impacts. For the Phased Approach alternatives (including the Preferred Alternative), the diameter to wavelength ratio is such that the flow would be in the slender-pile regime. This indicates that the presence of the piles (as an object that blocks the flow) should not substantially influence the wave form other than in the immediate vicinity of the pile group (Sumner and Fresoe, 2002).

In addition to the presence of the piles, the wave/structure/sediment interaction contributes to the change in the bathymetry (bottom topography) in and around the pile groups in the form of scour. This change in bottom topography could result in wave refraction (bending), wave reflection, local wave diffraction (bending around an object), and wave dissipation in the vicinity of a scour hole. This impact would be greatest when the piles are seaward of the breaking zone (where scour holes develop). Changes in the wave form from these effects also could affect the longshore currents since longshore current is a function of wave height and wave direction.

Finally, the presence of piles has the potential to interrupt the development of an offshore bar (see Section 4.6.8.1). The lack of development of the bar could cause relative changes in the alongshore wave height by changing the location of the breaking. This change could contribute to the formation of rip currents, a feature that occurs naturally along the coast but has been noted occurring in relationship to piers. The presence of the piles (and subsequent break in the bar) could serve to fix the location of a rip current under and aligned seaward with the bridge pier, but should not increase the frequency of occurrence since rip currents also are a function of the wave and tide conditions.

4.6.8.3 Effect of Bridge Piles on Longshore Sediment Transport

The local scour impact described in Section 4.6.8.1 could extend to a more global impact on the coastal processes if the structure were to interfere with either the longshore (north to south) transport of sediment or the cross-shore transport associated with storms. Although the scour holes would dominate in the vicinity of bridge piles, the USACE Field Research Facility (FRF) data shows no net loss of beach downdrift of its pier that would be suggestive of the trapping of sand that can be associated with structures perpendicular to the shore. The spacing of the pier's piles is such that the longshore sediment transport is not globally affected by the local scour that occurs. The cross-shore transport associated with storm events is dependent on the local bathymetry of the beach face; thus the scour holes necessarily change the cross-shore wave dynamics and sediment transport. The FRF data from the research pier does not suggest that the pier's piles have a substantial impact on the cross-shore transport. The upland areas at the FRF's pier, however, have higher elevations than those on Hatteras Island and have not experienced the repeated dune erosion and overwash that is common in the project area.

The FRF configuration resembles the case of a single pile group, but does not model the impact of a series of scour holes in the alongshore direction. In general, longshore sediment transport is a function of the breaking wave height and breaking wave angle. The length of shoreline along which these wave characteristics are changed because of the presence of the scour hole is a factor in the assessment of impact. Thus, the development of scour holes described in Section 4.6.8.1, as well as the subsequent effect on the local wave characteristics described in Section 4.6.8.2, could potentially have an impact on the localized longshore sediment transport and resulting erosion and accretion patterns along the shoreline, depending on the size and orientation of the holes.

4.6.8.4 Effect of Bridge Piles on Beach Erosion

Wave transformation over scour holes (see Section 4.6.8.1) would likely cause refraction of the incoming wave creating a persistent non-uniform wave climate on the beach. The degree of refraction would be a function of the scour depth and size and orientation of the holes. By bending the waves around the holes, energy would be focused in different patterns than without the presence of the holes. This could preferentially redistribute sediment creating erosional hot spots/troughs (or cold spots/crests), (Kraus and Galgano, 2001). If the effect is strong enough, it could result in a highly cuspate (scallop-like) beach, with the troughs being locations of erosion and crests the relative lack of erosion or accretion. The spatially alternate troughs and crests would be associated with the location of the scour holes, developing a rhythmic pattern of erosion and accretion along the shoreline.

The break in the offshore bar described in Section 4.6.8.2 would allow waves to move closer to shore before breaking. Once through the gap, waves would diffract (bending back toward the bar) creating complex flow patterns landward of the bar. Erosional hot spots could develop directly landward of the gap from the resulting larger wave heights that would propagate through the gaps (Kraus and Galgano, 2001).

Rips are observed to form in gaps in the bar (either in association with a structure such as a pier or without). Rips are strong shore perpendicular currents in the seaward direction and thus have the potential to transport sediment seaward. Erosional hot spots in association with rips locally narrow the beach. If the beach becomes too narrow, the rips also can be associated with dune erosion (Thorton et al., 2007).

Cusps, rips and breaks in the bar are all naturally occurring features along Hatteras Island today. The impacts on beach erosion as noted are already part of the system. However, the formation of these features associated with fixed locations (e.g., the piles) could create persistent features that would lead to focused erosional hot spots that are not currently present in the system.

4.6.8.5 Effect of Bridge Piles on the Potential for an Island Breach During Storm Events

In the foreshore, backshore and upland zones the impact on cross-shore sediment transport because of the Phased Approach alternatives' (including the Preferred Alternative) piles generally would be during storm events. Two impacts can be anticipated. Scour around the bridge supports is expected during events that bring the water level in contact with the bridge. The scour hole that would develop should be a function of water level, current, and wave action, as well as the duration of the storm. In the case of an overwash event in which sand is transported landward, scour holes would develop but sediment transport should not be substantially interrupted and a washover fan should develop. During an event in which flow is reversed from sound to ocean because of elevated water levels in Pamlico Sound, there could be more erosion because of the presence of the bridge supports. The combination of scour around the piles and the channeling of the flow in the cross shore direction would increase the erosion potential. Since these events are associated with the creation of a breach in the island, it is possible that the presence of the structure could accelerate the development of a breach during these events.

During non-storm conditions, the bridge elements in the upland area could increase sediment accumulation because of the interruption of the windblown transport processes. In the backshore, the interruption of windblown sediments could cause a loss of transport from the beach to the dune.

4.6.8.6 Short-Term NC 12 Maintenance Needs until Phases II, III, and IV are Implemented

This section identifies, based on past experience, potential short-term maintenance activities that likely would occur prior to implementation of Phases II, III, and IV with the Phased Approach alternatives (including the Preferred Alternative). One difference from past experience is that the Refuge has concluded that the selection of the Phased Approach/ Rodanthe Bridge Alternative (Preferred) as the project for implementation in a Record of Decision (ROD) will preclude future storm-related maintenance outside of the NC 12 easement from being found compatible with the Refuge under the requirements of National Wildlife Refuge System Improvement Act of 1997. Thus, after the issuance of the ROD for this project, NCDOT would confine future NC 12 maintenance in the Refuge, including storm-related maintenance, to the existing NC 12 easement. Maintenance prior to the completion of Phase I is not addressed because it would occur with all of the alternatives (Pamlico Sound Bridge Corridor and Parallel Bridge Corridor) and, thus, it is not a factor in the decision-making process.

Based on past experience, there are five characteristic types of maintenance needed to keep NC 12 clear and open to traffic. These activities occur on Hatteras Island. Such activities do not occur, nor are expected to occur, on Bodie Island in the project area. The five activities are listed and defined in Table 4-13.

Activity 1 (road scraping) can occur as part of routine maintenance whenever wind blown sands are deposited on NC 12 to such a degree that mechanical removal is necessary. Activities 2 (dune maintenance), 3 (dune rebuilding), and 4 (sandbag-based dune and berm replenishment) are generally storm related activities. Factors which play into determining whether these activities occur or how often they occur at any given location on NC 12 increases with:

1. Decrease in the distance between NC 12 and shoreline;

2. Degradation of the dunes along the shoreline;

3. Magnitude of a storm event;

4. Frequency of storm event; and

5. Sediment supply.

In the past, activity 5 (dune translation) has occurred only in the Canal Zone Hot Spot area because of the large supply of windblown sand available from the terminal groin fillet and the wider beaches just north of the hot spot.

The existing dunes protect NC 12 from overwash. When the dune is lost either because of long-term erosion or storm events, NC 12 is more vulnerable to sand and water on the pavement. Under conditions dominated by long-term erosion, the beach width narrows, the ocean is closer to the toe (ocean side) of the dune, and daily waves and tides can erode the base of the dune until the dune face collapses providing sand to the beach. The beach may temporarily widen (providing

Table 4-13. Types of Past Storm-Related NC 12 Maintenance Activities and Frequency

Activity	Characteristics	General Past Frequency of Events Necessitating These Activities[1]
Minimal to none (MN)	Shoreline and dune characteristics expected to be adequate to keep sand off the road.	
1. Road Scraping	Pushing sand off the road on to the shoulders of the road and regrading swales (within the easement).	1 to 2 times per month
2. Dune Maintenance	Patching small holes or loss of elevation in the dune. Sand is typically moved from the shoulder on the seaward side and pushed up on the dune. In areas of existing vegetation, equipment with rubber tires is used to minimize damage if the vegetated site cannot be avoided entirely. Sand fencing may also be a minor repair or used in areas dune growth and dune stabilization is desired.[2]	2 to 3 times per year
3. Dune Rebuilding	Similar to 2 but at a larger scale. Sand from the landward shoulder of the easement (or other source on Hatteras Island) needed. Bulldozers are typically used to push sand up into a dune formation from the landward side of the dune. Minimal work is done from the seaward side. Efforts from the seaward side are intended to shape the dune. There is no beach scraping to obtain material to form the dune. Dune planting to attempt re-vegetation also may occur, as well as sand fencing to help stabilize the dune.[2]	1 to 2 times per year
4. Sandbag-Based Dune and Berm Replenishment	Because of the lack of beach width, the dune is rebuilt with a sandbag core. Sand is placed on the beach to rebuild a berm. This berm provides habitat that would be available in the absence of the dune, as well as provides protection for the dune. The sole example of this in the project area is the maintenance project planned for Rodanthe in 2008 in which approximately 200,000 cubic yards (152,911 cubic meters) of sand will be excavated from the terminal groin fillet and trucked hauled and placed in the Rodanthe 'S' Curves Hot Spot. Sand is placed as much as possible above the high water line and natural processes are allowed to rework the material. Placement below the high water line occurs when the distance from toe of the dune to the high water line is less than that distance needed to operate the necessary equipment.	Only one occurrence of this activity; it is currently (2007/2008) being completed at the southern end of the Refuge. Prior to 2015, the sandbag area will need to be lengthened up to about 1,500 feet (762 meters).
5. Dune Translation	When the large windblown dunes migrate onto the shoulder of NC 12, excavating equipment is used to "scoop" the sand from the backside of the dune and place the sand forward of the dune crest so that it replenishes the front slope of the dune. This currently only occurs in the Canal Zone Hot Spot.[2]	1 to 2 times per year

[1] Based on NCDOT storm frequency and maintenance activity experience in the three hot spots found within the Refuge.
[2] In the past, this activity has generally occurred partially or completely outside of the existing NC 12 easement.

distance), but the lowering of the maximum elevation of the dune leaves the road vulnerable to overwash in subsequent storms. During storm events in which the water level is elevated because of the storm surge (water elevated by storm winds) the dune can be systematically undermined or overtopped, creating a dune blowout, overwash, and washover fan.

Using distance to shoreline, apparent dune integrity, and past storm maintenance experience (keeping in mind that future maintenance would occur within the NC 12 easement), the susceptibility of the NC 12 area needing maintenance can be projected. In addition, NC 12 maintenance experience has revealed that when the dune heel (side of the dune facing the sound) gets within 10 feet (3 meters) of NC 12 and the dune is un-vegetated, windblown sand on the road is a common occurrence. This has occurred in the Canal Zone Hot Spot area. The wind blown sand also creates a problem with water on the pavement because of the storm creates high shoulders and swales filled with sand. The road becomes a low point for standing water.

Table 4-14 and Table 4-15 present forecast shoreline areas likely to require maintenance activities assuming the average and the high erosion shoreline findings, respectively, that were prepared as a part of this FEIS. Maintenance activities are assumed to cease as each portion of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is completed.

The tables contain the following elements:

- Activities estimated under 2010, 2015, 2020, and 2030 shoreline conditions with the presumption that Phase II is completed shortly after 2015, Phase III is completed shortly after 2020, and Phase IV is completed shortly after 2030 (see Section 2.10.2.5);

- The length of NC 12 forecast to be likely to require each activity in each year; and

- The percent length of NC 12 within the Refuge that would require each activity in each year, including the length of NC 12 where the distance to the shoreline and dune integrity is expected to be great enough that none of the activities are expected to occur.

Given that maintenance would stay within the existing NC 12 easement, and the past activities presented in Table 4-13 can occur outside the easement, Table 4-14 and Table 4-15 assume the following three projected future activities:

1. Road Scraping. Same as defined in Table 4-13;

2. Dune Building and Maintenance in Easement. Since dunes that develop small holes or lose elevation as a result of a storm are generally outside of the NC 12 easement, they could no longer be repaired. Instead, a small dune would be built in the NC 12 easement to account for the weaker dune outside of the NC 12 easement. This activity could occur somewhere along NC 12 within the Refuge two to three times per year based on past experience with the development of small holes or loss of elevation in existing dunes. Maintenance of this dune also would occur once built. Once dunes are built, their maintenance or repair could occur at intervals more frequent than the manifestation of the original need since this activity would not restore the damaged original dune.

3. Sandbag Dune Building and Maintenance in Easement. In the past, dunes that have been substantially lost to a storm have been rebuilt. Because of the greater exposure to NC 12 resulting from the substantial loss of a segment of dune and because rebuilding would need to be confined to available space within the NC 12 easement, the dune would be rebuilt with a

Table 4-14. Forecast Areas in Refuge Susceptible to Three Projected Future Storm-Related NC 12 Maintenance Activities (Average Erosion Shoreline)

General Location	Phase	Total Length in Refuge in feet (meters)	Susceptible[1] Area and Activities							
			2010		2015		2020		2030	
			Length of Susceptible Area in feet (meters)	Activities	Length of Susceptible Area in feet (meters)	Activities	Length of Susceptible Area in feet (meters)	Activities	Length of Susceptible Area in feet (meters)	Activities
Rodanthe/'S' Curves Hot Spot	II	9,980 (3,043)	1,000 (305)	1,2,3	2,500 (762)	1,2,3	9,980 (3,043)	MN	9,980 (3,043)	MN
			2,500 (762)	1,2,3	2,000 (610)	1,2,3				
			4,000 (1,220)	1,2	3,000 (915)	1,2				
			2,480 (756)	MN	2,480 (756)	MN				
No Improvement Area	NA	9,944 (3,032)	9,944 (3,032)	MN	9,944 (3,032)	MN	9,944 (3,032)	MN	9,944 (3,032)	MN
New Inlet	III	11,400 (3,476)	11,400 (3,476)	MN	500 (152)	1	500 (152)	1	11,400 (3,476)	MN
					10,900 (3,324)	MN	10,900 (3,323)	MN		
South Ponds	IV	8,280 (2,524)	2,500 (762)	1	3,000 (915)	1,2	3,500 (1,067)	1,2	3,500 (1,067)	1,2
			5,780 (1,762)	MN	5,280 (1,609)	MN	1,500 (457)	1	1,500 (457)	1,2,3
							3,280 (1,000)	MN	3,280 (1,000)	MN
Visitor Center	II	3,720 (1,134)	1,000 (305)	1,2	1,500 (457)	1,2	3,270 (1,134)	MN	3,270 (1,134)	MN
			2,720 (829)	MN	2,220 (677)	MN				
North Ponds	IV	5,160 (1,573)	5,160 (1,573)	MN	5,160 (1,573)	MN	500 (152)	1	1000 (305)	1,2
							4,650 (1,421)	MN	4,160 (1,268)	MN
Canal Zone and Sandbag Hot Spots	II	13,560 (4,134)	1,000 (305)	1	1,000 (305)	1	13,560 (4,134)	MN	13,560 (4,134)	MN
			1,500 (457)	1,2	500 (152)	1,2,3				
			4,500 (1,372)	1,2	2,000 (610)	1,2,3				
			6,560 (2,000)	MN	4,000 (1,220)	1,2				
					6,060 (1,847)	MN				
Total Length		62,044 (18,911)								
Total Impact by Activity Type			**2010**		**2015**		**2020**		**2030**	
			Length	**Percent**	**Length**	**Percent**	**Length**	**Percent**	**Length**	**Percent**
MN			44,044 (13,424)	71%	42,044 (12,818)	68%	56,034 (17,084)	90%	56,044 (17,087)	90%
1			18,000 (5,488)	29%	20,000 (6,098)	32%	6,000 (1,829)	10%	6,000 (1,829)	10%
2			14,500 (4,421)	23%	18,500 (5,641)	30%	3,500 (1,067)	6%	6,000 (1,829)	10%
3			3,500 (1,067)	6%	7,000 (2,134)	11%	0	0%	1,500 (457)	2%

[1] The lengths reflect each location's susceptibility to the need for the storm-related maintenance activities indicated. The area actually affected by any given storm generally would be less than the lengths shown. Minor events tend to result in spotty activities and larger events tend to result in activities that affect larger portions of the susceptible locations. At locations susceptible to the more intensive activity 3, minor events are likely to cause more extensive 1 and 2 activities than at locations not susceptible to activity 3.

Table 4-15. Forecast Areas in Refuge Susceptible to Three Projected Future Storm-Related NC 12 Maintenance Activities (High Shoreline Erosion)

General Location	Phase	Total Length in Refuge in feet (meters)	Susceptible[1] Area and Activities							
			2010		2015		2020		2030	
			Length of Susceptible Area in feet (meters)	Activities	Length of Susceptible Area in feet (meters)	Activities	Length of Susceptible Area in feet (meters)	Activities	Length of Susceptible Area in feet (meters)	Activities
Rodanthe/'S' Curves Hot Spot	II	9,980 (3,043)	4,500 (1,372)	1,2,3	6,500 (1,982)	1,2,3	9,980 (3,043)	MN	9,980 (3,043)	MN
			3,000 (915)	1,2,3	1,000 (305)	1,2,3				
			2,480 (756)	MN	2,480 (756)	MN				
No Improvement Area	NA	9,944 (3,032)	9,944 (3,032)	MN	9,944 (3,032)	MN	9,944 (3,032)	MN	9,944 (3,032)	MN
New Inlet	III	11,400 (3,476)	1000 (305)	1	1,000 (305)	1,2	1,500 (457)	1,2,3	11,400 (3,476)	MN
			10,400 (3,171)	MN	10,400 (3,171)	MN	9,900 (3,019)	MN		
South Ponds	IV	8,280 (2,524)	1,000 (305)	1,2	1,500 (457)	1,2	1,000 (305)	1,2,3	2,000 (610)	1,2,3
			2,500 (762)	1	2,000 (610)	1,2	3,000 (915)	1,2	2,500 (762)	1,2
			4,780 (1,457)	MN	4,780 (1,457)	MN	4,280 (1,304)	MN	3,780 (1,152)	MN
Visitor Center	II	3,720 (1,134)	1,500 (457)	1,2	1,500 (457)	1,2,3	3,720 (1,134)	MN	3,720 (1,134)	MN
			1,000 (305)	1,2,3	2,220 (677)	1,2				
			1,220 (372)	MN						
North Ponds	IV	5,160 (1,573)	5,160 (1,573)	MN	5,160 (1,573)	MN	1,000 (305)	1,2	1,000 (305)	1,2
							4,160 (1,268)	MN	3,000 (915)	1,2
									1,160 (353)	MN
Canal Zone and Sandbag Hot Spots	II	13,560 (4,134)	3,000 (915)	1,2,3	4,000 (1,220)	1,2,3	13,560 (4,134)	MN	13,560 (4,134)	MN
			5,500 (1,677)	1,2,3	5,000 (1,524)	1,2,3				
			2,000 (610)	1,2	1,000 (305)	1,2				
			3,060 (932)	MN	3,560 (1,085)	MN				
Total Length		62,044 (18,911)								
Total Impact by Activity Type			2010		2015		2020		2030	
			Length	Percent	Length	Percent	Length	Percent	Length	Percent
MN			37,044 (11,293)	60%	31,544 (9,617)	51%	55,544 (16,934)	90%	53,544 (16,342)	86%
1			25,000 (7,623)	40%	25,720 (7,842)	41%	6,500 (1,982)	10%	8,500 (2,592)	14%
2			21,500 (6,556)	35%	23,720 (7,232)	38%	6,500 (1,982)	10%	8,500 (2,592)	14%
3			17,000 (5,184)	27%	18,000 (5,488)	29%	2,500 (762)	4%	2,000 (610)	3%

[1] The lengths reflect each location's susceptibility to the need for the storm-related maintenance activities indicated. The area actually affected by any given storm generally would be less than the lengths shown. Minor events tend to result in spotty activities and larger events tend to result in activities that affect larger portions of the susceptible locations. At locations susceptible to the more intensive activity 3, minor events are likely to cause more extensive 1 and 2 activities than at locations not susceptible to activity 3.

sandbag core. This activity could occur somewhere along NC 12 within the Refuge one to two times per year based on past experience with substantial dune loss. Maintenance of this dune also would occur once built. Once sandbag dunes are built, their maintenance or repair could occur at intervals more frequent than the manifestation of the original need since this activity would not restore the substantially lost original dune.

Items 2 and 3 in Table 4-13 could still be done if they could be done within the existing easement, but are not assumed in Table 4-14 and Table 4-15 because those solutions are generally applicable to repairs when the dunes are still outside or partially outside of the NC 12 easement. Item 4 could not be done as described in Table 4-13 because berm replenishment would occur outside of the NC 12 easement. Item 5 in Table 4-13 could not be done within the existing NC 12 easement.

The lengths shown in Table 4-14 and Table 4-15 reflect locations expected to require the storm-related maintenance activities indicated. The area actually affected by any given storm generally would be less than the lengths shown. Minor events tend to result in spotty activities, and larger events tend to result in activities that affect larger portions of the susceptible locations. At locations susceptible to the more intensive activity 3, minor events are likely to cause more extensive 1 and 2 activities than at locations not susceptible to activity 3.

Past activities and their frequencies presented in Table 4-13 were derived primarily from maintenance records dating from 1991. Maintenance requirements at the hot spots have increased substantially since 1999 with Hurricanes Dennis, Bonnie, and Floyd, and increased again with Hurricane Isabel in 2003. The projected three activities that likely would be used for maintenance in the future and their associated frequencies were developed from a post-1999 storm activity baseline. From 1999 to November 2007, there were six hurricanes, one tropical storm, and 13 nor'easters or other storms that required cleanup activities. Even larger, more frequent storms that directly affect Hatteras Island could alter the assessments of Table 4-14 and Table 4-15. Also, with this in mind, the category minimal to none carries two connotations: 1) the activity itself is minimal (infrequent occurrences of activity 1), or 2) there is a minimal probability of occurrence using the criteria just described.

Table 4-14 and Table 4-15 indicate that the level of NC 12 maintenance related to storms will continue in the three hot spots and likely increase in those areas until Phase II is completed. Again, NCDOT would confine this work to the existing NC 12 easement, since the Refuge has indicated that such work would not be found compatible with the Refuge under the requirements of the National Wildlife Refuge System Improvement Act of 1997. Recognizing the desirability of ending these activities, NCDOT intends to place a high priority on the implementation of Phase II, as discussed in Section 2.10.2.5. The completion of Phase II would substantially decrease the amount of storm-related maintenance on NC 12, but some would remain and would increase prior to the completion of Phases III and IV, but not to the extreme currently occurring in the three hot spots.

As indicated in Section 2.10.2.5 and in commitment number 15 of the Project Commitments section, NCDOT also would not perform storm-related NC 12 maintenance work outside of the existing easement in the Phase III, IV, and no action areas on NC 12 for the reason noted in the previous paragraph. Limiting the growth in the need for NC 12 storm-related maintenance in the Phase III and IV areas to the extent practicable given the availability of transportation funding and the efficient use of those funds also is considered desirable. In order to help accomplish that objective, NCDOT would implement a monitoring program, the particulars of which would be developed in consultation with representatives of the Refuge, including development of decision-making criteria for translating monitoring findings into a decision to move forward with an additional phase and how to refine the location of each phase to reflect actual future shoreline change.

4.7 Natural Systems

This section addresses each alternative's impacts to natural systems as they relate to: geology, topography, and soils; surface waters and water quality; biotic communities; wetlands and open water habitat; unique and rare habitats; fisheries and wildlife; protected species, and avoidance, minimization, and compensatory mitigation.

4.7.1 Geology, Topography, and Soils

The Pamlico Sound Bridge Corridor and, to a greater extent, the Parallel Bridge Corridor would result in localized, construction-related changes in topography and soils, especially in low-lying areas (see Section 4.7.3). Potential impacts to area soils would result from fill, vegetation removal and excavation, soil compaction, and erosion. Although many of these impacts would be short-term, a permanent loss of hydric soils and associated function would result from fill activities required for the proposed project. Also, an increase in impervious surface area would result from bridge pile placement. Steps to avoid and minimize impacts to hydric soils are discussed in Section 4.7.10. To minimize soil erosion while construction is underway, an erosion and sedimentation control plan would be prepared in accordance with the Sedimentation Pollution Control Act of 1973, GS 17-3A-50, *et seq.* and GS 113A-50.

4.7.1.1 Pamlico Sound Bridge Corridor

The Pamlico Sound Bridge Corridor would affect estuarine sediments of the Pamlico Sound. Barge traffic and pile placement would disturb sediments, although much of the disturbance would be temporary. However, pile placement would result in permanent loss of estuarine sediment area. The dredging likely required during construction at the shallow portions of the Pamlico Sound Bridge Corridor would result in substantial changes in estuarine sediments and topography. However, dredging would be short-term and likely would fill to near pre-construction contours in areas of active, high-energy currents (see Section 4.7.3).

4.7.1.2 Parallel Bridge Corridor with NC 12 Maintenance

With the Parallel Bridge Corridor, construction-related impacts to sediments would be similar to that of the Pamlico Sound Bridge Corridor, although impacts to estuarine sediments would be less extensive as less of the Parallel Bridge Corridor is over open water. The topography within the Parallel Bridge Corridor is flat, with little change in elevation aside from the dunes adjacent to existing NC 12. Fill material would be required for any construction, including dune maintenance, roadway elevation and/or maintenance, or bridge approach roads.

Temporary impacts from road and bridge construction would be the least for the Parallel Bridge Corridor with Nourishment Alternative, being confined to those impacts associated with the construction of a bridge over Oregon Inlet. The Nourishment Alternative, as well as the nourishment component of the Phased Approach/Rodanthe Nourishment Alternative, however, would require both frequent sand extraction (i.e., dredging) from off-shore borrow sites and beach nourishment for the 50-year planning period. Dredging would result in the removal of existing sediments from two off-shore borrow areas, although sediments from the USACE's ongoing ocean bar dredging also could be used (see Section 2.10.2.1). A total of 6.3 miles (10.1 kilometers) of beach would be subject to nourishment every four years with the Parallel Bridge Corridor with Nourishment Alternative. As indicated in Section 2.10.2.1, 46.6 million cubic yards (35.7 million cubic meters) of sand for dunes and nourishment would be needed through 2060. Approximately 6,000 feet (1,829 meters) would be subject to nourishment with the Parallel

Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative with 21.8 million cubic yards (16.7 cubic meters) of sand needed for nourishment though 2060. Prior investigations of sand extracted from borrow sites suggest that after sand removal, the amount of sand in the sediment decreases while the amount of fine sediments, organic matter, silt, and clay increase (Jutte et al., 2002; Van Dolah et al., 1994). Sand removal effects on sediment quality have been found to persist less than two years to more than ten years after dredging (Jutte et al., 2002; Van Dolah et al., 1998). Recovery time to pre-dredge conditions is variable and depends on the size of the dredged area, local currents, sediment availability, and sediment grain size and composition. The topography of the dredged area also would change substantially after dredging because it is not in a high current area, like the area dredged for the Oregon Inlet and Pamlico Sound bridges (see Section 4.7.1.1). Dredging equipment would create large furrows and depressions within the sand removal area.

4.7.2 Surface Waters and Water Quality

As stated in Chapter 3, all waters in the project area are classified as SA waters (Class A salt waters) with a supplemental classification of High-Quality Waters (HQW). The most stringent application of the Best Management Practices (BMPs) is expected where highway projects affect receiving waters of special designation, such as HQW (NCDOT, August 2003). Construction-related water quality impacts would be similar for both replacement bridge corridors. Both corridors would result in temporary increases in turbidity; however, given the dynamic nature of Oregon Inlet, a temporary increase in turbidity likely would not be notable, as the continuous flux of ocean water through Oregon Inlet would reduce the chances of any permanent water quality problems. Since the Parallel Bridge Corridor lies predominantly over land, there would be less open water construction and, therefore, direct water quality impacts during construction would be of a smaller temporal and spatial scale.

Offshore sand removal and beach nourishment associated with the Parallel Bridge Corridor with Nourishment Alternative could affect water quality by resuspending sediments. These impacts also would occur with the nourishment component of the Phased Approach/Rodanthe Nourishment Alternative, although smaller in scale because nourishment would only occur in the Rodanthe area.

Runoff, created while the highway is in operation, may contribute pollution to nearby ecosystems. Highway runoff can contain varying amounts of heavy metals, nutrients, organic compounds, and particulates, all of which can degrade water quality and impact aquatic organisms (see Section 4.7.3). BMPs identified in North Carolina Department of Environmental and Natural Resources (NCDENR) *Stormwater Best Management Practices Manual* (BMP Manual) (NCDENR, 2007) are capable of removing up to 85 percent of total suspended solids (TSS), 40 percent of total nitrogen (TN) and total phosphorous (TP), 100 percent of ortho-phosphorous (OP), 90 percent of nitrate and nitrite nitrogen (NOx), 97 percent of copper (Cu), and 99 percent of zinc (Zn). The combination of BMPs that can be used in conjunction with this project will be determined when designs are finalized.

4.7.2.1 Pamlico Sound Bridge Corridor

<u>*Construction Period Impacts*</u>

The primary water quality impacts of the Pamlico Sound Bridge Corridor during construction would result from construction barge traffic, general construction activity, construction channel dredging, and jetting/driving pile placement. All of these activities would cause a temporary increase in turbidity and a potential decrease in dissolved oxygen levels associated with the resuspension of sediment particles into the water column. Sediments within the affected area have been characterized by the USACE as predominantly fine sand with lesser amounts of silt and clay (USACE, 1980). Given the dynamic nature of Oregon Inlet, a temporary increase in turbidity likely would not be notable, as the continuous flux of ocean water through Oregon Inlet would reduce the chances of any permanent water quality problems. Furthermore, sediments within the project area do not contain significant levels of organic or inorganic pollutants; therefore, disturbance to sediments would not result in detrimental pollutant levels in the water column.

During construction of the Pamlico Sound Bridge Corridor, steps taken to minimize turbidity (when possible and practicable) would include the use of work bridges (rather than dredging for barges) for movement of construction equipment in shallow areas where submerged aquatic vegetation (SAV) is present. If SAV is in waters deep enough to float a barge without dredging, the use of a work bridge would not be necessary. Dredging generally would only be used for approximately 8 miles (12.8 kilometers) in depths less than 6.0 feet (1.8 meters) where SAV is not present and, because the Pamlico Sound Bridge Corridor extends into Pamlico Sound beyond the 6.0-foot (1.8-meter) depth contour, dredging would primarily be restricted to the shallow portions of the alignment near the Rodanthe and Bodie Island termini. Where dredging is needed, the dredging would be to a depth of 8.0 feet (2.4 meters) to 10.0 feet (3.0 meters) to provide more flexibility for construction barge operations and reduce the amount of redredging. Work bridges also would be used to carry construction equipment over intertidal marsh areas (black needlerush and smooth cordgrass). Options for dredged material disposal are discussed in Section 4.13.5. Opportunities to reduce the impact of jetting are discussed in Section 2.10.1.3.

Temporary BMPs also would be implemented prior to the start of construction to manage pollutants associated with construction activities such as sediment, pesticides, fertilizers, petrochemicals, construction chemicals, wash water, paper, wood, garbage, and sanitary waste. Consistent with USEPA guidance (USEPA, 2005), site erosion, sediment, and chemical control measures would include an erosion and sediment control plan detailing provisions such as perimeter controls, stabilization of exposed areas, and construction sequencing that would be implemented prior to the start of construction. Land disturbance activities would be conducted in a manner that reduces erosion, contains sediment on-site during and after construction, prevents off-site transport of waste and chemicals, and minimizes use and production of pollutants. For example, stormwater runoff impacts during construction can be reduced through proper management and disposal of wastes, completing construction in stages so that only a portion of the site is disturbed at a time and then stabilized before the next area is disturbed, and storm drain inlet protection.

Operational Impacts

Given its location and length, the Pamlico Sound Bridge Corridor bridge likely would increase the amount of highway runoff entering Pamlico Sound. Highway runoff can contain varying amounts of sediments, oils, grease, and metals, all of which can degrade water quality. Water quality impacts associated with current NC 12 operations are primarily related to the potential for contamination of receiving surface waters by runoff from impervious roadway surfaces. The impervious areas used to estimate pollutant loadings associated with the existing bridge and highway facility, the Pamlico Sound Bridge Corridor alternatives, and the Parallel Bridge Corridor alternatives (including the Preferred Alternative) are presented in Table 4-16.

Pollutant constituents and concentrations resulting from highway runoff are influenced by several different factors. Consequently, various methods have been developed for estimating pollutant loadings from urban watersheds and highway runoff. Two methods were chosen to evaluate and estimate the pollutant loadings from each of the alternatives studied. One is the Simple Method, a

Table 4-16. Summary of Impervious Areas for the Existing Project Area, Pamlico Sound Bridge Corridor and Parallel Bridge Corridor

	No-Action	Pamlico Sound		Parallel Bridge				
	Bonner Bridge/ NC 12	Curved Terminus	Intersection Terminus	Nourishment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge*	Phased Approach/ Rodanthe Nourishment
Oregon Inlet/Sound Bridge								
Length, mile (kilometer)	2.44 (3.93)	17.48 (28.13)	17.4 (28.02)	2.75 (4.43)	2.75 (4.43)	3.18 (5.12)	2.64 (4.25)	2.64 (4.25)
Lane Width, feet (meter)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)
Shoulder Width, feet (meter)	4 (1.2)	16 (4.9)	16 (4.9)	16 (4.9)	16 (4.9)	16 (4.9)	16 (4.9)	16 (4.9)
Bridge Approach Roadways								
Length, mile (kilometer)	1.07 (1.72)	0.48 (0.77)	0.42 (0.68)	0.90 (1.45)	0.62 (1.00)	0.62 (1.00)	0.85 (1.37)	0.85 (1.37)
Lane Width, feet (meter)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)
Shoulder Width, feet (meter)	10 (3.0)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)
NC 12 Unchanged								
Length, mile (kilometer)	12.23 (19.68)	-	-	12.23 (19.68)	2.32 (3.73)	1.65 (2.66)	2.05 (3.30)	2.05 (3.30)
Lane Width, feet (meter)	23 (7.0)	-	-	23 (7.0)	23 (7.0)	23 (7.0)	23 (7.0)	23 (7.0)
Shoulder Width, feet (meter)	-	-	-	-	-	-	-	-
NC 12 Relocation (Roads)								
Length, mile (kilometer)	-	-	-	-	7.86 (12.65)	1.34 (2.16)	-	-
Lane Width, feet (meter)	-	-	-	-	24 (7.3)	24 (7.3)	-	-
Shoulder Width, feet (meter)	-	-	-	-	8 (2.4)	8 (2.4)	-	-
NC 12 Relocation (Bridges)								
Length, mile (kilometer)	-	-	-	-	2.46 (3.96)	9.13 (14.69)	10.44 (16.80)	9.67 (15.56)
Lane Width, feet (meter)	-	-	-	-	24 (7.3)	24 (7.3)	24 (7.3)	24 (7.3)
Shoulder Width, feet (meter)	-	-	-	-	16 (4.9)	16 (4.9)	16 (4.9)	16 (4.9)
Total Length, mile (kilometer)	15.7 (25.3)	18.0 (29.0)	17.8 (28.6)	15.9 (25.6)	16.0 (25.7)	15.9 (25.6)	16.0 (25.7)	15.2 (24.5)
Total Impervious Area, acre (hectare)	46.8 (18.9)	86.6 (35.0)	86.1 (34.8)	50.9 (20.6)	64.6 (26.1)	71.9 (29.1)	72.4 (29.3)	68.7 (27.8)

Notes:
- Bonner Bridge characteristics for No-Action Alternative obtained from Dare County State Highway Plans (1961).
- Proposed 2.6-mile (4.2-kilometer) long Oregon Inlet bridge for Phased Approaches does not include the temporary maintenance bridge (2,600 feet long by 26 feet wide [792.5 meters by 7.9 meters]) planned during construction.
- Estimated lengths of proposed NC 12 relocation bridges for Phased Approaches do not include the two proposed one-lane frontage roads for the Rodanthe Bridge.
*Preferred Alternative

widely accepted empirically-based model used for estimating pollutant loadings of an urban watershed (Schueler, 1987). This model is consistent with the guidance set forth in NCDENR's BMP Manual.

The second is the FHWA Method, another well-established model developed to estimate pollutant loading resulting from highway runoff (Driscoll et al., 1990). The FHWA method focuses on pollutants contributed by highway segments within a watershed. For comparative analysis purposes, both of these models were used to estimate pollutant loadings associated with each of the alternatives (PB, 2008).

The estimated annual pollutant loadings associated with the Pamlico Sound Bridge Corridor alternatives using the Simple Method and the FHWA Method are summarized in Table 4-17 and Table 4-18, respectively. The receiving surface waters within the project area, Pamlico Sound and Oregon Inlet, are not included on the Impaired Waters List which indicates that water quality uses (e.g., shellfishing) are currently being met (NCDENR, 2006). Therefore, Total Maximum Daily Loads (TMDL), defined as the maximum amount of a pollutant that a water body can receive and still meet water quality standards, have not been developed for these water bodies of interest, so only a comparative analysis with existing conditions (i.e., No-Action Alternative) and between alternatives can be made with respect to water quality impacts.

Table 4-17. Simple Method Summary of Estimated Annual Pollutant Loads for the No-Action (Existing), Pamlico Sound Bridge Corridor, and Parallel Bridge Corridor Alternatives

Pollutant	Pounds per Year (Kilograms per Year)							
	No-Action	Pamlico Sound		Parallel Bridge				
	Bonner Bridge/ NC 12	Curved Terminus	Inter-section Terminus	Nourish-ment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge*	Phased Approach/ Rodanthe Nourishment
Total Phosphorus	146 (67)	239 (109)	237 (108)	158 (72)	192 (87)	210 (95)	207 (94)	197 (89)
Total Nitrogen	1,126 (512)	1,837 (835)	1,824 (829)	1,213 (551)	1,474 (669)	1,615 (733)	1,596 (724)	1,516 (688)
TSS	30,965 (14,075)	50,507 (22,958)	50,173 (22,806)	33,349 (15,159)	40,544 (18,390)	44,426 (20,151)	43,884 (19,905)	41,696 (18,913)
COD	51,120 (23,236)	83,382 (37,901)	82,831 (37,650)	55,056 (25,026)	66,934 (30,361)	73,343 (33,268)	72,449 (32,862)	68,837 (31,224)
BOD	6,700 (3,045)	10,928 (4,967)	10,856 (4,934)	7,216 (3,280)	8,772 (3,979)	9,612 (4,360)	9,495 (4,307)	9,022 (4,092)
Zinc	99 (45)	162 (73)	161 (73)	107 (49)	130 (59)	142 (64)	140 (64)	133 (60)
Lead	101 (46)	165 (75)	164 (75)	109 (50)	133 (60)	145 (66)	144 (65)	136 (62)
Copper	26 (12)	43 (20)	43 (19)	28 (13)	35 (16)	38 (17)	38 (17)	36 (16)

Note: TSS=Total suspended solids; COD=Chemical oxygen demand; BOD=Biological oxygen demand.
* Preferred Alternative. The relationship of the Phased Approach Alternatives to the shoreline assumes their 2060 high erosion condition.

Table 4-18. FHWA Method Summary of Estimated Annual Pollutant Loads for the No-Action (Existing), Pamlico Sound Bridge Corridor, and Parallel Bridge Corridor Alternatives

Pollutant	Pounds per Year (Kilograms per Year)							
	No-Action	Pamlico Sound		Parallel Bridge				
	Bonner Bridge/ NC 12	Curved Terminus	Inter-section Terminus	Nourish-ment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge*	Phased Approach/ Rodanthe Nourishment
Total Phosphorus	96 (44)	134 (61)	133 (61)	102 (46)	118 (54)	127 (58)	123 (56)	117 (53)
Total Nitrogen	795 (362)	1,115 (507)	1,108 (503)	847 (385)	981 (445)	1,056 (479)	1,019 (462)	970 (440)
TSS	24,517 (11,144)	34,386 (15,630)	34,146 (15,521)	26,103 (11,865)	30,257 (13,724)	32,564 (14,771)	31,405 (14,245)	29,906 (13,565)
COD	29,301 (13,319)	41,095 (18,679)	40,808 (18,549)	31,197 (14,180)	36,160 (16,402)	38,918 (17,653)	37,533 (17,025)	35,741 (16,212)
BOD	-	-	-	-	-	-	-	-
Zinc	48 (22)	67 (30)	67 (30)	51 (23)	59 (27)	64 (29)	61 (28)	
Lead	48 (22)	67 (30)	67 (30)	51 (23)	59 (27)	64 (29)	61 (28)	58 (26)
Copper	13 (6)	19 (9)	18 (8)	14 (6)	16 (7)	17 (8)	17 (8)	16 (7)

Note: TSS=Total suspended solids; COD=Chemical oxygen demand; BOD=Biological oxygen demand.
* Preferred Alternative. The relationship of the Phased Approach Alternatives to the shoreline assumes their 2060 high erosion condition.

Percent increases in annual pollutant loadings with reference to the No-Action Alternative are presented in Table 4-19. These values represent percent increase in annual loadings for each pollutant of concern. This comparative analysis indicates that the Pamlico Sound Bridge Corridor alternatives would result in the greatest increase in annual pollutant loadings, ranging from 39 to 63 percent increase. The results shown in Table 4-19 indicate that the difference between the percent increases in pollutant loadings estimated with the Simple and FHWA methods for each alternative in comparison to existing conditions increases with percent imperviousness. The reason for this is that the runoff coefficients employed in each method are a function of the percent imperviousness of an alternative, but are not linear functions. Once percent imperviousness exceeds 25 percent, the FHWA Method produces runoff coefficient values that are less than those computed using the Simple Method, and this difference between methods increases as percent imperviousness increases. In other words, for the same amount of imperviousness for each project alternative, the Simple Method yields higher stormwater runoff; therefore, it also yields higher pollutant loadings. As stated previously, the Simple Method is the method referenced in NCDENR's BMP Manual. The FHWA method was added for comparison.

Table 4-19. Summary of Percent Increases in Estimated Annual Pollutant Loads in Comparison to the No-Action Alternative

Alternative	Simple Method	FHWA Method
Pamlico Sound		
Curved Terminus	63%	40%
Intersection Terminus	62%	39%
Parallel Bridge		
Nourishment	8%	6%
Road North/Bridge South	31%	23%
All Bridge	43%	33%
Phased Approach/Rodanthe Bridge (Preferred)	42%	28%
Phased Approach/Rodanthe Nourishment	35%	22%

Note: The relationship of the Phased Approach Alternatives to the shoreline assumes their 2060 high erosion condition.

Best Management Practices (BMPs)

Public roads and bridges are considered as "Other Projects" for stormwater management purposes per 15A NCAC 2H.1003). This requires minimization of built-upon area, diversion of stormwater away from surface waters as much as possible, and employment of other BMPs to reduce water quality impacts compliant with NCAC 2H.1000 Stormwater Management. In addition to the state stormwater regulations, stormwater management and controls would be designed with reference to NCDOT's *Stormwater Best Management Practices Toolbox* (BMP Toolbox) (NCDOT, 2008) and NCDENR's BMP Manual. Potential BMPs considered for the alternatives studied and as described in NCDENR's BMP Manual include the following:

- Sand Filter**.** Stormwater runoff infiltrates through a sand media that filters out pollutants.
- Filter Strip. Vegetated section of land providing pollutant removal as stormwater travels over it.
- Grassed Swale. Shallow, vegetated, open channel for filtering pollutants.
- Infiltration Devices. Trenches or basins that allow stormwater runoff to infiltrate into the underlying soil.
- Bioretention**.** Depression in the ground to allow for temporary storage of runoff that is filled with a mixture of soils and plants intended to remove pollutants while providing landscaping and habitat enhancement.
- Stormwater Wetlands**.** Constructed to replicate natural wetlands using physical, chemical, and biological processes to treat runoff and temporary storage of runoff in shallow pools to support vegetation.
- Wet Detention Basin**.** A permanent pool of water is maintained for pollutant removal and additional capacity is available for detaining stormwater runoff.

The applicability of the last three BMPs listed above (bioretention, stormwater wetlands, and wet detention basin) with respect to this project could be limited because of barrier island influences that may include long-term maintenance issues related to wind and water transport of sand and a seasonal high water table. Stormwater management provisions would be implemented considering water quantity control and pollutant removal capacity for the selected alternative. In general, vegetated conveyance systems and infiltration would be incorporated, and a natural buffer between the roadway and receiving water body would be maintained to the extent feasible.

In order to prevent direct discharge of untreated runoff to the receiving surface waters, treatment prior to discharge is being considered for the Pamlico Sound Bridge Corridor alternatives. Runoff from the proposed bridge replacement will need to be either captured and conveyed to a treatment system on land (i.e., end-of-pipe treatment) or treated directly on the bridge before discharging to Oregon Inlet or Pamlico Sound. Conveyance along the entire 17.5-mile (28.2-kilometer) proposed bridge length may not be feasible because of maintenance and minimum slope (e.g., 0.3 percent recommended for underdrain systems in NCDOT's BMP Toolbox) requirements. However, end-of-pipe treatment is feasible at the northern and southern ends of the Pamlico Sound Bridge Corridor alternatives, but only for the relatively short sections at both ends in which the bridge rises from ground level to the typical bridge height (outside the navigation zone) of 10 feet (3.1 meters). Potential siting for end-of-pipe treatment exists at the northern terminus of the proposed bridge in the vicinity of the Coast Guard Station and Oregon Inlet Marina. At the southern terminus in Rodanthe, undeveloped, open land space exists near the Emergency Ferry Dock terminal on the west side of NC 12. These areas could be able to accommodate an infiltration system or basin facility to which stormwater runoff generated from the northern and/or southern end of the bridge could be conveyed and subsequently treated.

The remaining portion of the bridge through Pamlico Sound requires further consideration of stormwater controls to address bridge deck runoff. Currently, runoff is discharged without treatment from Bonner Bridge directly to Oregon Inlet via drain holes along the bridge length that connect to galvanized steel pipes through which runoff is discharged. Per NCDOT's BMP Toolbox, Bridge Stormwater Controls (BSCs) would be considered and applied appropriately to manage bridge deck runoff, such as designing drainage systems that eliminate direct discharge and applying downstream stormwater controls to treat and mitigate bridge runoff (NCDOT, 2008). The main components of BSCs are bridge type, bridge deck gutter, bridge drainage system, and outlet energy dissipater or stormwater control. Examples of bridge drainage systems provided by NCDOT include a system with no deck drains, a system with no deck drains over the water body, a closed system with longitudinal pipe over the entire bridge length, and a closed system with longitudinal piping over the water body. Essentially, bridge deck runoff falls from deck drains or is routed through a closed system and is then directed to a downstream stormwater control, such as infiltration, before discharging into the receiving water body. BSCs presented in NCDOT's BMP Toolbox, or proprietary devices applicable to controlling bridge deck runoff, would be considered for all bridge replacement segments traversing the receiving water bodies.

As project design moves forward, the NCDOT would incorporate BMPs for stormwater management into the project design.

4.7.2.2 Parallel Bridge Corridor with NC 12 Maintenance

<u>*Construction Period Impacts*</u>

Construction-related water quality impacts resulting from the Parallel Bridge Corridor would be similar to construction impacts related to the Pamlico Sound Bridge Corridor. However, with the Parallel Bridge Corridor there would be less open water construction and, therefore, direct construction water quality impacts would be of a smaller temporal and spatial scale.

The Parallel Bridge Corridor with Nourishment Alternative would require offshore sand extraction for beach nourishment every four years for the duration of the 50-year planning period. Nourishment of parts of the nourishment area (rotating on a four-year cycle) would occur annually if material from the USACE ocean bar channel dredging were used in the nourishment program. Offshore sand removal could cause a decrease in dissolved oxygen levels by resuspending sediment particles into the water column, or if the pit created by dredging becomes anoxic. A mechanical dredge would likely be used for dredging. BMPs to minimize turbidity include silt curtains, modified operational procedures (slower dredging, fewer dredge deployments), and modified dredge heads (Anchor Environmental, 2003).

Beach nourishment also would generate localized impacts to water quality. Like dredging, the impacts would be primarily related to the resuspension of sediments. These impacts would occur with the Parallel Bridge Corridor with Nourishment Alternative and with the nourishment component of the Phased Approach/Rodanthe Nourishment Alternative, although impacts of the latter alternative would be smaller in scale because nourishment would only occur in the Rodanthe area. Shorelines are high-energy areas, and it is likely that the spike in turbidity would be of short duration and baseline water conditions would return after beach replenishment ceased.

As with construction of the Pamlico Sound Bridge Corridor, steps taken to minimize turbidity (when possible and practicable) would include the use of work bridges (rather than dredging for barges) for movement of construction equipment in shallow areas where SAV is present. Work bridges also would be used to carry construction equipment over intertidal marsh areas (black needlerush and smooth cordgrass) and wetlands on Hatteras Island.

Construction within the ponds in the interior of the Refuge that is associated with the Road North/Bridge South and All Bridge alternatives would generate localized impacts to water quality. These impacts would be temporary and most likely affect turbidity and siltation of sediments.

Overall, a substantial degradation of water quality would not likely result from construction activity in the Parallel Bridge Corridor. Bridge construction activity and dredging and beach nourishment would result in a temporary increase in turbidity and a potential decrease in dissolved oxygen. Opportunities to reduce the impact of jetting for driving piles are discussed in Section 2.10.1.3. Although water quality impacts associated with each dredge/nourishment event are likely to be short-term, dredge and nourishment activity would occur rather frequently (every four years or annually at locations rotated on a four-year cycle) and last through 2060.

Temporary BMPs to manage pollutants associated with construction activities such as sediment, pesticides, fertilizers, petrochemicals, construction chemicals, wash water, paper, wood, garbage, and sanitary waste would be implemented prior to the start of construction. Consistent with USEPA guidance (USEPA, 2005), site erosion, sediment, and chemical control measures would include an erosion and sediment control plan detailing provisions such as perimeter controls, stabilization of exposed areas, and construction sequencing that would be implemented prior to the start of construction.

Operational Impacts

The two Phased Approach alternatives (including the Preferred Alternative) also could permanently affect water quality in the near-shore area by increasing the amount of highway runoff in locations where the bridge would extend east of the 2060 high erosion future shoreline. Highway runoff can contain varying amounts of sediments, oils, grease, and metals, all of which can degrade water quality.

As previously mentioned, water quality impacts associated with current NC 12 operations are primarily related to the potential for contamination of receiving surface waters by runoff from impervious roadway surfaces. Table 4-16 presents the impervious areas used to estimate pollutant loadings associated with the existing bridge and highway facility and the replacement bridge corridor alternatives. The estimated annual pollutant loadings associated with the Parallel Bridge Corridor alternatives using the Simple Method and the FHWA Method are presented in Table 4-17 and Table 4-18, respectively.

Percent increases in annual pollutant loadings with reference to the No-Action Alternative are presented in Table 4-19. These values represent percent increase in annual loadings for each pollutant of concern. This comparative analysis indicates that the Parallel Bridge Corridor with Nourishment Alternative would result in the least change in annual pollutant loadings (ranging from 6 to 8 percent increase) with respect to existing conditions (Table 4-19). The increases in annual pollutant loadings for the four remaining Parallel Bridge Corridor alternatives are similar, as follows (from least to greatest increase): 23 to 31 percent for Road North/Bridge South; 22 to 35 percent for Phased Approach/Rodanthe Nourishment; 28 to 42 percent for Phased Approach/ Rodanthe Bridge Alternative (Preferred); and 33 to 43 percent for All Bridge (Table 4-19).

Best Management Practices (BMPs)

Similar to the Pamlico Sound Bridge Corridor alternatives, BMP treatments of runoff from the proposed Oregon Inlet bridge with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) prior to discharge into Oregon Inlet are being considered. The Oregon Inlet bridge length of between 2.6 and 3.2 miles (4.2 and 5.1 kilometers) for the Parallel Bridge Corridor alternatives is substantially shorter than the Pamlico Sound bridge (17.5-mile [28.2-kilometer] length); however, conveyance of highway runoff along the entire bridge length may still be infeasible because of slope requirements for pipe conveyance and maintenance requirements. Nevertheless, conveyance of bridge runoff may be possible for a longer portion of the total bridge length as compared to the Pamlico Sound Bridge Corridor alternatives since the proposed Oregon Inlet bridge is shorter. An end-of-pipe treatment could be feasible at the northern terminus as described above in the vicinity of the Oregon Inlet Marina to which a portion of the northern end of the proposed Oregon Inlet bridge could be conveyed. Similarly, there are potential land side treatment sites at the southern terminus of the proposed Oregon Inlet bridge near an existing parking area that accesses the existing catwalks and at the northern end of the Refuge. However, these sites would use land from the Refuge and could be found incompatible with the mission of the Refuge.

For the remaining portion of the Oregon Inlet bridge for all Parallel Bridge Corridor alternatives (including the Preferred Alternative), BSCs would be considered and applied appropriately to manage bridge deck runoff such as designing drainage systems that eliminate direct discharge and applying downstream stormwater controls to treat and mitigate bridge runoff as presented in NCDOT's BMP Toolbox. As discussed above for the Pamlico Sound Bridge Corridor alternatives, BSCs presented in NCDOT's BMP Toolbox, or proprietary devices applicable to controlling bridge deck runoff, would be considered for all bridge replacement segments traversing the receiving water bodies.

The Nourishment Alternative would include maintenance of the existing 12.5-mile (20.1-kilometer) long NC 12 roadway through the project area, supplemented with beach nourishment. Grassed swales or filtration trenches could be constructed along the roadway shoulders to address highway runoff resulting from the existing roadway. Depending on the space available and treatment capacity, these could be supplemented with other recommended BMPs such as bioretention and stormwater wetlands, as necessary. Some vegetated trenches and wetland areas currently exist through portions of the Refuge; therefore, trenches or swales could be used to convey and pre-treat runoff before tying into existing systems. This applies to the unchanged NC 12 segments and new roadways within the current easement specified for the remaining Parallel Bridge Corridor alternatives.

For the Phased Approach alternatives (including the Preferred Alternative), all of the Phase II, III, and IV bridges would be built over land within the existing NC 12 easement, but as the shoreline erodes, much of their length would be over water by 2060. When initially built over land, BSCs could include deck drains that route runoff to BMPs such as grassed swales which may be required to control and pre-treat the stormwater discharge and prevent erosion of the underlying land. This also would apply to the proposed bridges passing through the Refuge with the All Bridge Alternative. However, once the shoreline erodes and substantial lengths of the Phased Approach bridges are over water, these types of BSCs would no longer be possible for the entire length of the bridges. Subsequently, water quality in the near-shore area could be affected by the increasing amount of highway runoff discharged directly into the ocean. Therefore, BMPs for the Phased Approach alternatives' bridges over Hatteras Island would take into consideration the eventual location of substantial portions of these bridges over the beach and in the Atlantic Ocean.

The Road North/Bridge South and All Bridge alternatives would incorporate a new bridge at the southern end of the project area that passes over Pamlico Sound. Appropriate BSCs would be implemented to treat bridge deck runoff prior to discharge into the sound.

For Parallel Bridge Corridor bridges terminating in Rodanthe, bridge runoff could be conveyed to the southern terminus of the bridge and then to the undeveloped land near the Emergency Ferry Dock that is a potential site for similar BMPs with the Pamlico Sound Bridge Corridor alternatives.

Similar to the Pamlico Sound Bridge Corridor alternatives, the NCDOT would incorporate BMPs for stormwater management into the project design. Temporary BMPs to manage pollutants associated with construction activities, such as sediment, pesticides, fertilizers, petrochemicals, construction chemicals, wash water, paper, wood, garbage, and sanitary waste, would be implemented prior to the start of construction. Consistent with USEPA guidance (USEPA, 2005), site erosion, sediment, and chemical control measures would include an erosion and sediment control plan detailing provisions such as perimeter controls, stabilization of exposed areas, and construction sequencing that would be implemented prior to the start of construction.

4.7.3 Biotic Communities

Construction activities within the Pamlico Sound Bridge and the Parallel Bridge corridors would result in biological impacts in an extensive, sensitive, and highly productive coastal ecosystem. The Pamlico Sound Bridge Corridor alternatives would fill mostly man-dominated uplands. A bridge with a Curved Rodanthe Terminus would fill 2.0 acres (0.8 hectare) more than the Intersection Rodanthe Terminus. Since most fill impacts for both options would be to man-dominated uplands, the Pamlico Sound Bridge Corridor would not result in a substantial loss of natural biotic communities. The biotic communities fill impacts for the replacement bridge corridor alternatives, in order from greatest to least, would be as follows:

- <u>Road North/Bridge South</u>: 91.6 acres (37.1 hectares);
- <u>Nourishment</u>: 24.6 acres (10.0 hectares);

- All Bridge: 17.2 acres (7.0 hectares);
- Phased Approach/Rodanthe Bridge (Preferred): 16.2 acres (6.6 hectares);
- Pamlico Sound Bridge Corridor alternatives: 10.8 to 12.8 acres (4.4 to 5.2 hectares); and
- Phased Approach/Rodanthe Nourishment: 9.5 acres (3.9 hectares).

As seen above, all of the replacement bridge corridor alternatives, except the Parallel Bridge Corridor with Road North/Bridge South Alternative, would be of a similar order of magnitude in terms of fill impacts, with a maximum difference between these alternatives of 15.1 acres (6.1 hectares).

4.7.3.1 Pamlico Sound Bridge Corridor

Habitat modifications with the Pamlico Sound Bridge Corridor would result from shading and fill activities (construction fill and pile placement). Table 4-20 shows the total area of each biotic community that would be affected directly by fill. Shading impacts on wetland biotic communities are described in Section 4.7.4.

The Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus would fill mostly man-dominated uplands (5.7 acres [2.3 hectares]). Fill also would be placed as follows:

- 0.9 acre (0.4 hectare) on dunes;
- 1.2 acres (0.5 hectare) on wetland man-dominated;
- 0.5 acre (0.2 hectare) on maritime grassland wetlands;
- 0.1 acre (0.04 hectare) on wetland maritime shrub thicket; and
- 1.4 acres (0.6 hectare) on upland maritime shrub thicket.

On Bodie Island, a less than 0.01 acre (0.01 hectare) area of both smooth cordgrass and black needlerush wetlands would be affected by pile placement. Open water and SAV impacts would result from pile placement alone and total 2.7 acres (1.1 hectares) and 0.3 acre (0.1 hectare), respectively.

The Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus also would fill mostly man-dominated uplands (5.3 acres [2.1 hectares]). Fill also would be placed as follows:

- 0.9 acre (0.3 hectare) on dunes;
- 0.4 acre (0.2 hectare) on wetland man-dominated;
- 0.5 acre (0.2 hectare) on maritime grassland wetlands;
- 0.3 acre (0.1 hectare) on wetland maritime shrub thicket; and
- 0.5 acre (0.2 hectare) on upland maritime shrub thicket.

Table 4-20. Construction Fill and Pile Placement Impacts to Biotic Communities with the Pamlico Sound Bridge Corridor

Biotic Community	Subject to Section 404 Jurisdictional?	Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus in Acres (hectares)	Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus in Acres (hectares)
Open water			
• Aquatic bottom	Yes	2.69 (1.09)	2.70 (1.09)
• Submerged aquatic vegetation (SAV)	Yes	0.31 (0.13)	0.30 (0.12)
• Impoundments	Yes	0.00 (0.00)	0.00 (0.00)
Beach	No	0.00 (0.00)	0.00 (0.00)
Dunes	No	0.89 (0.36)	0.85 (0.34)
Wetland man-dominated	Yes	1.19 (0.48)	0.40 (0.16)
Upland man-dominated	No	5.65 (2.29)	5.27 (2.13)
Wetland salt shrub/grasslands	Yes	0.00 (0.00)	0.00 (0.00)
Upland salt shrub/grasslands	No	0.00 (0.00)	0.00 (0.00)
Wetland maritime grassland	Yes	0.52 (0.21)	0.46 (0.19)
Upland maritime grassland	No	0.00 (0.00)	0.00 (0.00)
Wetland overwash	Yes	0.00 (0.00)	0.00 (0.00)
Upland overwash	No	0.00 (0.00)	0.00 (0.00)
Wetland maritime shrub thicket	Yes	0.11 (0.04)	0.30 (0.12)
Upland maritime shrub thicket	No	1.43 (0.58)	0.54 (0.22)
Wetland reed stand	Yes	0.00 (0.00)	0.00 (0.00)
Upland reed stand	No	0.00 (0.00)	0.00 (0.00)
Salt flat[1]	Yes	0.00 (0.00)	0.00 (0.00)
Brackish marsh[1]	Yes	0.00 (0.00)	0.00 (0.00)
Smooth cordgrass[1]	Yes	<0.01 (<0.01)	<0.01 (<0.01)
Wetland black needlerush[1]	Yes	<0.01 (<0.01)	<0.01 (<0.01)
Upland black needlerush	No	0.00 (0.00)	0.00 (0.00)
TOTAL IMPACT		**12.81 (5.18)**	**10.84 (4.39)**

[1]CAMA coastal wetlands.

NOTE:
- Calculated areas are based on conditions as verified with the USACE through January 2004.
- Hectares were calculated from acres, thus minor rounding error exists when adding the individual hectare numbers.

Again, on Bodie Island, a less than 0.01 acre (0.01 hectare) area of both smooth cordgrass and black needlerush wetlands would be affected by pile placement. Open water impacts would result from pile placement alone and would total approximately 2.7 acres (1.1 hectares). SAV fill totaling 0.3 acre (0.1 hectare) also would result from pile placement.

Since most fill impacts for both options would be to man-dominated uplands, neither Rodanthe terminus option would result in a substantial loss of natural biotic communities. Fill impacts to the most important biotic communities, such as SAV, would be the same for either terminus option.

Construction dredging would affect Pamlico Sound. Construction of the Pamlico Sound Bridge Corridor could be accomplished most easily and economically by working directly from barges used for shipping materials to the construction site (see Section 2.9.5). For part of the Pamlico Sound Bridge Corridor, construction barges could float above the bottom of Pamlico Sound without dredging a channel. In waters less than 6.0 feet (1.8 meters), however, dredging would be needed. The dredge channel would be approximately 100 feet (30.5 meters) wide.

Approximately 9 miles (14.4 kilometers) of the Pamlico Sound Bridge Corridor is in waters less than 6 feet (1.8 meters) in depth. Of that distance, SAV is on the sound bottom for approximately 1 mile (1.6 kilometers), based on the most recent SAV mapping. Here, a work bridge would be used instead of barges. Dredging would occur along the remaining 8 miles (12.8 kilometers). Thus, it is estimated that approximately 100 acres (40.5 hectares) of aquatic bottom would be dredged to create a channel along the Pamlico Sound Bridge Corridor for use by construction barges. Where dredging is needed, the dredging would be to a depth of 8 feet (2.4 meters) to provide more flexibility for construction barge operations and reduce the need for redredging. Indirect dredging effects on biotic communities would result from increased turbidity, noise, and siltation; this activity might cause temporary reductions in adjacent communities' plant and animal components. Also, the potential increase in turbidity and sedimentation would reduce light penetration, affecting photosynthesis by phytoplankton and SAV.

Although dredging is required, the loss of SAV would be minimal because most of the known permanent SAV beds in the project area are east of the Pamlico Sound Bridge Corridor and because work bridges, rather than dredging, would be used in portions of the bridge corridor that contain SAV. The Pamlico Sound Bridge Corridor, by nature of its location near Oregon Inlet in deeper sound waters, would minimize impacts to SAV beds.

Work bridges also would be used during construction over SAV areas and intertidal marsh areas (black needlerush and smooth cordgrass) at the Bodie Island end of the Pamlico Sound Bridge Corridor bridge.

Some habitat would be regained (143.6 acres [58.1 hectares]) with the Pamlico Sound Bridge alternatives because the existing NC 12 pavement would be removed and replanted with native vegetation. This habitat would not be equivalent to native, undisturbed habitat. However, potential habitat created by the removal of NC 12 could be colonized very quickly by ephemeral species that inhabit maritime islands. Natural shoreline movement, allowed to occur after the removal of NC 12 maintenance dunes, also would contribute to naturalizing this area of the Outer Banks, and benefiting wildlife in the Refuge.

4.7.3.2 Parallel Bridge Corridor with NC 12 Maintenance

Table 4-21 shows the total area of each biotic community that would be affected directly by fill (construction fill and pile placement) from the Parallel Bridge Corridor and its five alternatives. Shading impacts on wetland biotic communities are described in Section 4.7.4. The biotic communities fill impacts for the Parallel Bridge Corridor alternatives, in order from greatest to least, would be as follows:

- Road North/Bridge South: 91.6 acres (37.1 hectares);
- Nourishment: 24.6 acres (10.0 hectares);
- All Bridge: 17.2 acres (7.0 hectares);
- Phased Approach/Rodanthe Bridge (Preferred): 16.2 acres (6.6 hectares); and
- Phased Approach/Rodanthe Nourishment: 9.5 acres (3.9 hectares).

Most fill impacts for all five Parallel Bridge Corridor alternatives would be to wetland open water, wetland black needlerush, wetland salt shrub/grassland, upland dune, and upland maritime shrub thicket. Fill impacts to SAV would be the same for the All Bridge and Road North/Bridge South alternatives (1.4 acres [0.6 hectare]). The Nourishment Alternative would affect 0.2 acre (0.1 hectare) of SAV. Fill impacts of the two Phased Approach alternatives (including the Preferred Alternative) would be comprised mostly of open water (2.44 acres [0.99 hectare]) and upland man-dominated (11.6 acres [4.7 hectares] with Rodanthe Bridge and 5.9 acres [2.4 hectares] with Rodanthe Nourishment). The two Phased Approach alternatives would affect 0.2 acre (0.1 hectare) of SAV.

Some habitat partially occupied by the bridges along the NC 12 easement would be regained with the Road North/Bridge South (106.1 acres [42.9 hectares]), All Bridge (100.4 acres [40.6 hectares]), and two Phased Approach alternatives (including the Preferred Alternative) (117.1 acres [47.4 hectares]). As projects are built, the existing NC 12 pavement would be removed and replanted with native vegetation. Temporary work roads associated with the Phased Approach alternatives also would be removed and replanted with native vegetation. This habitat would not be equivalent to native, undisturbed habitat. However, potential habitat created by the removal of NC 12 could be colonized very quickly by ephemeral species that inhabit maritime islands. Natural shoreline movement, allowed to occur except with the alternatives involving nourishment, also would contribute to naturalizing this area of the Outer Banks, and possibly benefit wildlife in the Refuge.

Like the Pamlico Sound Bridge Corridor, dredging during construction would affect Oregon Inlet. Construction of the Oregon Inlet bridge could be accomplished most easily and economically by working directly from barges used for shipping materials to the construction site (see Section 2.10.1.3). For much of the area of the Oregon Inlet bridge, construction barges could float above the bottom of the inlet without dredging a channel. In waters less than 6.0 feet (1.8 meters), however, an alternative would be needed. Thus, in the area near the northern end of Hatteras Island where the sand bars are shoaling, a dredge channel would likely be required approximately 120 feet (36.6 meters) wide and approximately 30 feet from the bridge. Use of a temporary haul road could be used west of Bodie Island.

Table 4-21. Total Construction Fill and Pile Placement Impacts to Biotic Communities with the Parallel Bridge Corridor

Biotic Community	Subject to Section 404 Jurisdic-tions?	Parallel Bridge Corridor with Nourish-ment Alternative in Acres (hectares)	Parallel Bridge Corridor with Road North/Bridge South Alternative in Acres (hectares)	Parallel Bridge Corridor with All Bridge Alternative in Acres (hectares)	Parallel Bridge Corridor with Phased Approach/ Rodanthe Bridge Alternative in Acres (hectares)	Parallel Bridge Corridor with Phased Approach/ Rodanthe Nourishment Alternative in Acres (hectares)
Open water						
• Aquatic bottom	Yes	2.40 (0.96)	3.90 (1.58)	3.82 (1.55)	2.44 (0.99)	2.44 (0.99)
• Submerged aquatic vegetation (SAV)	Yes	0.20 (0.08)	1.40 (0.56)	1.40 (0.56)	0.20 (0.10)	0.20 (0.10)
• Impoundments	Yes	0.00 (0.00)	22.11 (8.95)	0.43 (0.17)	0.00 (0.00)	0.00 (0.00)
Beach	No	0.13 (0.05)	0.02 (0.01)	0.02 (0.01)	0.03 (0.01)	0.03 (0.01)
Dunes	No	10.44 (4.18)	0.38 (0.15)	0.25 (0.10)	0.39 (0.16)	0.23 (0.09)
Wetland man-dominated	Yes	0.15 (0.06)	0.18 (0.07)	0.15 (0.06)	0.00 (0.00)	0.00 (0.00)
Upland man-dominated	No	1.68 (0.67)	3.92 (1.57)	2.48 (0.99)	11.60 (4.69)	5.87 (2.38)
Wetland salt shrub/grasslands	Yes	0.00 (0.00)	29.39 (11.76)	2.64 (1.06)	0.01 (0.00)	0.01 (0.00)
Upland salt shrub/grasslands	No	1.14 (0.46)	0.64 (0.26)	1.87 (0.75)	0.15 (0.06)	0.06 (0.02)
Wetland maritime grassland	Yes	0.10 (0.04)	0.27 (0.11)	0.15 (0.06)	0.08 (0.03)	0.05 (0.02)
Upland maritime grassland	No	0.00 (0.00)	0.23 (0.09)	0.02 (0.01)	0.01 (0.00)	0.01 (0.00)
Wetland overwash	Yes	0.00 (0.00)	1.49 (0.60)	0.20 (0.08)	0.00 (0.00)	0.00 (0.00)
Upland overwash	No	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.12 (0.05)	0.12 (0.05)
Wetland maritime shrub thicket	Yes	0.90 (0.36)	6.67 (2.67)	1.33 (0.53)	0.05 (0.02)	0.05 (0.02)
Upland maritime shrub thicket	No	6.89 (2.76)	8.12 (3.25)	0.24 (0.10)	0.83 (0.34)	0.13 (0.05)
Wetland reed stand	Yes	0.20 (0.08)	0.94 (0.38)	0.03 (0.01)	0.00 (0.00)	0.00 (0.00)
Upland reed stand	No	0.02 (0.01)	0.02 (0.01)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Salt Flat[1]	Yes	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Brackish marsh[1]	Yes	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Smooth cordgrass[1]	Yes	0.20 (0.08)	0.22 (0.09)	0.22 (0.09)	0.20 (0.08)	0.20 (0.08)
Wetland black needlerush[1]	Yes	0.13 (0.05)	11.58 (4.63)	1.96 (0.78)	0.13 (0.05)	0.13 (0.05)
Upland black needlerush	No	0.00 (0.00)	0.12 (0.05)	0.01 (0.00)	0.00 (0.00)	0.00 (0.00)
TOTAL IMPACT		**24.58 (9.95)**	**91.60 (37.07)**	**17.22 (6.97)**	**16.24 (6.57)**	**9.53 (3.86)**

[1]CAMA coastal wetlands.

NOTE:

- Calculated areas are based on conditions as verified with the USACE through June 2005.
- Hectares were calculated from acres, thus minor rounding error exists when adding the individual hectare numbers.

*Preferred Alternative

Approximately 2,000 feet (610 meters) of the Oregon Inlet bridge in the Oregon Inlet Shoal area is likely to be in less than 6.0 feet (1.8 meters) of water. Approximately 5.5 acres (2.2 hectares) of aquatic bottom would be dredged to create a channel that is 120 feet (61 meters) wide for use by construction barges. Indirect dredging effects on biotic communities would result from increased turbidity, noise, and siltation; this activity might cause temporary reductions in adjacent communities' plant and animal components. Also, the potential increase in turbidity and sedimentation would reduce light penetration, affecting photosynthesis by phytoplankton and SAV.

A temporary haul road could be built for construction of the north approach spans on the Bodie Island end of the Oregon Inlet bridge. It would be placed on the west side of the new bridge near the outside edge of the foundations. It would affect 6.5 acres (2.6 hectares) of biotic communities, including 0.5 acre (0.2 hectare) of wetland black needlerush, 0.4 acre (0.2 hectare) of wetland maritime shrub thicket, 4.5 acres (1.8 hectares) of wetland open water/SAV (2.4 acres [0.9 hectare] of SAV affected), 0.6 acre (0.2 hectare) of smooth cordgrass, 0.2 acre (0.1 hectare) of upland dune, and 0.3 acre (0.1 hectare) of upland maritime shrub thicket. Dredging the area could be an alternative to a haul road. Use of a work bridge instead of a haul road or dredging, particularly for short distances at critical locations, such as SAV locations, would be considered prior to construction. Reasons for use of a temporary haul road are described in Section 2.10.1.3. The effects of a temporary haul road depend on the nature of the subsoil. If the subsoil is marine sand with little organic accumulation, the impacts would be minimal, involving only distortion of the upper root zone. To avoid the risk of permanent damage to plants within the footprint of the haul road, they could be transplanted to a "heeling-in" area until the demolition operation was completed. Following construction activities and removal of the temporary road, the plants could be planted and re-established in their original bed. If, however, there is a substantial organic or muck layer beneath the marsh, the construction of a temporary haul road would cause permanent changes in the marsh resulting from consolidation and distortion of the subsoil. Changes in biodiversity, as well as organic productivity, could be a direct result of the compaction and distortion of these marine sediments. However, the likelihood of there being a substantial area of organic material under the haul road is remote. There is only a thin layer of organic material covering sand in this area, which is not compactable. Therefore, the possibility of compaction is minimal.

Although dredging and a temporary haul road would be required to construct the Oregon Inlet bridge, the loss of SAV would be minimal because most of the known permanent SAV beds in the project area are west of the Parallel Bridge Corridor (except in the Rodanthe and Bodie Island areas) and because work bridges, rather than dredging, would be used in portions of the bridge corridor that contain SAV.

When working over water where SAV is present or over wetlands, other bridges associated with the Road North/Bridge South and All Bridge alternatives in the Rodanthe area would be erected from a work bridge. Most of the area over which the bridges would pass is classified as wetland. Given the closeness of the Rodanthe area bridge to the west side of Hatteras Island, it is expected that SAV would be present along most, if not all, of the bridge length over water.

In addition to the temporary construction impacts described above for the other Parallel Bridge Corridor alternatives, the Phased Approach alternatives (including the Preferred Alternative) would have temporary habitat impacts of 48.5 acres (19.6 hectares) as a result of temporary traffic maintenance roads, as described in Section 2.10. Table 4-22 shows the total area of each biotic community that would be temporarily affected by these roads. These impacts generally would be within the Refuge and would be the same for both Phased Approach alternatives. The habitat affected the greatest by these temporary roads would be man-dominated uplands (20.7 acres [8.4 hectares]). Temporary road fill also would be placed in 27.8 acres (11.2 hectares) of

Table 4-22. Temporary Construction Fill and Pile Placement Impacts to Biotic Communities with the Parallel Bridge Corridor with Phased Approach Alternatives (including the Preferred Alternative)

Biotic Community	Subject to Section 404 Jurisdiction?	Parallel Bridge Corridor with Phased Approach Alternatives in Acres (hectares)
Open water		
• Aquatic bottom	Yes	0.61 (0.25)
• Submerged aquatic vegetation (SAV)	Yes	0.00 (0.00)
• Impoundments	Yes	0.22 (0.09)
Beach	No	0.00 (0.00)
Dunes	No	0.00 (0.00)
Wetland man-dominated	Yes	0.00 (0.00)
Upland man-dominated	No	20.68 (8.37)
Wetland salt shrub/grasslands	Yes	1.56 (0.63)
Upland salt shrub/grasslands	No	2.29 (0.93)
Wetland maritime grassland	Yes	1.30 (0.53)
Upland maritime grassland	No	3.93 (1.59)
Wetland overwash	Yes	0.72 (0.29)
Upland overwash	No	7.98 (3.23)
Wetland maritime shrub thicket	Yes	0.44 (0.18)
Upland maritime shrub thicket	No	5.94 (2.40)
Wetland reed stand	Yes	0.64 (0.26)
Upland reed stand	No	0.23 (0.09)
Salt flat[1]	Yes	0.00 (0.00)
Brackish marsh[1]	Yes	0.00 (0.00)
Smooth cordgrass[1]	Yes	0.00 (0.00)
Wetland black needlerush[1]	Yes	0.96 (0.39)
Upland black needlerush	No	1.00 (0.40)
TOTAL IMPACT		**48.50 (19.63)**

[1]CAMA coastal wetlands.

- Calculated areas are based on conditions as verified with the USACE through June 2005.
- Hectares were calculated from acres, thus minor rounding error exists when adding the individual hectare numbers.

15 non-man-dominated habitat types with impacts ranging from 0.23 acre (0.09 hectare) to 8 acres (3.2 hectares) as shown in Table 4-22. A potential construction haul road on Bodie Island would affect 2.4 acres (0.97 hectare) of SAV.

Temporary traffic management roads built within the existing NC 12 easement would affect 10.4 acres (4.2 hectares) twice. Initial temporary impacts, accounted for in Table 4-22, would be affected a second time when Phase II and Phase III permanent bridges are lengthened in Phase IV. Temporary roads would be needed adjacent to the approach bridges and fills that took earlier phases back down to ground level to allow their removal prior to extending the full height bridge as a part of the next phase. The first impact would be to the current habitat type. The second impact would affect areas replanted with native vegetation after the completion of Phase II or III. The length of time between impacts would be approximately 10 years (when connecting Phase III bridge to Phase IV) to 18 years (when connecting Phase III bridges to Phase IV) assuming the phasing schedule presented in Section 2.10.2.5.

With the Phased Approach alternatives (including the Preferred Alternative), the habitat affected by the completed bridges would change from what is described above over time as the shoreline erodes under the bridges. Table 4-23 shows how this impact would change from 2020 to 2060 for the Phased Approach/Rodanthe Bridge Alternative (Preferred). The table indicates that over time the portion of Phases II to IV in the ocean would increase while the length of beach would decline somewhat after peaking in 2020. During construction, the entire Phase II to IV project would be within the "other" habitat category because Phases II and IV would not be constructed on the beach or in the ocean. The wet beach area is the intertidal zone under the jurisdiction of the USACE under Section 404 of the Clean Water Act.

4.7.4 Wetlands and Open Water Habitat

In terms of Section 404 (Clean Water Act) jurisdictional areas impact, the Parallel Bridge Corridor with Road North/Bridge South Alternative would have the largest impact of the replacement bridge corridor alternatives at 78.2 acres (31.6 hectares), consisting of 50.7 acres (20.5 hectares) of wetland and 27.4 acres (11.1 hectares) of open water. The jurisdictional area impact of the other six replacement bridge corridor alternatives would be at a comparable order-of-magnitude with the All Bridge Alternative being the greatest at 12.3 acres (5.0 hectares), including 6.7 acres (2.7 hectares) of wetland and 5.7 acres (2.3 hectares) of open water, and the Phased Approach alternatives (including the Preferred Alternative) being the least at 3.1 acres (1.3 hectares). Fill of CAMA coastal wetlands also would be greatest (11.8 acres [4.8 hectares]) with the Road North/Bridge South Alternative.

The Parallel Bridge Corridor bridge structure would shade mostly open water. Shading impacts to SAV and wetland biotic communities on Bodie Island and Hatteras Island would vary between the five alternatives, with the All Bridge Alternative having the greatest impact at approximately 44.5 acres (18.0 hectares), including 17.0 acres (6.9 hectares) of wetland and 27.5 acres (11.1 hectares) of open water, and the Nourishment Alternative having the least impact at approximately 10.1 acres (4.1 hectares), including 1.5 acres (0.6 hectare) of wetland and 8.6 acres (3.5 hectares) of open water. The Pamlico Sound bridge structure would shade mostly open water. Shading impacts to SAV and the wetland biotic communities would be up to 84.9 acres (34.4 hectares), including 1.2 acres (0.5 hectare) of wetland and 83.7 acres (33.9 hectares) of open water.

Table 4-23. Bridge Length and Area beneath Bridge by Habitat and Year

Year	Ocean Habitat Bridge Length/ Shaded Area Beneath Bridge[a] in Miles (kilometers)/ Acres (hectares)	Wet Beach[b] Habitat Bridge Length/ Shaded Area Beneath Bridge[a] in Miles (kilometers)/ Acres (hectares)	Dry Beach[c] Habitat Bridge Length/ Shaded Area Beneath Bridge[a] in Miles (kilometers)/ Acres (hectares)	Total Beach Habitat Bridge Length/ Shaded Area Beneath Bridge[a] in Miles (kilometers)/ Acres (hectares)	Other[d] Habitat Bridge Length/ Shaded Area Beneath Bridge[a] in Miles (kilometers)/ Acres (hectares)
2020	3.60 (5.79)/ 18.53 (7.50)	1.42 (2.29)/ 7.30 (2.95)	1.84 (2.96)/ 9.48 (3.84)	3.26 (5.25)/ 16.78 (6.79)	3.64 (5.86)/ 18.73 (7.58)
2030	4.80 (7.72)/ 24.75 (10.02)	1.78 (2.86)/ 9.16 (3.71)	1.09 (1.75)/ 5.62 (2.27)	2.87 (4.62)/ 14.78 (5.98)	5.37 (8.64)/ 27.65 (11.19)
2040	6.23 (10.03)/ 32.08 (12.98)	1.22 (1.96)/ 6.27 (2.54)	1.25 (2.01)/ 6.44 (2.61)	2.47 (3.98)/ 12.71 (5.14)	4.35 (7.00)/ 22.39 (9.06)
2050	7.24 (11.65)/ 37.31 (15.10)	1.00 (1.61)/ 5.15 (2.08)	1.43 (2.30)/ 7.37 (2.98)	2.43 (3.91)/ 12.52 (5.07)	3.37 (5.42)/ 17.34 (7.02)
2060	7.98 (12.84)/ 41.13 (16.64)	1.35 (2.17)/ 6.94 (2.81)	1.10 (1.77)/ 5.67 (2.29)	2.45 (3.94)/ 12.61 (5.10)	2.61 (4.20)/ 13.43 (5.43)

[a] Based on bridge length times width of 42.5 feet (13.0 meters).
[b] Wet beach habitat is area between low tide shoreline and 100 feet (30.5 meters) landward, based on average width estimated from 2007 aerial photography.
[c] Dry beach habitat is area between 100 and 200 feet (30.5 meters and 61.0 meters) landward of low tide shoreline, based on average width estimated from 2007 aerial photography.
[d] Other habitat is habitat not in ocean or on beach.

All of the Parallel Bridge Corridor alternatives also could have temporary Section 404 jurisdictional area impacts, associated with a temporary haul road for Oregon Inlet bridge construction access on Bodie Island, of approximately 6.0 acres (2.4 hectares), including 1.5 acres (0.6 hectare) of wetland and 4.5 acres (1.8 hectares) of open water. These temporary impacts also would include approximately 1.1 acres (0.4 hectare) of CAMA coastal wetlands. The two Phased Approach alternatives (including the Preferred Alternative) would result in an additional 6.5 acres (2.6 hectares) of temporary jurisdictional area impacts associated with construction of a temporary traffic maintenance road within the existing NC 12 easement on Hatteras Island, including 5.6 acres (2.3 hectares) of wetland and 0.8 acre (0.3 hectare) of open water. The total temporary jurisdictional area impacts for the Phased Approach alternatives (including the Preferred Alternative) would be 12.5 acres (5.0 hectares), including 7.1 acres (2.9 hectares) of wetland and 5.3 acres (2.2 hectares) of open water.

4.7.4.1 Pamlico Sound Bridge Corridor

The areas of individual jurisdictional community types affected by shading and by fill and pile placement for the Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus and the Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus are listed in Table 4-24.

A bridge in the Pamlico Sound Bridge Corridor would fill 4.8 acres (2.0 hectares) of jurisdictional areas with the Curved Rodanthe Terminus, including 1.8 acres (0.7 hectare) of wetland and 3.0 acres (1.2 hectares) of open water. The fill impact to jurisdictional areas would be 4.2 acres (1.7

hectares) with the Intersection Rodanthe Terminus, including 1.2 acres (0.5 hectare) of wetland and 3.0 acres (1.2 hectares) of open water. Fill of CAMA coastal wetlands (salt flat, brackish marsh, smooth cordgrass, and black needlerush) would each make up less than 0.01 acre (0.01 hectare) of this total. Fill in jurisdictional areas would primarily affect man-dominated wetlands, maritime shrub thicket wetlands, maritime grassland wetlands, and open water/aquatic bottom.

The Pamlico Sound Bridge Corridor's bridge structure also would shade Section 404 jurisdictional areas (see Table 4-24). The bridge structure would be approximately 40 feet (12.2 meters) wide and the bottom of its superstructure generally would be 10 feet (3.1 meters) above mean high water. The Pamlico Sound bridge structure would shade mostly open water. Shading impacts to SAV and the wetland biotic communities on Bodie Island and Hatteras Island would be similar under either terminus option at up to 84.9 acres (34.4 hectares), including 1.2 acres (0.5 hectare) of wetland and 83.7 acres (33.9 hectares) of open water. Less than 1 acre (0.4 hectare) of CAMA coastal wetlands would be shaded with either alternative.

Table 4-24. Shading, Fill, and Pile Placement Impacts to Wetlands and Waters for the Pamlico Sound Bridge Corridor

Biotic Community	Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus in Acres (hectares)		Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus in Acres (hectares)	
	Shading	Fill and Pile	Shading	Fill and Pile
Open water				
• Aquatic bottom	73.80 (29.88)	2.69 (1.09)	74.80 (30.28)	2.70 (1.09)
• SAV[1]	9.20 (3.72)	0.31 (0.13)	8.90 (3.60)	0.30 (0.12)
TOTAL OPEN WATER IMPACT	**83.00 (33.50)**	**3.00 (1.21)**	**83.70 (33.88)**	**3.00 (1.21)**
Wetland				
• Wetland man-dominated	0.04 (0.02)	1.19 (0.48)	0.06 (0.02)	0.40 (0.16)
• Wetland maritime grassland	0.00 (0.00)	0.52 (0.21)	0.00 (0.00)	0.46 (0.19)
• Salt shrub/grasslands	<0.01 (<0.01)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Wetland maritime shrub thicket	0.51 (0.21)	0.11(0.04)	0.50 (0.20)	0.30 (0.12)
• Reed stand	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Brackish marsh[2]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Smooth cordgrass[2]	0.50 (0.20)	<0.01 (<0.01)	0.49 (0.20)	<0.01 (<0.01)
• Black needlerush[2]	0.14 (0.06)	<0.01 (<0.01)	0.14 (0.06)	<0.01 (<0.01)
TOTAL WETLAND IMPACT	**1.20 (0.49)**	**1.84 (0.74)**	**1.19 (0.48)**	**1.18 (0.48)**
TOTAL IMPACT	**84.20 (34.09)**	**4.84 (1.96)**	**84.89 (34.37)**	**4.18 (1.69)**

[1] Indicates area of SAV based on unpublished NOAA/DMF mapping and limited ground truthing of imagery taken during 1985-1990. A survey conducted in September 2007 indicated that the current area of SAV coverage is similar to that reported when previous mapping was conducted (NCDOT, 2007).
[2] CAMA coastal wetlands.
NOTE: Hectares were calculated from acres, thus minor rounding error exists when adding the individual hectare numbers.

During construction, a work bridge would be used over intertidal marsh areas (black needlerush and smooth cordgrass) at the Bodie Island end of the Pamlico Sound bridge.

No practicable alternatives exist that would avoid impacts to Section 404 and CAMA coastal wetlands because of the pervasive nature of the resource. Where fill or pile placement is not required, the loss of flora and fauna associated with construction activity would be short-term. Also, the permanent loss of wetland habitat and function would be replaced through required compensatory mitigation. Mitigation is discussed in Section 4.7.10.

The bulk of the area affected by dredging and jetting/driving pile placement would be unvegetated aquatic bottom. The dynamics of the project area suggest that the bottom sand would, however, replenish itself over time, and losses would be temporary and short-term. Dredging is not planned in areas containing SAV. However, turbidity and siltation induced by dredging and the jetting-during-driving pile installation process could disturb or eliminate SAV in the vicinity of these activities. Opportunities to reduce the impact of jetting are discussed in Section 2.10.1.3.

4.7.4.2 Parallel Bridge Corridor with NC 12 Maintenance

The areas of individual Section 404 jurisdictional community types affected by shading and by fill and pile placement for the Parallel Bridge Corridor alternatives are listed in Table 4-25.

A bridge and/or relocated NC 12 in the Parallel Bridge Corridor would have the greatest fill impacts on jurisdictional areas with the Road North/Bridge South Alternative at approximately 78.2 acres (31.6 hectares), consisting of 50.7 acres (20.5 hectares) of wetland and 27.4 acres (11.1 hectares) of open water. The Nourishment Alternative would fill approximately 4.3 acres (1.7 hectares) of jurisdictional areas, consisting of 1.7 acres (0.7 hectare) of wetland and 2.6 acres (1.1 hectares) of open water. The All Bridge Alternative would fill 12.3 acres (5.0 hectares) of jurisdictional areas, consisting of 6.7 acres (2.7 hectares) of wetland and 5.7 acres (2.3 hectares) of open water. Both Phased Approach alternatives (including the Preferred Alternative) would fill approximately 3.1 acres (1.3 hectares) of jurisdictional areas. In addition, the Nourishment Alternative would require up to 76.5 acres (31.0 hectares) of jurisdictional intertidal beach to be nourished with sand (i.e., a rectangular area in the intertidal zone approximately 6.3 miles [10.1 kilometers] long by 100 feet [30.5 meters] wide) and the Phased Approach/Rodanthe Nourishment Alternative would require beach nourishment of up to 13.8 acres (5.6 hectares) (i.e., a rectangular area in the intertidal zone approximately 6,000 feet [1,829 meters] long by 100 feet [30.5 meters] wide).

Fill of CAMA coastal wetlands would be the greatest with the Road North/Bridge South Alternative at approximately 11.8 acres (4.8 hectares), consisting of 11.6 acres (4.6 hectares) of wetland black needlerush and 0.2 acre (0.1 hectare) of smooth cordgrass. The All Bridge Alternative would fill approximately 2.2 acres (0.9 hectare) of CAMA coastal wetlands (2.0 acres [0.8 hectare] of wetland black needlerush and 0.2 acre [0.1 hectare] of smooth cordgrass), whereas the Nourishment Alternative would only fill approximately 0.3 acre (0.1 hectare) of CAMA coastal wetlands. The two Phased Approach alternatives (including the Preferred Alternative) would fill 0.3 acre (0.1 hectare) of CAMA coastal wetlands (0.1 acre [0.1 hectare] of black needlerush and 0.2 acre [0.1 hectare] of smooth cordgrass). CAMA wetland fill would primarily affect maritime shrub thicket wetlands, salt shrub grassland wetlands, and open water/impoundments.

Table 4-25. Shading, Fill, and Pile Placement Impacts to Wetlands and Waters for the Parallel Bridge Corridor

Biotic Community	Parallel Bridge Corridor with Nourishment Alternative in Acres (hectares)		Parallel Bridge Corridor with Road North/Bridge South Alternative in Acres (hectares)		Parallel Bridge Corridor with All Bridge Alternative in Acres (hectares)		Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative* in Acres (hectares)		Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative in Acres (hectares)	
	Shading	Fill and Pile	Shading	Fill and Pile	Shading	Fill and Pile	Shading	Fill and Pile	Shading	Fill and Pile
Open Water										
• Aquatic bottom	7.62 (3.08)	2.40 (0.96)	8.24 (3.33)	3.90 (1.58)	8.64 (3.50)	3.82 (1.55)	5.37 (2.18)	2.44 (0.99)	5.37 (2.18)	2.44 (0.99)
• SAV[1]	1.01 (0.40)	0.20 (0.08)	7.32 (2.93)	1.40 (0.56)	7.32 (2.93)	1.40 (0.56)	1.01 (0.40)	0.20 (0.08)	1.01 (0.40)	0.20 (0.08)
• Impoundments	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	22.11 (8.95)	11.54 (4.67)	0.43 (0.17)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
TOTAL OPEN WATER IMPACT	**8.63 (3.49)**	**2.60 (1.05)**	**15.56 (6.30)**	**27.41 (11.09)**	**27.50 (11.13)**	**5.65 (2.29)**	**6.38 (2.58)**	**2.64 (1.07)**	**6.38 (2.58)**	**2.64 (1.07)**
Wetland										
• Wetland man-dominated	0.00 (0.00)	0.15 (0.06)	0.00 (0.00)	0.18 (0.07)	0.00 (0.00)	0.15 (0.06)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Salt shrub/grasslands	0.00 (0.00)	0.00 (0.00)	0.05 (0.02)	29.39 (11.76)	9.38 (3.75)	2.64 (1.06)	0.44 (0.18)	0.01 (0.00)	0.45 (0.18)	0.01 (0.00)
• Wetland maritime grassland	0.00 (0.00)	0.10 (0.04)	0.00 (0.00)	0.27 (0.11)	0.00 (0.00)	0.15 (0.06)	2.08 (0.84)	0.08 (0.03)	2.07 (0.84)	0.05 (0.02)
• Wetland overwash	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.49 (0.60)	0.00 (0.00)	0.20 (0.08)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Wetland maritime shrub thicket	0.40 (0.19)	0.90 (0.36)	0.67 (0.27)	6.67 (2.67)	1.69 (0.68)	1.33 (0.53)	0.56 (0.23)	0.05 (0.02)	0.56 (0.23)	0.05 (0.02)
• Reed stand	0.00 (0.00)	0.20 (0.08)	0.30 (0.12)	0.94 (0.38)	0.31 (0.12)	0.03 (0.01)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Salt flat[2]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Brackish marsh[2]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Smooth cordgrass[2]	0.59 (0.28)	0.20 (0.08)	0.80 (0.32)	0.22 (0.09)	0.81 (0.32)	0.22 (0.09)	0.39 (0.16)	0.20 (0.08)	0.39 (0.16)	0.20 (0.08)
• Black needlerush[2]	0.50 (0.24)	0.13 (0.05)	1.35 (0.54)	11.58 (4.63)	4.81 (1.92)	1.96 (0.78)	0.50 (0.20)	0.13 (0.08)	0.37 (0.15)	0.13 (0.08)
TOTAL WETLAND IMPACT	**1.49 (0.60)**	**1.68 (0.68)**	**3.17 (1.28)**	**50.74 (20.53)**	**17.00 (6.88)**	**6.68 (2.70)**	**3.97 (1.61)**	**0.47 (0.19)**	**3.84 (1.55)**	**0.44 (0.18)**
Intertidal Beach	NA	76.51 (30.96)	NA	NA	NA	NA	NA	NA	NA	13.8 (5.58)
TOTAL IMPACT	**10.12 (4.10)**	**4.28 (1.73)**	**18.73 (7.60)**	**78.15 (31.63)**	**44.50 (18.01)**	**12.33 (4.99)**	**10.35 (4.19)**	**3.11 (1.26)**	**10.22 (4.14)**	**3.08 (1.25)**

[1]Indicates area of SAV based on unpublished NOAA/DMF mapping and limited ground truthing of imagery taken during 1985-1990. A survey conducted in September 2007 indicated that the current area of SAV coverage is similar to that reported when previous mapping was conducted (NCDOT, 2007).
[2]CAMA coastal wetlands.

- Calculated areas are based on conditions as verified with the USACE through June 2005.
- Hectares were calculated from acres, thus minor rounding error exists when adding the individual hectare numbers.

*Preferred Alternative

The Parallel Bridge Corridor's bridge structure also would shade Section 404 jurisdictional areas (see Table 4-25). The bridge structure on Hatteras Island and west of Rodanthe with the Road North/Bridge South and All Bridge alternatives would be approximately 40 feet (12.2 meters) wide (clear roadway width) and the bottom of its superstructure generally would be 10 feet (3.1 meters) above mean high water. The bridge structure on Hatteras Island with the Phased Approach alternatives (including the Preferred Alternative) would be 40 feet (12.2 meters) wide (clear roadway width) and the bottom of its superstructure generally would be 25 feet (7.6 meters) above mean high water. The Oregon Inlet bridge also would be approximately 40 feet (12.2 meters) wide (clear roadway width). Its height would vary. When west of Bodie Island it would be approximately 75 feet (22.9 meters) above mean high water. At its Hatteras Island terminus the superstructure would be 25 to 70 feet (7.6 to 21.3 meters) above mean high water as it enters the Island depending on the alternative, but would quickly drop to ground or to a bridge 10 feet (3.1 meters) above ground level with the All Bridge Alternative. The proposed bridge structure would shade mostly open water and salt shrub/grassland wetlands. Shading impacts to SAV and wetland biotic communities on Bodie Island and Hatteras Island would vary between the five alternatives, with the All Bridge Alternative having the greatest impact at approximately 44.5 acres (18.0 hectares), including 17.0 acres (6.9 hectares) of wetland and 27.5 acres (11.1 hectares) of open water, and the Nourishment Alternative having the least impact at approximately 10.1 acres (4.1 hectares), including 1.5 acres (0.6 hectare) of wetland and 8.6 acres (3.5 hectares) of open water. Shading impacts to SAV and wetland biotic communities would be 18.7 acres (7.6 hectares) with the Road North/Bridge South Alternative, including 3.2 acres (1.3 hectares) of wetland and 15.6 acres (6.3 hectares) of open water. For the Phased Approach/Rodanthe Bridge Alternative (Preferred), the shading impacts would be approximately 10.4 acres (4.2 hectares), including 4.0 acres (1.6 hectares) of wetland and 6.4 acres (2.6 hectares) of open water. For the Phased Approach/Rodanthe Nourishment Alternative, the shading impacts would be approximately 10.2 acres (4.1 hectares), including 3.8 acres (1.6 hectares) of wetland and 6.4 acres (2.6 hectares) of open water. No more than approximately 5.6 acres (2.2 hectares) of CAMA coastal wetlands would be shaded with any one alternative.

Because of the phased timeline of construction with the Phased Approach alternatives (including the Preferred Alternative), wetland impacts could be less in Phases III and IV since westward sand movement within the Refuge could fill what are now considered wetlands in the NC 12 easement before bridge construction begins. It is unlikely that future shoreline erosion and associated habitat change will result in greater wetland impacts during future construction phases than those that exist today. This is because future overwash is likely to fill eastern portions of existing wetland. New wetland formation as a result of overwash or westward migration is likely to occur west of the NC 12 easement into which the Phased Approach alternatives would be placed.

During construction of any of the Parallel Bridge Corridor alternatives (including the Preferred Alternative), a temporary haul road could be used over open water and intertidal marsh areas (black needlerush and smooth cordgrass) at the Bodie Island end of the proposed bridge. It would affect 6.0 acres (2.4 hectares) of jurisdictional communities (see Table 4-26), including 0.5 acre (0.2 hectare) of wetland black needlerush, 0.4 acre (0.2 hectare) of wetland maritime shrub thicket, 0.6 acre (0.2 hectare) of smooth cordgrass, and 4.5 acres (1.8 hectares) of open water habitat. Of the open water affected, 2.4 acres (1.0 hectare) would consist of SAV habitat. A survey conducted by NCDOT in the fall of 2007 confirmed that SAV distribution has not changed significantly since the figures produced in this report were calculated. However, patches of SAV move around from year to year, and may be present in more of the available habitat in the future. Dredging in the same area or a work bridge also could be considered.

Table 4-26. Temporary Impacts to Wetlands and Waters for the Parallel Bridge Corridor

Biotic Community	Impact in Acres (hectares)		
	Bodie Island Temporary Haul Road (All Parallel Bridge Corridor Alternatives)*	Hatteras Island Temporary Traffic Maintenance Road (Phased Approach Alternatives only)*	Total for Phased Approach Alternatives*
Open Water			
• Aquatic bottom	2.10 (0.85)	0.61 (0.25)	2.71 (1.10)
• SAV[1]	2.40 (0.97)	0.00 (0.00)	2.40 (0.97)
• Impoundments	0.00 (0.00)	0.22 (0.09)	0.22 (0.09)
TOTAL OPEN WATER IMPACT	**4.50 (1.82)**	**0.83 (0.34)**	**5.33 (2.16)**
Wetland			
• Wetland man-dominated	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Salt shrub/grasslands	0.00 (0.00)	1.56 (0.63)	1.56 (0.63)
• Wetland maritime grassland	0.00 (0.00)	1.30 (0.53)	1.30 (0.53)
• Wetland overwash	0.00 (0.00)	0.72 (0.29)	0.72 (0.29)
• Wetland maritime shrub thicket	0.40 (0.16)	0.44 (0.18)	0.84 (0.34)
• Reed stand	0.00 (0.00)	0.64 (0.26)	0.64 (0.26)
• Salt flat[2]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Brackish marsh[2]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
• Smooth cordgrass[2]	0.60 (0.24)	0.00 (0.00)	0.60 (0.24)
• Black needlerush[2]	0.50 (0.20)	0.96 (0.39)	1.46 (0.59)
TOTAL WETLAND IMPACT	**1.50 (0.60)**	**5.62 (2.27)**	**7.12 (2.88)**
TOTAL IMPACT	**6.00 (2.43)**	**6.45 (2.61)**	**12.45 (5.04)**

[1]Indicates area of SAV based on unpublished NOAA/DMF mapping and limited ground truthing from imagery taken during 1985-1990. A survey conducted in September 2007 indicated that the current area of SAV coverage is similar to that reported from previous mapping (NCDOT, 2007).
[2]CAMA coastal wetlands.

- Calculated areas are based on conditions as verified with the USACE through June 2005.
- Hectares were calculated from acres, thus minor rounding error exists when adding the individual hectare numbers.

*Includes the Preferred Alternative.

The two Phased Approach alternatives (including the Preferred Alternative) would include additional temporary impacts to wetland habitat resulting from construction of a temporary traffic maintenance road within the existing NC 12 easement on Hatteras Island (see Table 4-26). These impacts would not occur with the other Parallel Bridge Corridor alternatives, but would be identical for the two Phased Approach alternatives. The combined temporary impact of the Phased Approach alternatives (including the Preferred Alternative) on Bodie Island and Hatteras Island would be 12.5 acres (5.0 hectares), including 7.1 acres (2.9 hectares) of wetland and 5.3 acres (2.2 hectares) of open water. These impacts would include 2.1 acres (0.8 hectare) of CAMA coastal wetlands (smooth cordgrass and black needlerush). The temporary construction impacts for the Phased Approach alternatives (including the Preferred Alternative) are shown in Table 4-26.

No practicable alternatives exist that avoid impacts to Section 404 and CAMA coastal wetlands because of the pervasive nature of the resource, although the alternatives under consideration vary in the amount of wetland impact. The Parallel Bridge Corridor with Road North/Bridge South Alternative would have by far the largest wetland impact of the alternatives under consideration. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would have among the least permanent jurisdictional impacts at 3.1 acres (1.3 hectares) of permanent fill, including 0.5 acre (0.2 hectare) of wetland and 2.6 acres (1.1 hectares) of open water (see Table 4-25). Where fill or pile placement is not required, the loss of flora and fauna associated with construction activity would be short-term. Also, the permanent loss of wetland habitat and function would be replaced through required compensatory mitigation. Mitigation is discussed in Section 4.7.10.

As with the Pamlico Sound Bridge Corridor, the bulk of the area affected by dredging would be unvegetated aquatic bottom. The dynamics of the project area suggest that the bottom sand would, however, replenish itself over time, and losses would be temporary and short-term. Dredging is not planned in areas containing SAV. However, turbidity and siltation induced by dredging could disturb SAV near the dredged channel.

4.7.4.3 Bonner Bridge Demolition and Removal

Wetland impacts associated with demolition and removal of Bonner Bridge would depend on which access technique is used. Three access scenarios for demolition may be considered: temporary haul road, dredged work channel, and temporary work bridge. A top-down approach probably would not be possible because the piles that make up Bonner Bridge's foundation cannot simply be broken off just below the existing ground line but must be removed to at least 25.0 feet (7.6 meters) below the mean low water elevation or possibly deeper, as requested by the USACE in a letter dated January 16, 2001 (see Appendix A).

If underlying marsh sediments are comprised of mineral deposits instead of organic muck or clay, a temporary haul road could be used through these areas with certain mitigation stipulations. If soils are organic muck or clay, a temporary work bridge would be used instead of a haul road through estuarine marsh and mudflat communities. Dredged work channels should be restricted to the open water or nearby unvegetated shallow water areas, where practicable.

Important considerations with respect to the three demolition options are:

- Temporary Haul Road. The effects of a temporary haul road would depend on the nature of the subsoil. If there is a substantial organic or muck layer beneath the marsh, the construction of a temporary haul road would cause permanent changes in the marsh resulting from consolidation and distortion of the subsoil. Changes in biodiversity, as well as organic productivity, could be a direct result of the compaction and distortion of these marine sediments. In this location, however, the likelihood of there being a substantial area of organic material under the haul road is remote.

- Temporary Work Bridge. Although more expensive than a haul road, a work bridge could be used for demolition and removal. If, however, Bonner Bridge is to be used as part of an offshore reef, it might need to be dismantled in large pieces, requiring the use of much larger equipment than could be handled on a work bridge. With a work bridge, direct impacts to the marsh and mudflats would result from driven piles, but the cumulative cross-sectional area of these structural supports would be relatively unsubstantial. Furthermore, after removal of these structures, it is anticipated that tidal flux would mitigate any minor sediment disturbances. The shade effect from the temporary structure could affect some portions of the marsh community; however, any shade-effect to the vegetation in the underlying marsh declines and the vegetation would recover almost immediately following the dismantling of the temporary bridge.

- Dredged Work Channel. Dredging would be limited to the open water and adjacent shallow water areas adjacent to the navigation zone. Much of this area is exposed to the high-energy currents and eddies common to Oregon Inlet. Sediments in these areas are shifting constantly so that little, if any, benthic community development occurs. However, bottom areas adjacent to Oregon Inlet would have increasingly developed benthic communities as the distance from the hyper-dynamic inlet increases. Dredging a channel in the high-energy portion of the channel and near-channel zones would have minor and short-lived effects on the biotic community resulting from sediment disturbances. Dredging activities in shallow water and marsh communities would be avoided because they would be much more disruptive to resident populations. Not only would all organisms, plant and animal, within the dredge zone be physically removed from the ecosystem, but any organism attracted to the re-sedimenting channel environment also would be removed during subsequent access channel maintenance activities. Substantial impacts would occur if dredging occurred within estuarine marsh and/or submerged aquatic communities where healing of the dredging “scar” would require a much longer recovery period than in open water. Though the long-term effects to community productivity would be minimal, the short-term effects would be relatively severe and would continue for an extended recovery period.

The FHWA and the NCDOT would coordinate with environmental resource and regulatory agencies prior to demolition and removal to determine the most practicable construction access methodology for the demolition of Bonner Bridge. Impacts for construction access would be determined and mitigated in full consultation with permitting agencies. A work bridge likely would be used over wetlands on Bodie Island for bridge demolition. Use of a temporary haul road could be requested if it is demonstrated that such access would not result in permanent impacts to marsh communities because these communities do not have underlying organic subsoil. This would be done if the cost of constructing and dismantling a temporary work bridge is so high that it would not be practicable to employ that methodology.

4.7.5 Unique and Rare Habitats

The Pamlico Sound Bridge Corridor would not result in permanent disturbance to Significant Natural Heritage Areas (SNHA) identified by the North Carolina Natural Heritage Program (NCNHP). SNHAs in the project area are the Refuge, dredge spoil islands used by nesting colonial waterbirds, and USFWS-proposed Wilderness areas. Permanent and temporary disturbance to the Refuge, identified as a SNHA by the NCNHP and included on the Register of Heritage Areas (RHA) identified under the Nature Preserves Act, would result from the construction of any of the five alternatives within the Parallel Bridge Corridor.

4.7.5.1 Pamlico Sound Bridge Corridor

The Pamlico Sound Bridge Corridor would not result in permanent disturbance to SNHAs (see Figure 3-7) as identified by the NCNHP. The Pamlico Sound Bridge Corridor would not pass through the Refuge. All islands proposed for Wilderness status by the USFWS are along the soundside of the Refuge, east of the Pamlico Sound Bridge Corridor. The Pamlico Sound Bridge Corridor would pass within a quarter-mile (0.4 kilometer) of three SNHA dredge spoil islands: Sand Shoal Island, Island C, and Island B (see Figure 3-7). These islands have been historically important waterbird nesting areas. However, because of erosion, nesting no longer occurs on Island B or Sand Shoal Island, and they are primarily used by birds as intertidal foraging areas. Only Island C still supports waterbird colonies. Any construction-related disturbance to SNHAs would likely be in the form of temporary noise and, during nighttime work, light.

4.7.5.2 Parallel Bridge Corridor with NC 12 Maintenance

Permanent and temporary disturbance to the Refuge, identified as a SNHA by the NCNHP, would result from the construction of the Parallel Bridge Corridor. Based on the maintenance and relocation of NC 12 in the Refuge to the west and bridge construction, the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives would affect wetland biotic communities and the three manmade freshwater impoundments, which serve as important foraging and resting areas for migratory birds. The Phased Approach alternatives (including the Preferred Alternative) would place a bridge structure adjacent to the freshwater impoundments. Construction-related disturbances would likely be in the form of temporary noise and, during nighttime work, light. The areas of effect within the Refuge would be:

- <u>Nourishment</u>: 19.9 acres (8.1 hectares) primarily for dunes plus nourishment of 6.3 miles (10.1 kilometers) of the seashore within the Refuge;

- <u>Road North/Bridge South</u>: 93.4 acres (37.8 hectares) primarily for new 100-foot (30.5-meter) easement; and

- <u>All Bridge</u>: 92.2 acres (37.3 hectares) primarily for new 100-foot (30.5-meter) easement.

- <u>Phased Approach Alternatives (including the Preferred Alternative)</u>: The total area of disturbance within the existing NC 12 easement in the Refuge would be 3.7 acres (1.5 hectares) permanent and 48.5 acres (19.6 hectares) temporary. With the Phased Approach/Rodanthe Nourishment Alternative, nourishment would occur on 1,500 feet (457.2 meters) of seashore within the Refuge.

The Parallel Bridge Corridor alternatives (including the Preferred Alternative) most likely would not affect the proposed Wilderness area of unnamed islands southwest of the southernmost freshwater pond and within 1.0 mile (1.6 kilometers) of Hatteras Island. The Oregon Inlet bridge in the Parallel Bridge Corridor would cross just east of the Oregon Inlet Shoal, which was recommended for Wilderness designation and is within the project area. The Parallel Bridge Corridor does not pass near the three SNHA islands: Sand Shoal Island, Island C, and Island B (see Figure 3-7).

4.7.6 Fisheries and Wildlife

4.7.6.1 Fish and Shellfish

Bridge construction over open water would disturb fish and shellfish resources in areas affected by pile placement and construction channel dredging. The temporary effects of channel dredging and jetting/driving pile placement would be similar. Both activities would generate a short-term increase in noise and turbidity. Noise from open water construction activity would be a temporary, localized disturbance to fish. Turbidity could result in a reduction in ecosystem productivity (i.e., ability of the system to produce and export energy) and nursery value by potentially covering shellfish beds within and near the corridor, eliminating organisms that cannot readily move, and displacing mobile organisms. Open water construction activities during the spring could also result in direct and indirect impacts on larval transport and migratory fish that use Oregon Inlet as a passageway to spawning grounds. The NCDOT would take practicable measures to minimize turbidity generated during bridge construction. Construction of the Pamlico Sound Bridge Corridor with either termini option would temporarily disturb fish and shellfish resources in areas affected by pile placement and channel dredging; however, non-mobile shellfish, such as clams and oysters, could suffer long-term impacts from construction-related dredging and siltation. The Parallel Bridge Corridor would have less of a construction impact on fish and shellfish communities because of less bridge construction over open water. The construction of the Rodanthe area bridge with the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives could create a temporary disturbance for commercial crabbing and fishing operations within the Pamlico Sound; however, no long-term impact to commercial or recreational fishing is expected.

Pamlico Sound Bridge Corridor

Construction of the Pamlico Sound Bridge Corridor occurring in open water would disturb fish and shellfish resources in areas affected by pile placement (jetting and driving) and construction channel dredging. The Pamlico Sound Bridge Corridor would avoid the highly productive Walter Slough area behind Bodie Island, as well as scattered shellfish beds on the west side of the Refuge (see Figure 3-7). Also, the location and anticipated extent of dredging and disposal operations would not directly affect spawning or nursery areas. However, the Pamlico Sound Bridge Corridor would cross the northern end of Crab Slough, an area of high shellfish density (see Figure 3-7).

Potentially long-term impacts to finfish and shellfish also could result from bridge construction and dredging through the removal of benthic habitat, cover, and food sources. With the Pamlico Sound Bridge Corridor, bridge pile placement would permanently eliminate approximately 3 acres (1.2 hectares) of benthic habitat. The jetting-during-driving pile installation process would also temporarily alter benthic habitat, creating a zone of disturbance similar in diameter to the sub-surface length of the pile (see Section 2.10.1.3). The result could be possible elimination of non-mobile and slow-moving organisms and displacement of mobile organisms in the immediate vicinity of each pile. Opportunities to reduce the impact of jetting are discussed in Section 2.10.1.3. In the case of dredging, the displacement of mobile organisms would be temporary and any losses would be short-term because the spatial extent of dredging and construction at any given point in time would be limited, and many organisms can maneuver around unfavorable areas. An abundance of similar habitat is available and could provide the displaced mobile animals with suitable habitat to ensure their survival. However, non-mobile shellfish, such as clams and oysters, could suffer long-term impacts from construction-related dredging and siltation. In particular, Crab Slough is a shallow depth area of high oyster density that could be permanently altered by the mechanical disturbance of dredging and pile placement.

The construction of a bridge in the Pamlico Sound Bridge Corridor could create a temporary disturbance for commercial crabbing and fishing operations within the Pamlico Sound; however, no long-term impact to commercial or recreational fishing is expected. The bridge height is anticipated to accommodate current commercial and recreational vessel traffic. Also, the piles could be beneficial to fish populations by creating submerged structure that attracts fish. This could create the additional benefit of enhancing recreational fishing in the Pamlico Sound. Similarly, concrete from the demolished Bonner Bridge could be used to create artificial reefs, an important habitat to offshore fish and shellfish.

Parallel Bridge Corridor with NC 12 Maintenance

Construction of the Oregon Inlet bridge in the Parallel Bridge Corridor occurring in open water would disturb fish and shellfish resources in areas affected by pile placement and construction channel dredging in the area near Hatteras Island where the sand bars are rising. The construction of a Rodanthe area bridge with the Road North/Bridge South and the All Bridge alternatives could create a temporary disturbance for commercial crabbing and fishing operations within the Pamlico Sound; no long-term impact to commercial or recreational fishing is expected. The bridge height is anticipated to accommodate current commercial and recreational vessel traffic. Again, the piles could be beneficial to fish populations by creating submerged structure that attracts fish. Compared to the Pamlico Sound Bridge Corridor, open water construction with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would be much more limited spatially and temporally.

The Parallel Bridge Corridor with Nourishment Alternative would include dredging and beach nourishment every four years (or use of USACE dredged material annually with the location of nourishment rotated so nourishment in any one location occurs only every four years) for the duration of the 50-year planning period. Direct dredging-related impacts on fish and shellfish include temporary changes in abundance and diversity during and immediately after dredging as well as potential entrainment in dredge equipment, especially of larval or post-larval fish and shrimp. Also, during dredging operations, fish and mobile shellfish could be displaced by turbidity and noise. However, the displacement would most likely be temporary and fish would return after dredging was completed. In the post-dredge period, some studies have found an increase in fish abundance at dredged sites (Saloman, 1974; Courtenay et al., 1980; Nelson and Collins, 1987), while others have found that dredging did not substantially change fish communities (USACE, 2001). However, if food resources are slow to recover or recover inadequately, long-term negative effects on fish and shellfish populations may result.

The effects of beach nourishment with the Nourishment Alternative on fish and shellfish would likely be similar to those of dredging. Individuals could avoid the replenished beach during periods of high turbidity, while less mobile species and larval fish may suffer mortalities. Prior research suggests that impacts to fish assemblages generally would be insignificant, but species specific impacts have been found (Wilber et al., 2003; Versar, 2004). The effects of beach nourishment would be temporary and localized; however, long-term-indirect impacts to feeding areas may result if benthic communities and primary productivity do not recover quickly or if the post-dredge habitat is of lesser forage quality compared to baseline conditions.

Mitigation measures for reducing dredging and nourishment impacts to fish and shellfish with the Nourishment Alternative include both restricting activity to winter months and avoiding dredging and beach nourishment during high recruitment periods, which for most species is spring and summer (Hobbs, 2002). Dredging effects could also be minimized by leaving patches undredged, thereby allowing individuals to recolonize quicker (Hobbs, 2002). A hopper dredge also could minimize impacts because it would not completely scour the bottom (Jutte et al., 2002). Hopper dredging could, however, affect protected sea turtles, as discussed in Section 4.7.9.1. Other recommended dredging BMPs for reducing turbidity include the use of a hydraulic cutterhead dredge that operates below the channel surface, dredging during the incoming tide, silt curtains (Nightingale and Simenstad, 2001), temporary dikes (personal communication, July 8, 2005, John Fisher, PhD, North Carolina State University [NCSU]), modified operational controls, and modified heads.

4.7.6.2 Essential Fish Habitat

This section includes a summary of the findings of the *Essential Fish Habitat Assessment* (CZR, Incorporated, 2008).

Both replacement bridge corridor alternatives would produce turbidity, noise, and siltation resulting from construction, which in turn would create localized, short-term impacts to essential fish habitat (EFH) including estuarine emergent wetlands, oyster reef and shell bank, SAV beds, intertidal flats, and marine and estuarine water column. Although some small adverse impacts to EFH would occur during construction, the impacts would be temporary and are not expected to result in significant short-term or long-term adverse effects on managed species. Direct dredging-related impacts on marine EFH would result from noise and turbidity, sediment removal, and burial of organisms by fine sediments falling back to the sea floor. The result would be short-term adverse effects on biota and managed species that use benthic habitats, but long-term and permanent impacts to EFH and managed species are expected to be minimal. The extent of benthic community impacts are discussed in Section 4.7.6.4. If changes to benthic invertebrate communities do result, this does not necessarily mean EFH would be degraded or that negative impacts to managed species would result because most benthic communities are resilient and likely to recover quickly. Permanent loss or alteration of estuarine emergent habitat, seagrass, oyster reef and shell bank, and intertidal flats would result directly from shading and pile placement. Bridge and pile placement could result in several indirect impacts, including changes to: water flow; sediment grain size and topography; and light levels of the area underneath the bridge and for some distance surrounding the bridge. However, these changes are expected to have a minimal adverse effect on EFH and managed species (CZR, Incorporated, 2008). In the case of the two Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative), with shoreline erosion, parts of the bridge ultimately will be in the ocean.

<u>Pamlico Sound Bridge Corridor</u>

Impacts to EFH in the project area that would result from the construction of a bridge in the Pamlico Sound Bridge Corridor are presented in Table 4-27.

Turbidity, noise, and siltation resulting from construction would create localized, short-term impacts to estuarine emergent wetlands, oyster reef and shell bank, SAV beds, intertidal flats, and marine and estuarine water column. Permanent loss or alteration of estuarine emergent habitat, seagrass, oyster reef and shell bank, and intertidal flats would result directly from shading and pile placement. Potential loss of SAV was minimized by selection of a corridor that is in water greater than 6 feet (1.8 meters) in depth for approximately half its length. Using the most recent SAV mapping, it is estimated that pile fill with the Pamlico Sound Bridge Corridor alternatives would remove 0.3 acre (0.1 hectare) of SAV habitat. Permanent shading impact on SAV would be between 8.9 acres (3.6 hectares) and 9.2 acres (3.7 hectares) with the Pamlico Sound Bridge Corridor alternatives. SAV findings were based on available data.

Channel dredging required for the Pamlico Sound bridge construction would create temporary impacts. Using work bridges, rather than dredged channels (when possible and practicable), in

Table 4-27. Potential Construction Impacts to Inshore and Marine Essential Fish Habitat

Pamlico Sound Bridge Corridor		
Inshore EFH	**Bridge Construction**	**Dredging**
Estuarine emergent	Temporary disturbance; shading; some permanent loss from piles	None
Seagrass [1]	Temporary disturbance; shading; some permanent loss from piles	Temporary indirect disturbance; potential for some permanent loss because of turbidity and siltation
Oyster reef and shell bank[2]	Temporary disturbance; some permanent loss from piles	Removal in areas where this habitat is present; potential permanent loss of living beds through direct or indirect dredging impact
Intertidal flats	Temporary disturbance; some permanent loss of habitat from piles	Removal of sediment
Palustrine emergent and forested (freshwater wetlands)	Small loss of wetland maritime grassland	None
Estuarine water column (Pamlico Sound)[3]	Temporary increase in turbidity and decline in dissolved oxygen	Temporary increase in turbidity and decline in dissolved oxygen
Marine EFH	**Fill and Pile**	**Dredging**
Water column (Oregon Inlet)[4]	Potential temporary increase in turbidity in Oregon Inlet	Potential temporary increase in turbidity in Oregon Inlet
Parallel Bridge Corridor (Oregon Inlet and Rodanthe area bridges)		
Inshore EFH	**Bridge Construction**	**Dredging**
Estuarine emergent	Temporary disturbance; shading; some permanent loss from piles and temporary loss of habitat from construction of temporary haul road for the Oregon Inlet bridge	None
Estuarine shrub-scrub mangroves	None	None
Seagrass [1]	Temporary disturbance; shading; some permanent loss from piles	Temporary indirect disturbance; potential for some permanent loss because of turbidity and siltation
Oyster reef and shell bank[2]	Temporary disturbance; some permanent loss from piles	Removal in areas where this habitat is present; potential permanent loss of living beds through direct or indirect dredging impact
Intertidal flats	Temporary disturbance; some permanent loss of habitat from piles	Removal of sediment
Palustrine emergent and forested (freshwater)	Temporary disturbance; shading; some permanent loss from piles	None
Estuarine water column (Pamlico Sound)[3]	Temporary increase in turbidity and decline in dissolved oxygen	Temporary increase in turbidity and decline in dissolved oxygen
Marine EFH	**Fill and Pile**	**Dredging**
Water column (Oregon Inlet)[4]	Potential temporary increase in turbidity in Oregon Inlet with Oregon Inlet bridge	Potential temporary increase in turbidity in Oregon Inlet with Oregon Inlet bridge

[1]Also Habitat Areas of Particular Concern (HAPC) for summer flounder, red drum, and the snapper grouper management unit.
[2]Oyster reef and shell bank is also HAPC for the snapper grouper management unit.
[3]Pamlico Sound is also HAPC for Penaeid shrimp.
[4]Oregon Inlet is also HAPC for Penaeid shrimp, red drum, and the snapper grouper management unit.

areas of known SAV could minimize permanent loss of seagrass EFH. NCDENR Division of Marine Fisheries (DMF) maps do not indicate the presence of significant areas of shell bottom along the Pamlico Sound Bridge Corridor; therefore, dredging impacts to this habitat likely would be minor. However, permanent loss of EFH may result from dredging in sensitive oyster reefs like the northern end of Crab Slough (see Figure 3-7). Crab Slough is the only large oyster bed known to exist along any part of the Pamlico Sound Bridge Corridor. As seen on Figure 3-7, the Pamlico Sound Bridge Corridor would only cross the far northern end of Crab Slough and the crossing would be nearly perpendicular to the slough.

Parallel Bridge Corridor with NC 12 Maintenance

Impacts to EFH in the project area that would likely result from the construction of bridges in the Parallel Bridge Corridor also are presented in Table 4-27. Like the Pamlico Sound Bridge Corridor, turbidity, noise, and siltation resulting from construction would create localized, short-term impacts to EFH. Permanent loss or alteration of EFH would result directly from shading and pile placement. Using the most recent SAV mapping, it is estimated that pile fill would remove 0.2 acre (0.1 hectare), 1.4 acres (0.6 hectare), and 1.4 acres (0.6 hectare) of SAV habitat with the Nourishment, Road North/Bridge South, and All Bridge alternatives, respectively. The two Phased Approach alternatives (including the Preferred Alternative) would remove an estimated 0.2 acre (0.1 hectare) of SAV habitat. Again, using work bridges, rather than dredged channels (when possible and practicable), in areas of known SAV would minimize permanent loss of seagrass EFH. Permanent shading impact on SAV would be 1 acre (0.4 hectare), 7.3 acres (2.9 hectares), and 7.3 acres (2.9 hectares) with the Nourishment, Road North/Bridge South, and All Bridge alternatives, respectively. The Phased Approach Alternatives are estimated to include a permanent shading impact on SAV of 1 acre (0.4 hectare).

The Parallel Bridge Corridor with Nourishment would require dredging and beach nourishment every four years (or use of USACE dredged material annually with the location of nourishment rotated so nourishment in any one location occurs only every four years) for the duration of the 50-year planning period. Marine water column EFH in the vicinity of the offshore sand extraction and beach replenishment operations would be affected because these activities would generate turbidity and potentially low dissolved oxygen conditions. The direct effects of beach nourishment would be temporary and localized. However, long-term indirect impacts to marine EFH and managed species could result if the post-nourishment habitat is of lesser quality compared to baseline conditions (causing changes in sediment fill characteristics, beach morphology, and hydrology, properties that largely structure beach communities). Sediment grain size influences biogeochemical process, species biomass, and species diversity. Thus, changes in sediment could indirectly affect managed species by disturbing their habitat and food sources. For example, several studies suggest that recovery is rapid for most invertebrate species (reviewed in Greene, 2002); however, if poorly matched, silty fill material is used, recovery may take years and impacts could extend to adjacent off-shore areas (Green, 2002; Bilodeau and Bourgeois, 2004). Poorly matched fill impacts also would extend to microbial communities and primary producers, thereby affecting nutrient and organic matter processing and energy transfer to higher trophic levels. Similarly, adverse changes in beach morphology and hydrology can result in long-term loss of habitat value. Sandy beach species diversity is strongly related to Deans Parameter, a descriptive measure of beach profile. In general, narrow, steeply sloped, reflective beaches have much lower diversity than broad, gently sloping, dissipative beaches because of the presence of a large intertidal swash zone in the latter (Defeo and McLachlan, 2005; McLachlan and Dorvlo, 2005). Consequently, maintaining a gently sloping beach grade is essential to minimizing biological impacts, as increasing the beach slope will amplify wave energy on the beach, thereby creating a harsher swash zone environment and potentially decreasing species diversity (Speybroeck et al., 2006). NC 12 maintenance associated with other

Parallel Bridge Corridor alternatives (including the Preferred Alternative) may require some beach nourishment (see Section 4.6.8.6). However, sand mining and/or deposition of sand in aquatic environments is not anticipated to be necessary for NC 12 maintenance.

Once bridge piles are in the ocean because of shoreline erosion, the two Phased Approach alternatives (including the Preferred Alternative) could permanently affect diversity and density of some aquatic wildlife within these communities. Studies of oil and gas platforms and piers indicate that piles are typically colonized by a variety of sessile invertebrates such as mussels, barnacles, anemones, corals, bryozoans, and poriferans. This complex biogenic structure in turn attracts small mobile fish and invertebrates that in turn attract larger consumers (Nelson, 2003; Clynick et al., 2007). Research at oil platforms clearly shows that piles serve as fish aggregating structures (Stanley and Wilson, 2000). Davis et al., (1982) found fish and invertebrate communities changed substantially after platform installation, with some species disappearing completely and new species coming to dominate the assemblage. Similarly, in a study of artificial reefs constructed of piles, Ambrose and Anderson (1990) found some fish and invertebrate species increased in abundance while others declined. Because of habitat alteration and diminished vegetative growth, shading could impact managed species by locally diminishing the primary producers on which the managed species rely for food and cover, thereby resulting in an overall reduction in local carrying capacity. Fish abundance and growth have been found to be lower beneath fishing piers compared to adjacent waters (Able et al., 1998; Duffy-Anderson and Able, 1999). The high energy around the piles may reduce habitat quality for larval and adult fish, as well as reduce invertebrate species abundance and diversity. However, there are no known studies that have been conducted to document, prove, or disprove these potential effects.

Long-term permanent changes in surf zone community composition resulting from the two Phased Approach alternatives (including the Preferred Alternative) would not necessarily be detrimental to managed species. The introduction of bridge piles would provide a type of hard substrate previously unavailable in the surf zone, thereby increasing habitat complexity. In this way the bridge may act as an artificial reef, which, although different than the current habitat, should not be considered a loss or degradation of existing EFH. In addition, beaches are zonated with species abundance and diversity varying considerably from the high intertidal to subtidal zones (Defeo and McLachlan, 2005). It has been suggested that the natural assemblage of species found in areas where no hardened structures exist would not be displaced (personal communication, January 3, 2007, Dr. Thomas Lankford, University of North Carolina at Wilmington). Glasby and Connell (1999) reviewed studies of piles as artificial reefs and concluded that piles increase local species richness. For example, structure-oriented managed fishes, such as black sea bass, snapper grouper complex, and red drum, are likely to congregate at the bridge piles. However, the reef function of the bridge would evolve over time as the habitat in the vicinity of the piles shifts in response to natural erosion and water depths. Also, even by 2060, segments of the bridge structure will be in the shallow (6 to 10 feet/1.8 to 3.0 meters), high energy surf zone, which may not be suitable for managed reef associated species. In addition, Glasby and Connell (1999) emphasize that piles do not always support the same communities as natural marine hard substrate and should not be considered functionally equivalent to natural reefs.

Permanent loss or alteration of estuarine emergent habitat, seagrass, oyster reef and shell bank, and intertidal flats would result directly from shading and pile placement. In addition to direct loss of habitat, the Phased Approach/Rodanthe Bridge Alternative (Preferred) would result in the existence of 1.4 miles (2.3 kilometers) of bridge in the intertidal zone and an additional 8.0 miles (12.9 kilometers) of bridge in the surf zone by 2060. Bridge and pile placement could result in several associated impacts, including changes to water flow sediment grain size and topography; and light levels of the area underneath the bridge and for some distance surrounding the bridge.

An additional consideration is the long-term impacts resulting from potential maintenance activities for portions of the bridge that over time would be located in the surf zone. Although the impacts of solitary, over water construction events are often minimal, the Phased Approach alternatives (including the Preferred Alternative) would require periodic maintenance. Unlike much of the construction of the initial bridge on land, potential maintenance activities in the surf zone would occur over and/or in water and represent a long-term impact. However, maintenance activity will be undertaken in a way that minimizes impacts to EFH and managed species.

4.7.6.3 Effect of Alternatives on Commercial Fishing

Ongoing commercial fishing activity exists in the project area. The Pamlico Sound Bridge Corridor alternatives likely would not disrupt commercial fishing activity since the bridge structure will be in the sound where few commercial netting operations are conducted. Crabbing could be conducted regardless of the presence of bridge structure.

The Parallel Corridor with Nourishment, with All Bridge, and with Road North/Bridge South would most likely result in no change to commercial fishing compared to existing conditions. The two Phased Approach alternatives (including the Preferred Alternative) could result in some effect to inshore commercial fishing. As the shoreline erodes, the location of bridges associated with these alternatives would change relative to the beach so that by 2060 portions of these bridges would be beyond the off-shore breaker zone (see Table 4-10). Because of their location, there is the potential for the bridges to disrupt inshore commercial fishing operations by physically reducing potential trawling area and restricting net deployment. Although the Phased Approach alternatives (including the Preferred Alternative) could eliminate potential fishing areas in the vicinity of the bridge, impacts to overall commercial fishing operations would not be substantial as most fishing occurs further offshore and fishing area would be eliminated in only a small portion of the inshore.

4.7.6.4 Benthic Communities

Benthic communities would be affected primarily by fill impacts in open water (including SAV) and marsh communities (smooth cordgrass, black needlerush, salt flats, and brackish marsh). Both Pamlico Sound Bridge Corridor alternatives would result in pile fill of 2.7 acres (1.1 hectares) of open water and 0.3 acre (0.1 hectare) of SAV. Fill impacts to open water and marsh communities with the Parallel Bridge Corridor alternatives would be:

- <u>Nourishment</u>: 2.9 acres (1.2 hectares), including 2.6 acres (1.0 hectares) of open water and 0.3 acre (0.1 hectare) of marsh communities plus additional impacts associated with dredging for sand and then nourishment of 6.3 miles (10.1 kilometers) of the seashore within the Refuge;

- <u>Road North/Bridge South</u>: 39.2 acres (15.8 hectares), including 27.4 acres (11.0 hectares) of open water and 11.8 acres (4.8 hectares) of marsh communities;

- <u>All Bridge</u>: 7.9 acres (3.2 hectares), including 5.7 acres (2.3 hectares) of open water and 2.2 acres (0.9 hectare) of marsh communities; and

- <u>Phased Approach Alternatives (including the Preferred Alternative)</u>: 3.0 acres (1.2 hectares), including 2.4 acres (1.0 hectare) of open water, 0.2 acre (0.1 hectare) of SAV, and 0.3 acre (0.1 hectare) of marsh communities (CAMA wetlands).

Pamlico Sound Bridge Corridor

With the Pamlico Sound Bridge Corridor, localized short-term impacts to benthic communities could result from all construction activity that occurs on estuarine or marine sediments. However, most benthic communities are resilient and likely to recover quickly. Bridge pile placement would permanently remove approximately 3 acres (1.2 hectares) of benthic habitat. Dredging of aquatic bottom would result in the removal of benthic habitat, resulting in localized losses of non-mobile organisms. Benthic loss would be minimal in the active Oregon Inlet area (since few species of organisms are capable of inhabiting this dynamic habitat) and greater in Pamlico Sound. Also, because of the many species-specific associations between invertebrates and SAV, measures taken to minimize SAV impacts could substantially reduce impacts to benthic invertebrates as well. In addition, it has been shown that benthic macroinvertebrates could recolonize dredged areas in a short time period after dredging ceases. Studies conducted in Hatteras Inlet during 1976 indicate that there is no apparent difference between benthic populations in a dredged channel and in natural, undredged channels, once the invertebrates have reestablished viable populations (Coastal Zone Resources Corporation, 1977). Thus, the loss of benthic organisms would most likely be temporary and short-term.

Parallel Bridge Corridor with NC 12 Maintenance

Construction of the Parallel Bridge Corridor occurring in open water (including Pamlico Sound, ponds in the Refuge, and Oregon Inlet) would disturb fish and shellfish resources in areas affected by pile placement, construction channel dredging, and a likely temporary construction haul road west of Bodie Island. Compared to the Pamlico Sound Bridge Corridor, open water construction with the Parallel Bridge Corridor would be much more limited spatially and temporally.

The Parallel Bridge Corridor with Nourishment Alternative would require dredging and beach nourishment every four years (or use of USACE dredged material annually with the location of nourishment rotated so nourishment in any one location occurs only every four years) for the duration of the 50-year planning period. The effect of offshore dredging on marine benthos has been studied extensively. Dredging would remove benthic organisms from the borrow site of sand removal. Many studies show a large initial decrease in abundance and biomass following dredging (Deis et al., 1992; Desprez, 2000; Guerra-Garcia et al., 2003). Effects are temporary, but recovery time varies by community composition, local physical conditions, and the season in which mining occurs (Hobbs, 2002; Diaz et al., 2004). Recovery of abundance and diversity can take three months to three years, and pre- and post-dredge species composition may display long-term differences (Jutte et al., 2002; Byrnes et al., 2004). Previous studies suggest that repeated dredging every four years (or less) may not allow benthic communities adequate time to recover.

Beach nourishment with the Nourishment Alternative would cover existing benthic organisms and create adverse water quality conditions in adjacent areas. Reduction in benthic macroinvertebrate abundance and diversity are often found (Reilly and Bellis, 1983; Rakocinski et al., 1996; Versar, Inc., 2004); however, when replenishment occurred in winter, no substantial effects were detected (Gorzelany and Nelson, 1987). Recovery time varies with species, the quality of sand, and time of year replenishment occurs (Rakocinski et al., 1996; Versar, Inc., 2004).

Mitigation measures for reducing dredging and beach nourishment impacts to benthos with the Nourishment Alternative include restricting activity to winter months and avoiding dredging and beach replenishment during high recruitment periods, which for most species is spring and summer (Peterson et al., 2000; Hobbs, 2002). One of the most important mitigation measures for beach replenishment is to replenish with sand similar to existing conditions. Dredging effects also could be minimized by leaving patches undredged, thereby allowing individuals to recolonize quicker (Hobbs, 2002). Hopper dredging also may minimize impacts, because it does not completely scour the bottom (Jutte et al., 2002), although hopper dredging can adversely affect protected sea turtles (see Section 4.7.9.1). Other recommended dredging BMPs for reducing turbidity include silt curtains (Nightingale and Simenstad, 2001), temporary dikes (personal communication, July 8, 2005, John Fisher, PhD, NCSU), modified operational controls, and modified heads.

4.7.6.5 Biological Effects of Stormwater Runoff

Highway systems near water bodies may potentially contribute pollutants via stormwater runoff, road maintenance activity, litter, and atmospheric deposition. The primary pollutants associated with stormwater runoff are: heavy metals and organic compounds that may accumulate to toxic levels in aquatic organisms (e.g., Barwick and Maher, 2003); nutrients that lead to dissolved oxygen depletion (Rabalais et al., 2002); and particulates that often carry other pollutants into the environment (e.g., Basha et al., 2007). Pollutants associated with runoff also have the potential to effect terrestrial and avian species that feed in the effected aquatic environments (Thompson and Hamer, 2000). Without appropriate mitigation, water quality in receiving waterbodies could be diminished, increasing the potential for the project to impact managed species and their resources. Runoff from the Bonner Bridge is not captured and treated; therefore, the proposed project will not substantially change runoff in the vicinity of Oregon Inlet. Increases in impervious surface (as discussed in Section 4.7.2) that lead to increases in stormwater runoff have some potential to affect the aquatic environment; however, dilution of stormwater because of wave action and use of BMPs may serve to reduce negative impacts.

Section 4.7.2 describes the existing and future impervious surface associated with NC 12 in the project area, as well as characteristics of that runoff and how it would differ with each of the detailed study alternatives. Also as discussed in Section 4.7.2, NCDOT would incorporate BMPs for stormwater management into the project design.

4.7.6.6 Wildlife

A 3.9-million-mile (6.3-million-kilometer) network of public roadways covers approximately 1 percent of the United States, yet directly or indirectly affects wildlife in 15 to 20 percent of the total land area (Forman and Deblinger, 2000; Forman, 2000; Jackson, 2000; Forman et al., 2003). This results from what is known as the “road-effect zone” (Forman and Alexander, 1998; Forman and Deblinger, 2000). The road-effect zone is typically asymmetrical and represents the area extending outward along both sides of the roadbed in which substantial ecological effects are experienced. The extent and intensity of these ecological effects depends upon slope, wind, and habitat cover in relation to the roadbed (Forman and Alexander,1998; Forman and Deblinger, 2000; Coffin, 2007).

Roadkill

Because the Pamlico Sound Bridge Corridor is mostly a bridge over water, avian species are the most probable roadkill concern. The primary species that could be affected would be those that commonly perch on bridges such as gulls, terns, wading birds, pelicans, and raptors. For instance, substantial road mortality has been documented in royal terns (*Sterna maxima*; Bard et al., 2001) and brown pelicans (*Pelecanus occidentalis*; Owens and James 1991). It is unlikely that threatened or endangered species such as the piping plover would be subject to road mortality because of their behavior patterns. In the case of the Parallel Bridge Corridor alternatives (including the Preferred Alternative), small mammals, reptiles, amphibians, and avian species could all be roadkill concerns. However, except for some rare species, road mortality has a minimal effect on animal populations (Forman and Alexander, 1998) despite it being a leading cause of mortality. In addition, some species seem to be capable of learning to avoid road mortality (Mumme et al., 2000; Coffin, 2007).

Noise Disturbance

Although evidence of wildlife population declines as a result of roadway mortality has persisted for years, the long-term effects of road avoidance resulting from traffic noise have only recently been actively studied. Traffic noise is a potential threat to an animal's health, reproductive success, physiology and behavior (Forman and Alexander, 1998; Radle, 2006). Road avoidance because of noise/human activity has been extensively documented for wildlife species such as black bears (*Ursus americanus*; Brody and Pelton, 1989), bobcats, (*Felis rufus*; Lovallo and Anderson, 1996), wolves (*Canis lupus*; Thurber et al., 1994), and songbirds (Reijnen et al., 1995; Reijnen et al., 1996; Forman and Alexander, 1998). Some species may become habituated to disturbance, but many species display reduced nesting and activity near areas of traffic noise (Fenandez-Juricic, 2001). Even though road noise has a varying effect on wildlife, it seems to substantially affect avian communities that utilize sound in their basic behaviors (Coffin, 2007). Noise levels as low as those found in a library reading room (42 to 48 decibels) have been found to negatively affect avian species (reviewed in Forman and Alexander, 1998).

The Pamlico Sound Bridge Corridor would be outside the Refuge, an area of concentrated use by waterfowl, wading birds, shorebirds, and various other wildlife species, removing the existing disturbance of NC 12 operations and maintenance from the Refuge. A bridge in this corridor could disturb birds using Pamlico Sound, such as waterfowl, but it would leave nesting birds largely undisturbed. The disturbance that would occur would be a new disturbance from both the perspectives of construction and operations.

A project in the Parallel Bridge Corridor could disturb avian nesting, resting, and foraging habitat (including the federally threatened piping plover), as well as nesting habitat for sea turtle species, both on the Bodie Island side of Oregon Inlet and on Hatteras Island within the Refuge. Disturbances occur today from traffic and NC 12 maintenance. Parallel Bridge Corridor Alternatives could alter that disturbance in the following ways:

- The All Bridge and Road North/Bridge South alternatives would move operational disturbances to the west, with the greatest change being at the north end of the Refuge in areas used most intensely by feeding birds. Construction noise also would occur in this westerly area with the greatest potential disturbance associated with the construction of bridges, particularly pile placement. These alternatives are not defined as phased in this FEIS and as such it would be expected that construction disturbance would occur over a three-year period throughout the Refuge.

- The Nourishment Alternative would reduce disturbances related to NC 12 storm maintenance by reducing the amount of maintenance required along the road and leave operational disturbances unchanged.

- The Phased Approach alternatives (including the Preferred Alternative) would remain in the existing right-of-way, leaving operational disturbances where they currently exist. As the shoreline erodes under the Phased Approach bridges, the Refuge wildlife habitat would move away from the bridge. The greatest new disturbance would come from bridge construction, particularly pile placement. As the project would be phased, the most intense construction disturbance would be confined to the location of the construction of any given phase.

However, the four phases would be built over an estimated 12.5 years of construction within a period of approximately 20 years, and movement of construction equipment and materials could be expected throughout the Refuge during the construction of each phase.

Direct Habitat Losses

Clearing within the construction limits of the replacement bridge corridor alternatives and subsequent fill placement could either eliminate or displace most biota. These activities would primarily affect animal communities of maritime shrub thickets. Typically, less mobile animals—such as small mammals, reptiles, and amphibians—would be lost with the removal of their habitat. More mobile animals, such as larger mammals and birds, might be able to move out of the area of impact. Survival of these displaced animals should be great considering the small area of habitat (7.8 to 9.8 acres [3.2 to 4.0 hectares]) that would be affected by the Pamlico Sound Bridge Corridor, as most of the bridge is over water. The Parallel Bridge Corridor would entail greater impacts to terrestrial communities with two alternatives because of the relocation of NC 12. The area of terrestrial habitat (upland and wetland) filled with each of the Parallel Bridge Corridor alternatives would be:

- Nourishment: 22.0 acres (8.9 hectares);
- Road North/Bridge South: 64.2 acres (26.0 hectares);
- All Bridge: 11.6 acres (4.7 hectares);
- Phased Approach/Rodanthe Bridge (Preferred): 13.6 acres (5.5 hectares); and
- Phased Approach/Rodanthe Nourishment: 6.9 acres (2.8 hectares).

Displaced animals might move temporarily or permanently to adjacent areas. However, this immigration could negatively affect or be prevented by adjacent wildlife communities that are already at carrying capacity. This impact could be mitigated in part by reclamation of habitat after removal of existing NC 12 pavement. With any of the alternatives, except the Nourishment Alternative, NC 12 pavement could be removed and replanted with native vegetation. This habitat may be of lower quality than natural habitat, but habitats on the Outer Banks are already subject to extensive disturbance, and many wildlife species there are capable of dispersing quickly into newly created habitat.

Effects of Construction Timing

Regardless of the alternative being considered, timing of construction would largely determine the level of disturbance that some wildlife experience. For instance, nesting birds are most sensitive to nesting disturbance during early nesting season (April-August), and sea turtles would be most sensitive to lighting and noise disturbance during nesting season (May-October). Night time construction also has more potential to disturb wildlife. Lighting is highly disorienting to sea turtles attempting to nest or to leave the beach after nesting or hatching (Witherington 1992; Witherington and Martin, 2000; Kikukawa et al., 1999). Light could also disturb roosting and migrating birds (Bruderer et al., 1999), which can reduce avian energy reserves if conducted during winter (Wiersma and Piersma, 1994). Therefore, impacts associated with the project would affect different species in different ways depending on the time of year and time of day that construction is conducted. Activities that disturb nesting (spring and early summer) should be considered the most detrimental because they could result in direct losses of potential young.

The Pamlico Sound Bridge alternatives would disturb fewer nesting species because construction would be conducted mostly out of wildlife nesting habitat.

4.7.6.7 Oregon Inlet Birds

Pamlico Sound Bridge Corridor

The Pamlico Sound Bridge Corridor would have minimal impact on the birds of Oregon Inlet because sensitive bird habitat was avoided whenever possible in selecting the location of the corridor. The sand flats at the southern tip of Bodie Island and the northern tip of Hatteras Island, frequently used by birds for foraging, resting, and sporadic nesting, would be avoided. In addition, the numerous dredged material islands used by colonial waterbirds for nesting are outside of the Pamlico Sound Bridge Corridor.

Most disturbances to birds would result from temporary construction activity, although fill and pile placement activity would entail a small but permanent loss of habitat used by a variety of birds. In a larger area, noise generated during construction activity also could displace birds inhabiting marsh habitat, primarily on Bodie Island where the Pamlico Sound Bridge Corridor would cross marsh for approximately 1,200 feet (366 meters). Also, because bridge construction would occur in the waters of Pamlico Sound, there is the potential for construction activity to disturb feeding and resting wintering waterfowl that migrate to the region every year. However, the disturbances would be localized and temporary.

Because the Pamlico Sound Bridge Corridor is mostly a bridge over water, avian species would be the most probable roadkill concern. The primarily species that may be affected are those that commonly perch on bridges such as gulls, terns, wading birds, pelicans, and raptors (see Section 4.7.6.6 under "Roadkill"). It is unlikely, that threatened or endangered species such as the piping plover would be subject to road mortality.

Parallel Bridge Corridor with NC 12 Maintenance

The Parallel Bridge Corridor could have minimal impact on the birds using Oregon Inlet, because sensitive bird habitat on the east side of Oregon Inlet Shoal was avoided whenever possible in selecting the location of the corridor. The beach and sand flats at the southern tip of Bodie Island and the northern tip of Hatteras Island, frequently used by birds for foraging, resting, and sporadic nesting, would be avoided by the Parallel Bridge Corridor. In addition, the numerous dredged material islands used by colonial waterbirds for nesting are outside of the Parallel Bridge Corridor. However, the Parallel Bridge Corridor with All Bridge and Road North/Bridge South alternatives could have moderate to substantial impact to the ponds and fields (brackish impoundments) in the Refuge used by migratory birds for nesting, foraging, and/or resting.

Like the Pamlico Sound Bridge Corridor, most disturbance to birds would result from temporary construction activity, although fill and pile placement activity would entail a small but permanent loss and/or degradation of habitat used by a variety of birds. In a larger area, noise generated by pile placement during construction activity also could displace some birds, primarily on Hatteras Island where the Parallel Bridge Corridor with All Bridge Alternative would relocate NC 12 on structure for approximately 7 miles (11.3 kilometers); however, avian response to construction activities has not been well studied and varies by species and site conditions. Also, because bridge and road construction would occur within the ponds of the Refuge with the Road North/Bridge South and All Bridge alternatives, there is the potential for construction activity to disturb feeding and resting waterbirds that regularly use the area. However, the disturbances would be localized and temporary.

The two Phased Approach alternatives (including the Preferred Alternative) include bridge construction over four phases, with construction in different parts of the Refuge, as described in Section 2.10. Thus, there would be four periods of construction disturbance of birds within the Refuge. Phase II would likely immediately follow Phase I for a construction period for the two phases totaling seven years. Phases III and IV likely would be 10 years each for a total construction period of 17 years with approximately a seven-year gap between Phases II and III and approximately a 10-year gap between Phases III and IV. The other Parallel Bridge Corridor alternatives analyzed would not be phased (see Section 2.10.2.5). Thus, construction noise disturbances in the Refuge would occur over a single construction period of approximately four years.

An additional factor to consider would be that of increased highway mortality for adults, hatchlings, and immature birds when a road or bridge is constructed through habitat they have always used for nesting, foraging, or resting. (Personal communication, Dennis Stewart, July 22, 2005, USFWS.) (See Section 4.7.6.6 under "Roadkill.")

Both Corridors

Although dredging would have little direct effect on the birds of Oregon Inlet, indirect effects could result if dredged material disposal techniques employed do not consider nesting activities of the colonial waterbirds. The terms and conditions outlined in the *Biological and Conference Opinion*s (USFWS, 2008) for the Phased Approach/Rodanthe Bridge Alternative (Preferred) related to piping plovers specify that "all dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission." The NCDOT is committed to implementing this measure. Numerous species depend on these dredge spoil islands, and their continued availability is critical. They also are heavily used during the non-breeding season. Species that nest on these islands include all of the coastal wading birds, royal terns, sandwich terns, brown pelicans, least terns, common terns, gull-billed terns, black skimmers, Caspian terns, and American oystercatchers. Oregon Inlet is heavily used by migrating and wintering piping plovers, and they frequent the dredge islands in the area as well. This area is also important to red knots since this species is being proposed for emergency listing (personal communication, December 2, 2006, Sue Cameron, North Carolina Wildlife Resources Commission [NCWRC]). Dredged material disposal islands near Oregon Inlet are experiencing severe erosion and, without further deposition of dredged material, some islands would likely disappear within a few years. Thus, properly controlled disposal of material could be beneficial by maintaining dredge spoil islands as viable nesting habitat. The effects of beach nourishment, including as a means for disposing of dredged materials, on nesting and migrating waterbirds also are a subject of interest and research. Recent studies conducted by the USACE have shown few substantial effects on shorebirds in North Carolina, but the ability to detect impacts is often difficult to determine on seasonal and highly variable waterbird populations (CZR Incorporated, 2003).

4.7.7 Positive Benefits of Allowing Natural Barrier Island Change

The positive benefit of allowing new inlets to remain, dunes to erode, storms to overwash the island, and washover deposits to remain in place is that this natural cyclic process is thought to preserve the barrier island system over time and despite sea level rise; however the island would not likely remain in its original location (e.g., island migration), configuration (e.g., number, location or size of inlets), or current vegetated state. Sediment pathways are restored, and new habitat is generated with each overwash cycle. Preventing the accumulation of washover fans, as is done by the human-made dune system in the project area, interrupts this process. Restoration of the dune system after a storm involves artificially moving the sand seaward and reintroducing it into the beach/dune system. If the material is then removed seaward during later storms, it could be lost to the specific site as it moves downdrift. If in a later storm, the material is swept up again in an overwash event, the natural process is delayed by dune restoration but not prevented (Godfrey and Godfrey, 1976; Leatherman, 1988; Pilkey et al., 1998).

Habitats on the Outer Banks are highly ephemeral in nature because of the high level of natural disturbance present in barrier island ecosystems. Plants and wildlife such as seabeach amaranth and piping plovers have evolved to specialize in these habitats. Allowing natural barrier island change on Hatteras Island, which has been prevented in the project area by the presence of NC 12 and human dune building for many decades (including dune building by the CCC), as well as most recently by the closure of the breach formed at the southern end of the island during Hurricane Isabel, will allow the formation of ephemeral habitats that are essential to maintaining the natural ecological character of a barrier island. Overwash fans, new inlets, and low sloping beaches may be formed that serve as habitat for resting, feeding, and nesting of avian species.

The Pamlico Sound Bridge Corridor would allow the most natural barrier island change to occur. The Parallel Bridge Corridor Alternatives, except for the Nourishment Alternative, would allow for natural shoreline movement in most of the project area.

4.7.8 Impacts Prior to Implementation of Phases II to IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred) from Potential Short-Term or Emergency Actions

Prior to the completion of Phases II to IV of the Phased Approach alternatives (including the Preferred Alternative), maintenance of the existing NC 12 roadway within the existing NC 12 easement would be necessary in response to storms in order to allow continued travel along NC 12. Section 4.6.8.6 discusses the nature of these activities. These activities may disturb wildlife in the manner listed in Table 4-28. They also would affect habitat within the NC 12 easement in the areas in which they would occur (see Table 4-14 and Table 4-15). Continuation of these activities would interrupt natural shoreline processes with the loss of the benefits addressed in Section 4.7.7.

Table 4-28. Impacts of Storm-Related NC 12 Maintenance Activities on Natural Resources

Activity	Affect on Natural Resources	General Past Frequency of Events Necessitating Projected Activities
1. Road Scraping	Noise/vibration disturbance for wildlife. Lighting disturbance for sea turtles if conducted at night. Not likely to cause substantial impacts.	1 to 2 times per month
2. Dune Building and Maintenance in Easement	Noise/vibration disturbance for wildlife. Lighting disturbance for sea turtles if conducted at night. Not likely to cause substantial impacts.	2 to 3 times per year
3. Sandbag Dune Building and Maintenance in Easement	Noise/vibration disturbance for wildlife. Lighting disturbance for sea turtles if conducted at night. Not likely to cause substantial impacts.	1 to 2 times per year

Most NC 12 maintenance activities likely would result in few impacts to fish and wildlife. All activities are a potential noise/vibration disturbance; and, if conducted at night, lighting from maintenance activities has potential to disturb nesting sea turtles.

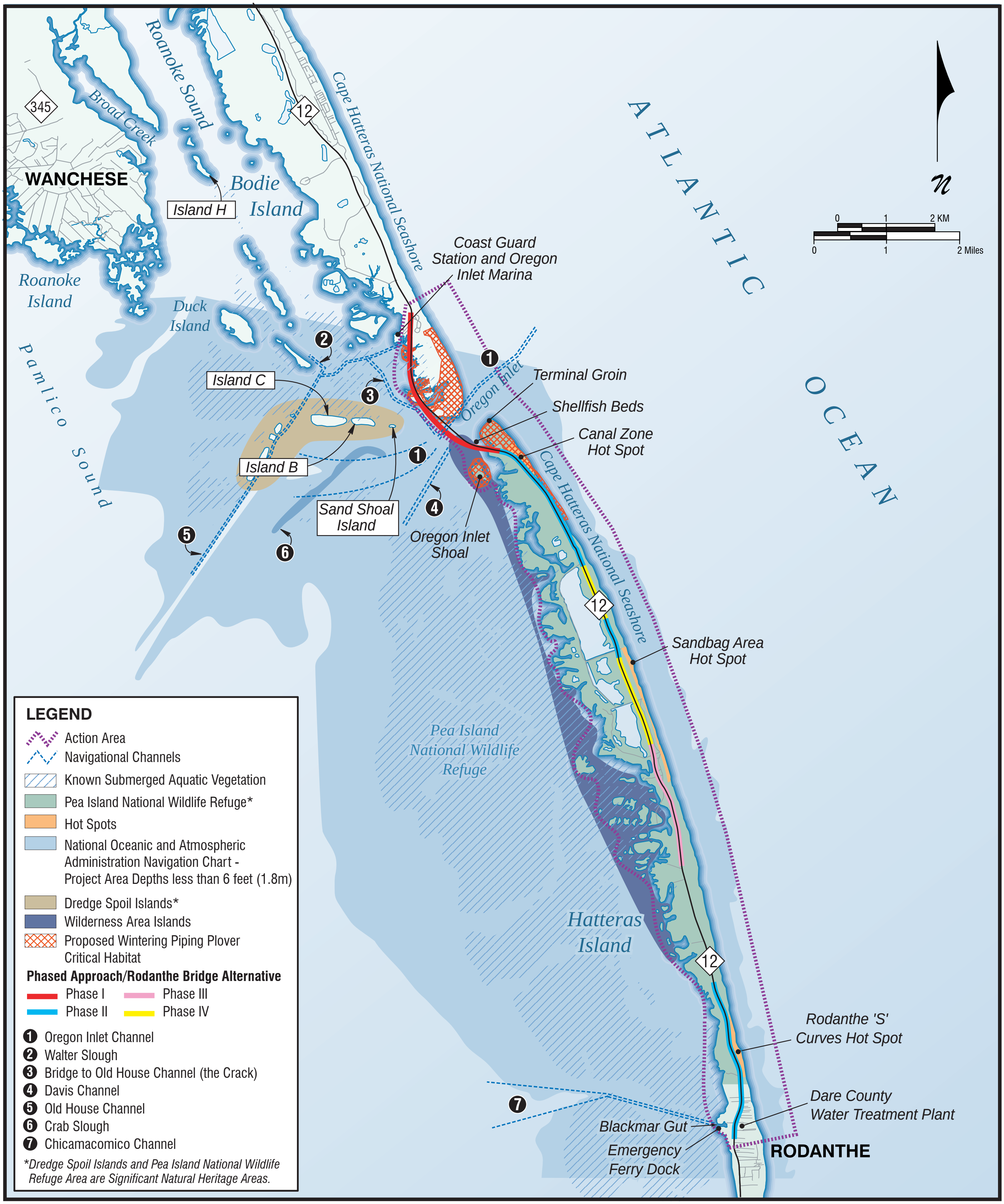
Table 4-14 and Table 4-15 indicate that the current level of NC 12 maintenance caused by storm damage would continue, and likely increase, in the three hot spot areas until Phase II is completed. Future maintenance would be confined to the existing NC 12 easement, since the Refuge has concluded that the selection of the Phased Approach/Rodanthe Bridge Alternative (Preferred) as the project for implementation in a ROD will preclude any future storm-related maintenance outside the NC 12 easement from being found compatible with the Refuge under the requirements of National Wildlife Refuge System Improvement Act of 1997. However, recognizing that the level of maintenance at the hot spots is not desirable, NCDOT intends to place a high priority on implementing Phase II, as discussed in Section 2.10.2.5. The completion of Phase II would substantially decrease the amount of storm-related maintenance on NC 12; however some would remain and may increase prior to the completion of Phases III and IV, though not to the extreme currently occurring in the three hot spots.

Also, as indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside of the existing easement in the Phase III and IV areas, as well as in the 2.1-mile (3.4-kilometer) section of NC 12 in the southern half of the Refuge that is not expected to be threatened by erosion prior to 2060. Limiting the growth of NC 12 storm-related maintenance in the Phase III and IV areas to the extent practicable given the availability of transportation funding and the efficient use of those funds also is considered desirable by NCDOT. In order to help accomplish that objective, NCDOT would implement a monitoring program, the particulars of which would be developed in consultation with representatives of the Refuge. This program would include the development of decision-making criteria for translating monitoring findings into a decision to move forward with Phases III and IV.

4.7.9 Protected Species

The Pamlico Sound Bridge Corridor would not likely result in adverse impacts to the 13 federally-listed threatened or endangered species in Dare County. With the Pamlico Sound Bridge Corridor, the biological conclusion for 10 of these species is "May Affect – Not Likely to Adversely Affect," and the biological conclusion for three species is "No Effect." With the Parallel Bridge Corridor, the biological conclusion for six of these species (five species with the Nourishment and Phased Approach/Rodanthe Nourishment alternatives) is "May Affect – Not Likely to Adversely Affect," the biological conclusion for three species is "No Effect," and the biological conclusion for four species (five species with the Nourishment and Phased Approach/ Rodanthe Nourishment alternatives) is "May Affect – Likely to Adversely Affect." Possible effects on state-listed rare species, federal species of concern, and candidates for federal listing are discussed in Section 3.7.7. Section 7 (of the Endangered Species Act of 1973) formal consultation for these species is not currently necessary as they are not listed as a federally threatened or endangered species.

A *Biological Assessment* (FHWA and NCDOT, 2008) was submitted to the USFWS and National Marine Fisheries Service (NMFS) in March 2008 as part of Section 7 formal consultation for the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred). It addressed protected species within an action area shown in Figure 4-1. The USFWS subsequently



BIOLOGICAL ASSESSMENT ACTION AREA AND NATURAL RESOURCE-RELATED FEATURES

Figure 4-1

issued their *Biological and Conference Opinions* (USFWS, 2008) in July 2008 (see Appendix E). The USFWS concurred with the NCDOT's biological conclusions for the following protected species and indicated that these species would not be part of the formal consultation:

- West Indian manatee – May Affect, Not Likely to Adversely Affect;
- Roseate tern – May Affect, Not Likely to Adversely Affect;
- Seabeach amaranth – May Affect, Not Likely to Adversely Affect;
- Red-cockaded woodpecker – No Effect; and
- Red wolf – No Effect.

The *Biological and Conference Opinions* (USFWS, 2008) also indicated that the hawksbill sea turtle and Kemp's ridley sea turtle do not normally nest in North Carolina, but occur in waters off the North Carolina coast. Therefore, these two turtle species, along with the shortnose sturgeon, fall within the purview of the NMFS, so they also were not part of the formal consultation with the USFWS. The four protected species that the USFWS issued biological opinions on were piping plover, loggerhead sea turtle, green sea turtle, and leatherback sea turtle. In addition, the USFWS also issued a biological opinion for the proposed critical habitat for wintering piping plovers. As stated in the *Biological and Conference Opinions* (USFWS, 2008) (see Appendix E), the USFWS' biological opinion on these protected species was:

> "After reviewing the current status of the piping plover, loggerhead sea turtle, green sea turtle and leatherback sea turtle; the environmental baseline for the action area; and all effects of the proposed project, it is the USFWS's biological and conference opinion that the proposed replacement of the Bonner Bridge and subsequent phases of elevating portions of NC 12 onto bridges (Transportation Improvement Program [TIP] No. B-2500), as proposed, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify proposed critical wintering habitat for piping plover. No critical habitat has been designated for the loggerhead sea turtle; therefore, none will be affected. Critical habitat has been designated for the green sea turtle in Puerto Rico, and critical habitat has been designated for the leatherback sea turtle in the US Virgin Islands; however, this action does not affect these areas and no destruction or adverse modification of that critical habitat is anticipated."

The USFWS' *Biological and Conference Opinions* (USFWS, 2008) (see Appendix E) included the following Reinitiation/Closing Statement with respect to formal Section 7 consultation:

> "This concludes formal consultation on the action outlined in your March 5, 2008 request for formal consultation. As provided in 50 CFR section 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

You may ask the USFWS to confirm the conference opinion as a biological opinion issued through formal consultation, if the critical habitat is designated. The request must be in writing. If the USFWS reviews the proposed action and finds that there have been no significant changes in the action as planned or information used during the conference, the USFWS will confirm the conference opinion as a biological opinion on the project and no further Section 7 consultation will be necessary."

The following section discusses in more detail the reasons for the biological conclusions for each federally-protected species with each of the proposed replacement bridge corridor alternatives (including the Preferred Alternative).

4.7.9.1 Federally-Listed or Proposed Species

Of the 13 federally-listed threatened or endangered species listed by the USFWS for Dare County (see Section 3.7.7), ten species were documented or may be present in the project area. The USFWS has jurisdiction over protected sea turtles species when they are on land. The NMFS has jurisdiction when they are in the water. The Pamlico Sound Bridge Corridor would not likely result in adverse impacts to any federally protected species. With all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative), a biological conclusion of "May Affect – Likely to Adversely Affect" was found for the green sea turtle, loggerhead sea turtle, leatherback sea turtle, and piping plover. In addition, a biological conclusion of "May Affect – Likely to Adversely Affect" was also found for the seabeach amaranth with the Nourishment and Phased Approach/Rodanthe Nourishment alternatives.

- **Bald eagle** (*Haliaeetus leucocephalus*) Federal Status – Delisted
State Status – Threatened

  Biological Conclusion:
Pamlico Sound Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>
Parallel Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>

  Bald eagles were a federally-listed species (threatened), but have since been delisted in June 2007. Bald eagles, however, remain federally-protected under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940 (BGPA). The BGPA prohibits take of bald and golden eagles and provides a statutory definition of "take" that includes "disturb." The bald eagle is a year-round transient species found regularly along the Outer Banks during migration and occasionally as a winter resident. The species has been sighted foraging over the ponds, marshes, open water, and sandy beaches of the area (Personal communication, July 25, 1990, Scott Lanier, USFWS). The abundance of suitable foraging habitat in the area and the transient nature of the bald eagle suggest that only temporary disturbances to the bird would be caused by construction activities. No eagles or eagle nests were observed during the field surveys of the project area in March 2003 and May/June 2004. Additionally, no trees of sufficient size to support a nest were observed within the project area. Any altered habitat resulting from bridge construction would be minimal and no substantial impacts are anticipated. The NCNHP has no records of any known populations of this species within the project area. Therefore, the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor would not likely adversely affect this species.

- **Red-cockaded woodpecker** (*Picoides borealis*) Federal Status – Endangered
State Status – Endangered

Biological Conclusion:
Pamlico Sound Bridge Corridor: NO EFFECT
Parallel Bridge Corridor: NO EFFECT

This species occurs in mature open pine forests in the southeastern United States, mostly longleaf pine forests. It prefers open longleaf pine savannas for foraging and nesting habitat. It excavates roosting and nesting cavities in live pine trees. The absence of mature stands of pine or pine-mixed hardwood limits its distribution. Suitable nesting or foraging habitat does not exist within one-half mile (0.8 kilometer) of the project area. Because of the lack of suitable habitat for foraging and nesting, this species would not be affected by the Pamlico Sound Bridge Corridor or by the Parallel Bridge Corridor.

- **Roseate tern** (*Sterna dougallii*) Federal Status – Endangered
State Status – Endangered

Biological Conclusion:
Pamlico Sound Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT
Parallel Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT

This coastal bird prefers sandy, open beach and interdunal habitat. It typically nests colonially by forming depressions in the sandy substrate near grass clumps or other vegetation. Suitable habitat is available within the project area and records show documentation of the roseate tern within the project area (Mack, 1969). Solitary roseate tern nests have been sporadically reported in North Carolina; however, there is only one documented nest of this species from North Carolina and it was reported in Carteret County (Lee and Parnell, 1990). Appropriate nesting habitat for the roseate tern is available in the project area; however, the NCNHP has no records of any known populations of this species within the project area. The rarity of this species in North Carolina along with the absence of established nesting in the state make the possibility of roseate terns nesting in the project area very unlikely. The presence of the species in the project area mostly likely would be migrant birds seeking rest or food. Thus, the construction, operation, and existence of a bridge in the Pamlico Sound Bridge Corridor or the Parallel Bridge Corridor would not affect any nesting areas. Beach nourishment along the shoreline with the Parallel Bridge Corridor with Nourishment Alternative could potentially encourage future nesting species. No substantial impact would occur to the fishery resources upon which it depends during migratory periods. Therefore, the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor would not likely adversely affect the roseate tern.

- **Piping plover** (*Charadrius melodus*) Federal Status – Threatened
State Status – Threatened

Biological Conclusion:
Pamlico Sound Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT
Parallel Bridge Corridor: MAY AFFECT – LIKELY TO ADVERSELY AFFECT

This shore bird prefers open, sandy habitats, particularly those undergoing early succession. It is known to winter and nest on North Carolina beaches in which the nest is typically a hollow in the sand that may be lined with shells or pebbles. Two nests were found near

Bonner Bridge in 1996 surveys conducted by the NPS. NCWRC and NPS verified a single territorial pair at the southern end of Bodie Island in 2006. NCWRC also conducted a coast-wide wintering piping plover survey in January 2006 in which eleven piping plovers were found wintering at Oregon Inlet (personal communication, December 2, 2006, Sue Cameron, NCWRC). Oregon Inlet is heavily used by migrating and wintering piping plovers and they frequent the dredge islands in the area as well. Review of NCNHP maps indicated one known population of the piping plover within the northernmost portion of the Parallel Bridge Corridor area south of the terminal groin and west of the ocean shoreline. NPS has also confirmed that individuals from the federally-listed endangered Great Lakes population utilize the study area (personal communication, December 4, 2006, Karen Sayles, NPS).

The USFWS has proposed that the Oregon Inlet area on Bodie Island and some islands in Pamlico Sound be designated as critical habitat for wintering piping plovers. Although this habitat is not officially designated at this time, the piles of the bridge in the Parallel Bridge Corridor alternatives (including the Preferred Alternative) could directly use up to 0.05 acre (0.02 hectare) of critical habitat. The piles of the Pamlico Sound Corridor alternatives also could use this habitat, but to a lesser extent since the corridor is generally located further west.

Construction activities within the Pamlico Sound Bridge Corridor would affect less than 1 acre (0.4 hectare) of potential nesting or foraging habitat in the project area where sandy beaches and dunes have formed along the Pamlico Sound and along oceanic beaches. This effected dune area is near existing NC 12, and it provides little if any foraging or nesting habitat value. Since construction of the two Phased Approach alternatives (including the Preferred Alternative) would take place within the existing NCDOT easement, disturbance to potential nesting or foraging habitat in the project area would be minimal. However, construction noise/vibration could affect nesting, and shoreline erosion could create what could have served as Piping Plover habitat that would be instead shaded by the bridges as the shoreline erodes.

Beach nourishment along the shoreline within the Parallel Bridge Corridor with Nourishment Alternative and the Phased Approach/Rodanthe Nourishment Alternative could potentially encourage future nesting species. However, the inability to predict future nest locations, as well as the lack of information pertaining specifically to the effects of noise-related disturbances, leads to difficulty in drawing absolute conclusions. In addition, the dynamic nature of the Oregon Inlet area results in a continually changing distribution of suitable habitat that could require reevaluation in the future.

A Section 7 consultation was initiated for the Oregon Inlet bridge of the Parallel Bridge Corridor in 1997 after piping plovers nested in the Oregon Inlet area following the release of the 1993 DEIS. The consultation addressed piping plover feeding, nesting, and critical wintering habitat. Consultation to resolve the effect of the Preferred Alternative was initiated in March 2008 and completed with USFWS providing its *Biological and Conference Opinion*s (USFWS, 2008) document (see Appendix E). Since construction/demolition might result in a “take” of potential plover nests, the biological conclusion was determined to be “May Affect – Likely to Adversely Affect” for the Parallel Bridge Corridor alternatives (including the Preferred Alternative). Because construction and operation of the Parallel Bridge Corridor alternatives would have the potential to alter approximately 0.05 acre (0.02 hectare) of the proposed critical habitat north of Oregon Inlet, the effect on proposed critical habitat for wintering piping plovers was determined to be “May Affect – Likely to Adversely Affect” for the Parallel Bridge Corridor alternatives. Since the Pamlico Sound Bridge Corridor would avoid almost all piping plover habitat, a conclusion of “May Affect – Not Likely to Adversely Affect” was reached for this alternative.

Conservation measures and reasonable and prudent measures specified for the Phased Approach/Rodanthe Bridge Alternative (Preferred) by USFWS’ *Biological and Conference*

*Opinion*s (USFWS, 2008) document (see Appendix E) are presented in Sections 4.7.10.4 and 4.7.10.5, respectively. They will be carried out by FHWA and NCDOT.

- **Hawksbill sea turtle** (*Eretmochelys imbricata***)** Federal Status – Endangered
State Status – Endangered

  Biological Conclusion:
  Pamlico Sound Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>
  Parallel Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>

  The hawksbill sea turtle occurs in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. Although this species is found along the eastern coast from Massachusetts southward, its nesting within the continental United States is limited to infrequent occurrences along the coast of Florida. Suitable habitat is available for the hawksbill sea turtle within the project area. However, the hawksbill is a highly tropical species that prefers the open ocean and has not been documented within the project area by the NCNHP (NCNHP database, 2003). Hawksbill turtle nesting in the United States is restricted to the southeastern coast of Florida and the Florida Keys, where they are nocturnal nesters (NMFS and USFWS, 1993). Because of the infrequent occurrence of this species within the project area and the absence of nesting activity, it is concluded that the proposed project would not likely adversely affect this species. This conclusion is affirmed in the USFWS' *Biological and Conference Opinion*s (USFWS, 2008) in Appendix E and in a letter from NMFS in Appendix A.

- **Kemp's ridley sea turtle** (*Lepidochelys kempii*) Federal Status – Endangered
State Status – Endangered

  Biological Conclusion:
  Pamlico Sound Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>
  Parallel Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>

  This small Atlantic sea turtle species has been captured inadvertently in North Carolina waters numerous times, but is found typically along the Gulf of Mexico. It nests on tropical sandy beaches and is only an occasional visitor to North Carolina's marine waters. The NCNHP has no records of this species within the project area (NCNHP Database, 2003); however, open water in the Oregon Inlet area (ocean, inlet, and sound) can provide suitable habitat. Because of the infrequent occurrence of this species in the project area and the absence of nesting activity in North Carolina, it is concluded that the proposed project would not likely adversely affect this species. This conclusion is affirmed in the USFWS' *Biological and Conference Opinion*s (USFWS, 2008) in Appendix E and in a letter from NMFS in Appendix A.

- **Leatherback sea turtle** (*Dermochelys coriacea*) Federal Status – Endangered
State Status – Endangered

  Biological Conclusion:
  Pamlico Sound Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>
  Parallel Bridge Corridor: <u>MAY AFFECT – LIKELY TO ADVERSELY AFFECT (land)</u>
  <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT (aquatic)</u>

  This species prefers the open ocean, preferably the warmer parts of the Atlantic Ocean; however, they occasionally forage in shallow bays, estuaries, and the mouths of rivers. It is not known to nest regularly along the North Carolina coast and the NCNHP has no records of this species in the project area. Aerial surveys conducted between April and November in 1979, 1982, and 1983 revealed leatherback sea turtles near the ocean shoreline between Cape Hatteras, North Carolina, and Cape Sable, Nova Scotia (NMFS and USFWS, 1992). It is expected that occurrences of leatherback sea turtles in the ocean near the vicinity of the proposed project would be transients migrating between the nesting grounds in the Gulf of Mexico and cooler waters of the New England coast. Nests have been found only south of Cape Hatteras. However, open water in the Oregon Inlet area (ocean, inlet, and sound) does provide suitable habitat. Construction related noise/vibration and lighting could temporarily impact turtle nesting habitat with the Parallel Bridge Corridor alternatives (including the Preferred Alternative). With the two Phased Approach alternatives (including the Preferred Alternative), bridge and piles would eventually be on the beach or in the surf. The locations where this would occur would vary year-by-year along the bridge with the location and extent of beach erosion. The presence of a bridge piles on the beach and in the surf could reduce the quality of sea turtle nesting habitat by altering beach dynamics (wind/currents). Shading on the beach by the bridge could alter incubation periods and the ratio of male to female hatchlings. Because leatherback sea turtles have nested in North Carolina, it is concluded that the proposed project has potential to adversely affect this species on land. Therefore, the effect on the leatherback sea turtle with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) from the perspective of the jurisdiction of the USFWS is determined to be “May Affect – Likely to Adversely Affect.” Since the Pamlico Sound Bridge Corridor would be in the sound and not on Hatteras Island, the effect of this alternative is “May Affect – Not Likely to Adversely Affect.”

Conservation measures and reasonable and prudent measures specified for the Phased Approach/Rodanthe Bridge Alternative (Preferred) by USFWS’ *Biological and Conference Opinion*s (USFWS, 2008) document (see Appendix E) are presented in Sections 4.7.10.4 and 4.7.10.5, respectively. They will be carried out by FHWA and NCDOT.

The effects on sea turtles while they are in the aquatic environment would be discountable. Turbidity, associated with construction, would be limited to dredging for barge access and pile driving. These activities would take place in a relatively small portion of Oregon Inlet at any one time, and would not limit travel by sea turtles between ocean and sound habitats. In addition, the presence of divers and barges would not represent a new disturbance to sea turtles because the area is already used by recreational users and boats. Also, it is unlikely that highway runoff would have a substantial negative affect on juvenile sea turtles. Stormwater runoff from bridges would be filtered by soil when over land, and could be diluted by wave action after Hatteras Island migrates westward. In the Phase II to IV area of the Phased Approach alternatives (including the Preferred Alternative), the potential for attraction of predatory fishes to newly created habitat (pilings) is unknown, but it is unlikely that these fishes would have a substantial effect on juvenile turtle populations because the pilings also would attract many species of prey fishes. Therefore, the effect on the leatherback sea turtle in the aquatic environment (jurisdiction of the NMFS) for all alternatives was determined to be “May Affect – Not Likely to Adversely Affect.” A letter from NMFS affirming this conclusion is presented in Appendix A.

- **Green sea turtle** (*Chelonia mydas*) Federal Status – Threatened
  State Status – Threatened

  Biological Conclusion:
  Pamlico Sound Bridge Corridor: <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT</u>
  Parallel Bridge Corridor: <u>MAY AFFECT – LIKELY TO ADVERSELY AFFECT (land)</u>
  <u>MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT (aquatic)</u>

  The green sea turtle is essentially a tropical species and does not breed in temperate zones, but it does occasionally occur in North Carolina waters during the warmer months. Green sea turtles occupy three habitat types: high-energy oceanic beaches that are used for nesting, convergence zones in the open sea that are used for migration, and benthic feeding grounds in relatively shallow, protected waters (NMFS and USFWS, 1991). The NCNHP has a record of this species nesting within the Parallel Bridge Corridor study area from 1980 (NCNHP Database, 2003). The known nesting site is along the beach east of the southern dike of the southernmost manmade pond within the Refuge. With the two Phased Approach alternatives (including the Preferred Alternative), bridge and piles would eventually be on the beach or in the surf. The locations where this would occur would vary year-by-year along the bridge with the location and extent of beach erosion. The presence of bridge piles on the beach and in the surf could reduce the quality of sea turtle nesting habitat by altering beach dynamics (wind/currents). Shading on the beach by the bridge could alter incubation periods and the ratio of male to female hatchlings. Because of the presence of nesting habitat and a known nesting site for the green sea turtle within the project area, impacts to this federally protected turtle from project construction noise/vibration and nighttime lighting could occur. Therefore, it is concluded that the proposed project has potential to adversely affect this species. Therefore, the effect on the green sea turtle with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) from the perspective of the jurisdiction of the USFWS is determined to be "May Affect – Likely to Adversely Affect." Since the Pamlico Sound Bridge Corridor would be in the sound and not on Hatteras Island, the effect of this alternative is "May Affect – Not Likely to Adversely Affect."

  Conservation measures and reasonable and prudent measures specified for the Phased Approach/Rodanthe Bridge Alternative (Preferred) by USFWS' *Biological and Conference Opinion*s (USFWS, 2008) document (see Appendix E) are presented in Sections 4.7.10.4 and 4.7.10.5, respectively. They will be carried out by FHWA and NCDOT.

  For the reasons discussed under the discussion of the leatherback sea turtle, the effects on the green sea turtle while they are in the aquatic environment would be discountable. Therefore, the effect on the green sea turtle in the aquatic environment (jurisdiction of the NMFS) for all alternatives was determined to be "May Affect – Not Likely to Adversely Affect." A letter from NMFS affirming this conclusion is presented in Appendix A.

- **Loggerhead sea turtle** (*Caretta caretta*) Federal Status – Threatened
State Status – Threatened

Biological Conclusion:
Pamlico Sound Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT
Parallel Bridge Corridor: MAY AFFECT – LIKELY TO ADVERSELY AFFECT (land)
MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT (aquatic)

The loggerhead turtle is found in temperate and subtropical waters worldwide. It is fairly common along the coast of North Carolina and can be found from open to inland waters such as bays, salt marshes, and the mouths of large rivers, but it prefers open, pelagic habitat. Suitable nesting habitat for the loggerhead turtle exists within the Parallel Bridge Corridor project area. In North Carolina, these turtles nest on ocean-facing beaches along the Outer Banks from mid-May through the end of August. The NCNHP has noted all ocean-facing beaches within the project area as suitable nesting habitat. However, at the time of site reconnaissance in March 2003, May and June 2004, and November and December 2004, no current nesting sites or markers denoting current nesting sites were observed within the project area. With the two Phased Approach alternatives (including the Preferred Alternative), bridge and piles would eventually be on the beach or in the surf. The locations where this would occur would vary year-by-year along the bridge with the location and extent of beach erosion. The presence of bridge piles on the beach and in the surf could reduce the quality of sea turtle nesting habitat by altering beach dynamics (wind/currents). Shading on the beach by the bridge could alter incubation periods and the ratio of male to female hatchlings.

The duration of the construction, while temporary, is of a long-term nature and bridge and road construction, nourishment, and associated activity, such as dredging and construction-related boat traffic, could harm sea turtles in the Pamlico Sound. The only type of dredge that is known to present a threat to turtles is the hopper dredge. Pipeline and clamshell dredges do not present a threat to turtles. (Dickerson et al., 1995; NMFS and USFWS, 1991; personal communication, April 8, 1997, Dave Nelson, Marine Biologist, USACE Waterways Experiment Station, Vicksburg, Mississippi; personal communication, May 2, 1997, Bill Adams, Planning Department, Environmental Resources Branch, USACE, Wilmington, North Carolina.)

The loggerhead sea turtle periodically nests on stretches of open beaches of the project area from May 1 through November 15. Therefore, the effect on the loggerhead sea turtle with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) from the perspective of the jurisdiction of the USFWS is determined to be "May Affect – Likely to Adversely Affect." Since the Pamlico Sound Bridge Corridor would be in the sound and not on Hatteras Island, the effect of this alternative is "May Affect – Not Likely to Adversely Affect."

Conservation measures and reasonable and prudent measures specified for the Phased Approach/Rodanthe Bridge Alternative (Preferred) by USFWS' *Biological and Conference Opinion*s (USFWS, 2008) document (see Appendix E) are presented in Sections 4.7.10.4 and 4.7.10.5, respectively. They will be carried out by FHWA and NCDOT.

For the reasons discussed under the discussion of the leatherback sea turtle, the effects on loggerhead sea turtle while they are in the aquatic environment would be discountable. Therefore, the effect on the loggerhead sea turtle in the aquatic environment (jurisdiction of the NMFS) was determined to be "May Affect – Not Likely to Adversely Affect." A letter from NMFS affirming this conclusion is presented in Appendix A.

- **American alligator** (*Alligator mississippiensis*) Federal Status – Threatened (S/A)
State Status – Threatened

Biological Conclusion:
Pamlico Sound Bridge Corridor: NO EFFECT
Parallel Bridge Corridor: NO EFFECT

In North Carolina, American alligators are at the northern edge of its range. Although a resident of localized areas of mainland Dare County, most are found in the southeastern portion of the state, in lakes, swamps, marshes, and other fresh to brackish water coastal wetlands. Suitable habitat exists within the Parallel Bridge Corridor's project area in the wetland areas in the western portion of the Refuge, however, no alligators or nests were observed during field surveys within the project area. The NCNHP has no records of any known populations of the American alligator within the project area; therefore, the proposed project would not affect this species.

- **West Indian manatee** (*Trichechus manatus*) Federal Status – Endangered
State Status – Endangered

Biological Conclusion:
Pamlico Sound Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT
Parallel Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT

In the United States, the manatee occurs primarily in Florida, although occasional occurrences during the summer have been documented as far north as coastal Virginia (USFWS, 1993). The water depth in the project area is deep enough to support habitat for the manatee. Manatees are reported as being sighted approximately 0.5 mile (0.8 kilometer) west of Rodanthe in the Pamlico Sound. Although manatees may move through Oregon Inlet to reach the waters of Roanoke and Pamlico Sounds, because of the extreme rarity of its occurrence in the area, the proposed project may affect but would not likely adversely affect this species. However, construction contracts would require compliance with the USFWS's *Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters* (USFWS, June 2003).

- **Shortnose sturgeon** (*Acipenser brevirostrum*) Federal Status – Endangered
State Status – Endangered

Biological Conclusion:
Pamlico Sound Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT
Parallel Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT

Among the most primitive of the bony fishes, the shortnose sturgeon is an anadromous species that inhabits the lower sections of larger rivers and coastal waters of the Atlantic coast, moving into freshwater only to spawn in the spring. It occurs from the St. John River in New Brunswick Canada south into the St. Johns River in north Florida. Unlike other anadromous species, the shortnose sturgeon does not seem to make long distance offshore migrations.

Historically the species probably occurred in major rivers throughout North Carolina, however, the current distribution is not well known. USFWS cites 2003 NC Natural Heritage Program data indicating records from 11 counties in North Carolina, not including Dare

County. There is, however, a record from 2006 in Pamlico Sound in Dare County (personal communication, November 30 2006, David Rabon, USFWS). A bottom dweller and benthic feeder, it prefers areas with soft substrate and vegetated bottom for most of the year. At spawning, the fish requires fast current and rough bottoms.

Suitable habitat exists within the project area and historic records document the species within Dare County. The rarity of occurrence in Albemarle and Pamlico Sounds, and because the fish prefer deep spots during the day and move to tidal flats for the night in the summer and early fall (Jackson et al., 1992), reduces the likelihood that the proposed project would adversely affect this species. In addition, any occurrence of this species within the project area would likely be short-term and in conjunction with annual spring migrations, further decreasing the likelihood that the project would adversely affect this species.

The variety of conservation measures that would be implemented to reduce potential impacts associated with sea turtles, also would serve as conservation measures to the shortnose sturgeon. However, because the shortnose sturgeon is rare in the action area, any effects from construction and lose of habitat will be discountable. Therefore, the effect of all alternatives on shortnose sturgeon has been determined to be "May Affect – Not Likely to Adversely Affect." A letter from NMFS affirming this conclusion is presented in Appendix A.

- **Red wolf** (*Canis rufus*) Federal Status – Experimental
  State Status – Significantly rare

  Biological Conclusion:
  Pamlico Sound Bridge Corridor: NO EFFECT
  Parallel Bridge Corridor: NO EFFECT

  Although once found throughout the southeastern United States, red wolves were extinct in the wild by 1980. Four pairs were released in the Alligator River National Wildlife Refuge in 1987. Pups and second-generation pups have been born in the wild, and the population has grown. Any heavily vegetated area of sufficient size to provide adequate food, water, and cover is considered potential habitat for the red wolf. They establish dens in hollow trees, stream banks, abandoned dens of other animals, drain pipes, and culverts. In Dare County, the red wolf occurs only on the mainland in large wilderness areas within the Alligator River National Wildlife Refuge. Suitable habitat does not exist in the project area; therefore, the proposed project would not affect this species.

- **Seabeach amaranth** (*Amaranthus pumilus*) Federal Status – Threatened
  State Status – Threatened

  Biological Conclusion:
  Pamlico Sound Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT
  Parallel Bridge Corridor: MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT except for the Nourishment and the Phased Approach/Rodanthe Nourishment alternatives, for which the conclusion is MAY AFFECT – LIKELY TO ADVERSELY AFFECT

  Seabeach amaranth is a fleshy stemmed annual herbaceous plant found on barrier island beaches and dunes. The flowering period is from June to frost. The sand flats and the foredune found in the Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor project areas offer suitable habitat for seabeach amaranth. Other habitats such as soundside beaches, foredune blowouts, and sand and shell material placed as beach nourishment, or dredge spoil are also suitable habitat found within the project area of both replacement bridge corridors. This species was not documented from the project area prior to 2004, despite previous surveys over multiple years looking for this species. The NPS located a single amaranth plant on the Bodie Island flats, near Bonner Bridge on July 6, 2004. A complete survey was postponed because of nesting piping plovers; however, as a result of tropical storm events, the flats were washed out and no other plants were found associated with the sand spit. (Personal communication, November 19, 2004, Marcia Lyons, Cape Hatteras National Seashore.) Surveys for this species in 2006 did not document any plants within the Seashore or Refuge (personal communication, December 2006, Marcia Lyons, Cape Hatteras National Seashore).

Therefore, the effect on this species has been determined to be “May Affect – Not Likely to Adversely Affect” for all alternatives except the two involving nourishment. However, since the favored habitat is highly ephemeral, a survey of the project area could be conducted for the habitat of this species prior to potential disturbances from nourishment. If suitable habitat were found, a survey for the species would then be conducted. With the two detailed study alternatives that would involve nourishment, adaptation of that program to avoid impacts could be considered.

4.7.9.2 Federal Species of Concern

The Pamlico Sound Bridge Corridor and the Parallel Bridge Corridor would not adversely affect any federal species of concern and would not destroy substantial areas of habitat for these species. Table 3-25 lists the federal species of concern, their state status, and the existence of habitat within the project area.

Rafinesque’s big-eared bat is not found in the project area, nor does suitable habitat exist in the project area for this species. The “Buxton Woods” white-footed mouse is primarily a resident of maritime forests in the Cape Hatteras area. The proposed project would not likely affect this species because it would not affect maritime forest. Maritime grasslands and maritime shrub thicket communities exist in the project area, and could serve as suitable habitat for “dune bluecurls;” however, it has not been documented north of Avon. Long-beach seedbox has been documented in Dare County along the margins of ponds in Buxton and in a roadside ditch near Wanchese. However, no survey has found these two plant species to exist in the project area; therefore, the proposed project is unlikely to directly affect these species. In addition, construction-related loss of habitat potentially used by “dune bluecurls” and long beach seedbox would be minimal.

The black rail and the northern diamondback terrapin are present in the project area and inhabit marsh communities, primarily along the sound. American eel also occurs throughout coastal North Carolina in fresh, brackish, and salt water bodies. Localized, short-term disturbance to habitat for these three species would likely result from construction activity in the replacement bridge corridors. However, considering the small loss or disturbance of habitat along the sound entailed by the replacement bridge corridors and the abundance of adjacent similar habitat in the project area, construction would not likely result in substantial adverse impacts to any of these three mobile species.

4.7.9.3 North Carolina-Listed Species

As indicated in Section 3.7.7.4, habitat exists in the project area for several state-listed species (gull-billed tern, peregrine falcon, bald eagle, saltmarsh spikerush, and possibly Carolina glasswort, blue witch grass, and small-flowered hemicarpha). The NCDOT would keep the NCNHP, the North Carolina Botanical Garden, the North Carolina Wildlife Resources

Commission, and/or other interested agencies informed regarding the status of the project. If any of these species were found to occur within the project area, the NCDOT would participate in the efforts of these agencies to design and implement a program to reduce potential effects.

4.7.9.4 Marine Mammals

Marine mammals are protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits, with certain exceptions, the "take" of marine mammals in US waters and by US citizens on the high seas, and the importation of marine mammals and marine mammal products into the US. "Take" is defined under the MMPA as "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." The construction activities associated with the detailed study alternatives (including the Preferred Alternative) will not result in a "take" of marine mammals.

4.7.10 Avoidance, Minimization, and Compensatory Mitigation

This section describes mitigation options for the use of natural resources associated with the Pamlico Sound Bridge and the Parallel Bridge corridors. The CEQ has defined mitigation in its regulations (40 CFR 1508.20) as avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts. This section also includes information from the USFWS' Incidental Take Statement from the *Biological and Conference Opinions* (USFWS, 2008) (see Appendix E). The Incidental Take Statement applies to the federally-protected species that were part of formal Section 7 consultation and reflects the maximum potential take for each protected species that is authorized for the entire project over the proposed extended timeframe of the project.

4.7.10.1 Avoidance

Avoiding impacts is the preferred method of mitigation according to the CEQ (40 CFR 1508.20). Avoidance was taken into account during the corridor alternatives development studies for both the Pamlico Sound Bridge and the Parallel Bridge corridors. Wetlands are so pervasive in the project area that it is impossible to completely avoid some impact. Both the Pamlico Sound Bridge Corridor and Parallel Bridge Corridor, however, would avoid construction fill in emergent intertidal wetlands and the productive aquatic bottom of the Walter Slough area to the northwest. Also, two of the most notable avoidance measures were the decision to move the Pamlico Sound Bridge Corridor to a location west of the extensive SAV beds found behind Hatteras Island, and the decision to move its location outside the Refuge. These avoidance measures reduced impacts to wildlife communities, EFH, and important wetland habitats. Five Parallel Bridge Corridor alternatives (including the Preferred Alternative) were evaluated in detail in this FEIS partly in order to examine different wetland avoidance options.

The two Parallel Bridge Corridor alternatives that rely on nourishment (the Nourishment Alternative and Phased Approach/Rodanthe Nourishment Alternative) could fill large areas of intertidal beach during nourishment (76.51 acres and 13.8 acres [30.96 hectares and 5.58 hectares], respectively). However, beach nourishment occurs in an extremely ephemeral habitat; and, if done correctly, does not have long-term negative effects. In terms of impacts to other Section 404 jurisdictional areas, the Parallel Bridge Corridor alternatives may be listed in descending order as follows: Road North/Bridge South Alternative (78.15 acres [31.63 hectares]), All Bridge Alternative (12.33 acres [4.99 hectares]), Nourishment Alternative (4.28 acres [1.73 hectares]), Phased Approach/Rodanthe Bridge Alternative (Preferred) (3.11 acres [1.26 hectares]), and Phased Approach/Rodanthe Nourishment Alternative (3.08 acres [1.25

hectares]). Excluding intertidal beach, the Phased Approach/Rodanthe Nourishment Alternative would entail the fewest impacts to most Section 404 jurisdictional areas. However it is only slightly (0.03 acres [0.01 hectares]) less than the Phased Approach/Rodanthe Bridge Alternative (Preferred) and the lack of direct intertidal beach impacts would make the Preferred Alternative the least damaging to Section 404 jurisdictional areas.

4.7.10.2 Minimization

The locations of the Pamlico Sound Bridge and the Parallel Bridge corridors offer different levels of habitat and wetland avoidance, as described in Sections 4.7.3 and 4.7.4. The use of bridges over habitat and wetlands in place of a roadway on fill is one means incorporated in the alternatives to help minimize wetland impact. The beach nourishment included in the Parallel Bridge Corridor with Nourishment Alternative also would reduce wetland impact by allowing NC 12 to remain in its current location. Several additional measures would be used to minimize adverse impacts to natural resources:

- Conservation measures and reasonable and prudent measures specified for the Phased Approach/Rodanthe Bridge Alternative (Preferred) by USFWS' *Biological and Conference Opinion*s (USFWS, 2008) document (see Appendix E) would be implemented. They are presented in Sections 4.7.10.4 and 4.7.10.5, respectively.

- Work bridges, rather than dredging from barges (when possible and practicable), would be used for movement of construction equipment in areas where SAV is present. Work bridges also would be used to carry construction equipment over intertidal marsh areas (black needlerush and smooth cordgrass) at the Bodie Island end of the Pamlico Sound Bridge Corridor bridge. A temporary haul road likely would be used at the Bodie Island end of an Oregon Inlet bridge with the Parallel Bridge Corridor. Use of a work bridge instead of a haul road for short distances at critical locations, such as SAV locations, would be considered prior to construction.

- Depending on the particular construction activity being performed, turbidity curtains or other means of sediment and erosion control would be implemented in an effort to minimize impacts to adjacent areas of SAV and/or wetlands. Prior to construction, the design-build contractor would submit the proposed sediment and erosion control measures for each stage of construction to the NCDOT and the permitting agencies for review. The reviewing agencies may stipulate additional sediment and erosion control measures that would be followed accordingly.

- BMPs will also be implemented to manage pollutants associated with construction and operation activities to minimize the amount of pollutant loading that is discharged from the bridge and highway to the Oregon Inlet and Pamlico Sound. This could include development of an erosion and sediment control plan both to manage site erosion, sediment, and chemicals and to conduct land disturbance activities in a way that reduces erosion, contains sediment on-site during and after construction, prevents off-site transport of waste and chemicals, and minimizes use and production of pollutants.

4.7.10.3 Compensatory Mitigation

The 1990 Memorandum of Agreement (MOA) between the USACE and the USEPA states that "appropriate and practicable compensatory mitigation is required for unavoidable adverse impacts which remain after all appropriate and practicable minimization has been required."

Compensatory mitigation refers to the restoration, creation, enhancement, or preservation of wetlands as compensation for unavoidable wetland impacts. Guidance provided in the MOA indicates that restoration should be the first option considered and that on-site and in-kind mitigation is preferable to off-site and out-of-kind mitigation. The following mitigation ratio guidelines (ratio of the acres [hectares] of wetland replacement to acres [hectares] of wetlands permanently filled) are used by the USACE regulatory division in Washington, North Carolina:

- Restoration 2:1
- Enhancement 4:1
- Creation 3:1
- Preservation 10:1

In consultation with the other agencies, NCDOT may determine that there are circumstances where in-lieu-fee, fee mitigation, or other similar arrangements would serve as appropriate mitigation options. The *Ecosystem Enhancement Program* (EEP) could also serve as a potential in-lieu-fee source for compensatory mitigation.

Mitigation of Temporary Wetland Impacts

Construction equipment on land would be confined to the proposed right-of-way for the Pamlico Sound Bridge Corridor. Work bridges would be used over intertidal marsh areas (black needlerush and smooth cordgrass) at the Bodie Island end of the Pamlico Sound Bridge Corridor bridge to minimize potential temporary wetland impact.

With the Parallel Bridge Corridor, construction equipment would generally operate in the proposed right-of-way. A temporary haul road, however, could be used at the Bodie Island end of the Oregon Inlet bridge given the larger foundation components of the Oregon Inlet bridge. This activity would affect 6.0 acres (2.4 hectares) of wetlands. Construction of the two Phased Approach alternatives (including the Preferred Alternative) also would include traffic maintenance roads within the existing NC 12 easements on Hatteras Island, which would affect an additional 5.6 acres (2.3 hectares) of wetlands (see Table 4-26).

Temporary impacts to wetlands would be mitigated on a 1:1 basis by restoring these areas to their pre-construction condition. If needed, dredged materials could be used to return these wetland areas to their pre-construction elevation. Settling of the dredged materials would be taken into account in order to ensure a return to the proper elevation. These areas would be replanted immediately following the placement of dredged materials in order to provide rapid coverage and to prevent erosion. Species composition of the plantings would be based on pre-construction baseline data on species composition of the affected areas. Detailed monitoring of hydrology and vegetation would be conducted in order to ensure a return to full wetland function.

The USACE has successfully established salt marsh on dredge spoil deposited at proper elevations with complete vegetation coverage in three years (Broome, 1990). Woodhouse et al. (1972) also have successfully developed marshes on dredge spoil with complete coverage in two years. The USACE has developed guidelines for implementing salt marsh development on dredged material (USACE, 1978).

Mitigation of Permanent Wetland Impacts

Permanent wetland losses would be mitigated by restoring, creating, or enhancing wetlands at agency-approved ratios. Potential compensatory wetland mitigation includes on-site restoration and enhancement of in-kind wetlands as compensation for as much of the permanently affected area as possible; however, the limited availability of potential mitigation sites in the immediate vicinity of the project area would necessitate an exploration of additional options, which include off-site restoration, creation, and enhancement of wetlands.

Within the Pamlico Sound Bridge Corridor, permanent fill and pile placement would affect primarily man-dominated wetlands and maritime shrub thicket wetlands. Open water within the impoundments, salt shrub/grasslands, and black needlerush wetlands would be primarily affected by permanent fill and pile placement within the Parallel Bridge Corridor. Mitigation by wetland type would include:

- Wetland Maritime Shrub Thicket. Within the Pamlico Sound Bridge Corridor with either Rodanthe terminus option, less than 0.3 acre (0.1 hectare) of wetland maritime shrub thicket would be filled. Within the Parallel Bridge Corridor with any of the NC 12 Maintenance alternatives, less than 6.7 acres (2.7 hectares) of wetland maritime shrub thicket would be filled. These areas could be mitigated on an equitable basis by creating shrub thickets on land currently used for the Bonner Bridge approach on Hatteras Island. These areas are somewhat protected from salt spray and harsh winds. Once excavated and backfilled with organic material (to establish appropriate elevation and substrate) and planted with shrub species typical of adjacent shrub thickets, these areas eventually would develop into functioning maritime shrub thickets. If sufficient area is not available on Hatteras Island, several small shrub thickets exist adjacent to the man-dominated approach onto Bodie Island, and their habitat value could be enhanced by expanding this wetland community. If sufficient and suitable area still is not available on-site because of the high proportion of land that is wetlands, other options—including exchange (converting one wetland type to another wetland type of higher functional value in this case) and off-site mitigation—would be explored.

- Wetland Man-Dominated. Within the Pamlico Sound Bridge Corridor, Curved Rodanthe Terminus option, 1.2 acres (0.5 hectare) of man-dominated wetlands would be filled. With the Intersection Rodanthe Terminus option, 0.4 acre (0.2 hectare) would be filled. Within the Parallel Bridge Corridor, approximately 0.2 acre (0.1 hectare) of man-dominated wetlands would be filled with all three alternatives. These highly disturbed wetlands provide little value for animal communities; therefore, equitable mitigation options are numerous and are described later in this section.

- Wetland Maritime Grassland. Within the Pamlico Sound Bridge Corridor, approximately 0.5 acre (0.2 hectare) of wetland maritime grassland would be filled with both alternatives. Within the Parallel Bridge Corridor with Nourishment Alternative, 0.1 acre (0.04 hectare) of maritime grassland wetlands would be filled. With the Parallel Bridge Corridor with All Bridge Alternative, 0.2 acre (0.1 hectare) would be filled. A 0.3-acre (0.1-hectare) impact to maritime grassland wetland communities would occur with the Parallel Bridge Corridor with Road North/Bridge South Alternative. Within the Parallel Bridge Corridor with either Phased Approach alternative (including the Preferred Alternative), 1.3 acres (0.5 hectare) would be filled. Maritime grasslands are primarily transitional wetlands and are functionally less important than other emergent wetlands more common in the project area. Mitigation options are described later in this section.

- Wetland Salt Shrub/Grasslands. Pile placement with either terminus option of the Pamlico Sound Bridge Corridor would not affect this wetland community, which is normally found between small areas of salt marshes (smooth cordgrass and black needlerush) and the more stable maritime shrub thicket. With the Parallel Bridge Corridor with All Bridge Alternative, 2.6 acres (1.1 hectares) of wetland salt/shrub grasslands would be filled. A substantial impact (29.4 acres [11.8 hectares]) to salt shrub/grassland wetland communities would occur with the Parallel Bridge Corridor with Road North/Bridge South Alternative because of the relocation of NC 12. Within the Parallel Bridge Corridor with either Phased Approach alternative (including the Preferred Alternative), 1.6 acres (0.6 hectare) of wetland salt shrub/grasslands would be filled. The Parallel Bridge Corridor with Nourishment Alternative would not require impacts to this community. Salt shrub/grasslands are primarily transitional wetlands and are functionally less important than other emergent wetlands; however, the quality of this habitat has been enhanced within the project area through the use of prescribed burning. This increases foraging habitat for wildlife such as snow geese. (Personal communication, Dennis Stewart, July 28, 2005, USFWS.) Mitigation options are described later in this section.

- Wetland Reed Stand. Pile placement within the Pamlico Sound Bridge Corridor would not affect this wetland community because of its isolated location on the soundside of the Rodanthe area. The Parallel Bridge Corridor with Nourishment Alternative would affect 0.2 acre (0.1 hectare) of reed stand, whereas the Parallel Bridge Corridor with Road North/Bridge South Alternative would affect 0.9 acre (0.4 hectare). The Parallel Bridge Corridor with All Bridge Alternative would permanently affect 0.03 acre (0.01 hectare) of reed stand wetlands, primarily at the emergency ferry dock in Rodanthe. Within the Parallel Bridge Corridor with either Phased Approach alternative (including the Preferred Alternative), 0.6 acre (0.3 hectare) of wetland reed stand would be filled. Because of this community's encroaching nature, chemical spray treatment could be applied to potentially provide additional habitat for adjacent emergent marsh communities. These disturbed wetlands provide limited food resources for animal communities; therefore, equitable mitigation options are numerous and are described later in this section.

- Wetland Overwash. This community exists only within the Parallel Bridge Corridor; it consists of areas that have been recently overwashed from severe storm events, as well as areas in which NC 12 abuts the dunes, and sand removal from the roadway is performed on a regular basis. The Parallel Bridge Corridor with Nourishment Alternative would not affect this community. The Parallel Bridge Corridor with Road North/Bridge South Alternative would affect 1.5 acres (0.6 hectare) of overwash wetland fans, and the Parallel Bridge Corridor with All Bridge Alternative would affect 0.2 acre (0.1 hectare). Within the Parallel Bridge Corridor with either Phased Approach alternative (including the Preferred Alternative), 0.7 acre (0.3 hectare) of wetland overwash would be filled. This community is a transitional community and could be potentially restored by creating wetland shrub habitat or other similar grassland communities.

- CAMA Wetlands. Salt flat and brackish marsh wetland communities were identified within the project area; however, neither the Pamlico Sound Bridge Corridor nor the Parallel Bridge Corridor would affect these communities. Pile placement would fill less than 0.01 acre (0.01 hectare) each of black needlerush and smooth cordgrass communities with either terminus option of the Pamlico Sound Bridge Corridor. The Parallel Bridge Corridor with Nourishment Alternative would affect less than 0.3 acre (0.1 hectare) each of black needlerush and smooth cordgrass communities. The Parallel Bridge Corridor with Road North/Bridge South Alternative would substantially affect these communities (11.6 acres

[4.6 hectares] of black needlerush and 0.2 acre [0.1 hectare] of smooth cordgrass) because of the relocation of NC 12. Pile placement within the Parallel Bridge Corridor with All Bridge Alternative would affect approximately 2.2 acres (0.9 hectare) of these communities. Within the Parallel Bridge Corridor with either Phased Approach alternative (including the Preferred Alternative), 1.0 acre (0.4 hectare) of black needlerush would be filled. Both of these communities are considered areas of high value and are relatively scarce on a national basis. These wetlands would be mitigated or replaced in-kind. Mitigation options are described later in this section.

- Submerged Aquatic Vegetation Beds. Pile placement would fill approximately 0.3 acre (0.1 hectare) of SAV along the length of the Pamlico Sound Bridge Corridor. The Parallel Bridge Corridor with All Bridge and Road North/Bridge South alternatives would affect 1.4 acres (0.6 hectare) of SAV along the length of the Oregon Inlet bridge and the Rodanthe area bridge. The Parallel Bridge Corridor with Nourishment Alternative would affect 0.2 acre (0.1 hectare) of SAV because of the use of existing NC 12. Impacts from the construction of a temporary haul road to the west of the Oregon Inlet bridge would affect 2.4 acres (0.9 hectare) of SAV based on the most recent available survey data from the Division of Marine Fisheries. According to the USFWS Mitigation Policy, this highly productive, relatively scarce habitat must be mitigated for with no net loss of in-kind habitat value. Between 1985 and 1994, the Habitat Protection field office in Beaufort, NC, recommended seagrass mitigation for five permits which destroyed a total of 3.25 acres (1.32 hectares) of SAV. Compensatory mitigation for these permits totaled 4.74 acres (1.92 hectares) (Fonseca et al., 1998). Two of the five mitigation sites were evaluated and only one was judged successful. The difficulties associated with the creation of a functional SAV bed within a reasonable time suggest that avoidance is the best and most logical mitigative measure. This was accomplished for the most part by the placement of the Pamlico Sound Bridge and the Parallel Bridge corridors and the planned use of work bridges to carry construction equipment through SAV areas.

  Compensatory mitigation would involve planting and subsequent monitoring using recommendations provided by the National Oceanic and Atmospheric Administration (NOAA) (Fonseca et al., 1998). Mitigation site selection is critically important in the success of SAV mitigation. On-site mitigation is preferred, rather than the selection of an off-site location, since the historic presence of seagrass in the area of impact suggests a greater chance of replanting success (Fonseca et al., 1998). A four-year monitoring effort following planting or remedial replanting is recommended by the NOAA with success determination based on yearly documentation of: number of rhizome apicals, planning unit survival, shoot density, and aerial coverage of planning units. Prior to construction, mitigation options for SAV would be further evaluated after the NCDOT has completed a final SAV survey. The most recent NCDOT SAV survey was completed in 2007.

Mitigation considerations for individual wetland types were discussed above. Impacts to Section 404 jurisdictional wetlands will total 0.47 acre (0.19 hectare) for the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred). At a maximum mitigation ratio of 10:1, the Preferred Alternative would require 4.7 acres (1.9 hectares) of mitigation.

The Ballance Farm Mitigation Site is in Currituck County approximately 5 miles (8.0 kilometers) southeast of Moyock. The 430-acre (470-hectare) property was purchased by NCDOT to mitigate for wetland impacts associated with the widening of NC 168 (TIP Project No. R-2228) and future impacts in the Pasquotank River basin (High Unit Cost Grant Program [HUC] 03010205). The site originally consisted of 297 acres (120.2 hectares) of prior converted agricultural fields along with existing tidal freshwater marsh and nonriverine forested wetlands. According to the Ballance Farm Mitigation Plan, implementation of the site was to provide marsh creation, marsh preservation, nonriverine wetland restoration, nonriverine wetland preservation and upland habitat preservation. After five years of monitoring, the nonriverine wetland restoration portion of the site was deemed successful and closed out in 2004. In 2005 a portion of the marsh creation site was deemed successful and accepted as suitable mitigation for TIP Project No. R-2228. The site was then transferred to the EEP as an asset.

Mitigation credit available from the Ballance Farm Mitigation could provide for all or a portion of the mitigation required for the Preferred Alternative. The amount of mitigation credit available from this site cannot be currently determined because other projects could debit credit from the site. Any mitigation not accounted for by the Ballance Farm would be reconciled through onsite mitigation and monetary contributions to the EEP.

4.7.10.4 Conservation Measures for Protected Species

Conservation measures represent actions, pledged in the project description, that the action agencies (FHWA and NCDOT) will implement to minimize the effects of a proposed action and further the recovery of the species under review. Such measures should be closely related to the action and should be achievable within the authority of the action agencies. Since conservation measures are part of a proposed action, their implementation is required under the terms of Section 7 consultation. Conservation measures for protected species were agreed to in formal consultation with USFWS and NMFS for the Phased Approach/Rodanthe Bridge Alternative (Preferred). The USFWS' *Biological and Conference Opinions* (USFWS, 2008) (see Appendix E) lists the following conservation measures:

- The Phased Approach/Rodanthe Bridge Alternative (Preferred) will allow natural shoreline migration and the formation of new inlet habitats to occur.
- The project will incorporate the most current BMPs to reduce habitat degradation from stormwater runoff pollution.
- Phase I of the project will be built at least 125 feet (38.1 meters) farther west of the Bonner Bridge and currently occupied piping plover habitat.
- NCDOT does not anticipate the use of explosives during construction or demolition of the existing bridge.
- The NCDOT contractor will use pipeline or clamshell dredging, rather than a hopper dredge to minimize effects to sea turtles.
- No permanent light fixtures will be installed on the bridge or the approaches (with the exception of navigation lights as required by the US Coast Guard).
- Seabeach amaranth surveys will be conducted at least one year prior to initiating bridge construction activities.
- Temporary facilities such as haul roads that affect proposed critical habitat will be removed as soon as possible.

Several additional conservation measures incorporated into the Phased Approach/Rodanthe Bridge Alternative (Preferred) are associated with species under the jurisdiction of the NMFS, including sea turtles (when in the ocean and sound) and the shortnose sturgeon. Additional conservation measures for the sea turtles will mainly involve measures to minimize impacts to water quality during demolition, construction, and maintenance. Although turtles are air-breathing reptiles and highly mobile while in the water, they could be temporarily affected by potential contaminants in the water column if they were in the vicinity. Minimization measures would include BMPs involving use, storage, and disposal of demolition/construction materials to minimize short-term turbidity or water quality degradation during over water construction in Oregon Inlet and during periodic maintenance. Stormwater management and controls would be designed with reference to NCDOT's BMP Toolbox and NCDENR's BMP Manual. Conservation measures to protect shortnose sturgeon would be similar to those protecting sea turtles, including no hopper dredging and BMPs to minimize habitat degradation during construction and periodic maintenance. In addition, construction and demolition activities associated with Phase I of the project would be completed as quickly as possible in order to minimize deterring spawning sturgeon from entering Oregon Inlet. Stormwater management and controls would be designed with reference to NCDOT's BMP Toolbox and NCDENR's BMP Manual.

NCDOT will comply with the NMFS's March 23, 2006, *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006) that restrict in-water construction-related activities when these protected species are observed in the project area. However, the NMFS and NCDOT agree that bridge construction or demolition activities do not need to stop when a protected species is sighted in the proximity of construction if the construction activities are not in the water. The in-water moratorium prohibits pile installation and removal, as well as activities associated with bridge construction and demolition when listed species are present, but does not restrict terrestrial activity.

4.7.10.5 Incidental Take Statement, Including Reasonable and Prudent Measures, for Protected Species

The material in this section was prepared by the USFWS and agreed upon by FHWA and NCDOT as it relates to protected species under the jurisdiction of USFWS that were the subject of formal Section 7 consultation. It is contained in the USFWS' *Biological and Conference Opinions* (USFWS, 2008) document (see Appendix E). Consultation with the NMFS resulted in their agreement for a biological conclusion of "May Affect – Not Likely to Adversely Affect" for species under its jurisdiction with the Preferred Alternative. Thus, an incidental take statement and reasonable and prudent measures beyond the conservation measures described in the previous section were not required or prepared by NMFS. The letter confirming the NMFS' conclusions is presented in Appendix A. This material applies to the Phased Approach/Rodanthe Bridge Alternative (Preferred).

Section 9 of the Endangered Species Act and federal regulations pursuant to Section 4(d) of the Endangered Species Act prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Endangered Species Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and will be undertaken by FHWA so that they may become binding conditions of any grant or permit issued to NCDOT, as appropriate, for the exemption in Section 7(o)(2) to apply. FHWA has a continuing duty to regulate the activity covered by this Incidental Take Statement. If FHWA (1) fails to assume and implement the terms and conditions or (2) fails to require NCDOT to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of incidental take, FHWA or NCDOT will report the progress of the proposed project and any impact on the species to USFWS.

Amount or Extent of Take Anticipated

The incidental take anticipated for piping plovers with the Phased Approach/Rodanthe Bridge Alternative (Preferred) is:

- Breeding Piping Plovers. USFWS expects incidental take of breeding plovers will be difficult to detect. The take would be the lost potential for nesting because of disturbance of breeding pairs at the nesting sites from nearby construction activity. It would be impossible to determine whether the lack of nesting or the absence of breeding pairs was because of the project or some other unrelated factor. It would only be possible to infer that the project directly caused the loss of a nest if an established nest was abandoned at the time construction began in the vicinity. Also, plover nests are cryptic and easily overlooked. However, this undetected level of take may occur near Oregon Inlet at historical nesting locations. Based on historical nesting data, the maximum level of incidental take is three breeding pairs per year precluded from nesting or caused to abandon nests during construction for Phases I and II of the Phased Approach/Rodanthe Bridge Alternative (Preferred) during each nesting season (i.e., April 1 to July 15) and the harassment of the associated breeding pairs.

- Migrating and Wintering Piping Plovers. USFWS expects incidental take of nonbreeding plovers with the Phased Approach/Rodanthe Bridge Alternative (Preferred) will be difficult to detect for the following reasons: sub-lethal effects are not easily determined; harassment which contributes to lessened survivorship may only be apparent on the breeding grounds the following year; and dead plovers may not be detectible. However, take of all migrating and wintering plovers throughout the extent of suitable habitat within the action area can be anticipated in all four phases of the Phased Approach/Rodanthe Bridge Alternative (Preferred) by the disturbance of feeding or roosting plovers from nearby construction activity.

The USFWS expects incidental take of all species of sea turtles will be difficult to detect for the following reasons:

- The turtles nest primarily at night and all nests are not found because (a) natural factors, such as rainfall, wind, and tides may obscure crawls and (b) human-caused factors, such as pedestrian and vehicular traffic, may obscure crawls;

- The total number of hatchlings per undiscovered nest is unknown;

- An unknown number of females may avoid the project beach and be forced to nest in a less than optimal area; and

- Lights may misdirect an unknown number of hatchlings and cause death.

However, take of all sea turtles throughout the extent of nesting habitat within the action area can be anticipated in all four phases of the Phased Approach/Rodanthe Bridge Alternative (Preferred) by harm or harassment because the effects of artificial light and disturbance from construction and future maintenance and repair activities on nesting females and hatchlings. Also, as portions of the beach migrate westward, take of all undetected nests throughout the extent of the nesting habitat can be anticipated from future maintenance or repair activities that may crush undetected nests. Finally, as portions of the beach migrate westward, take of all nesting sea turtles throughout the extent of nesting habitat within the action area can be anticipated from reduced nesting by females deterred by bridge piles on the beach and by shading effects on sex ratios of eggs in nests constructed underneath the bridges.

Effect of the Take

In its *Biological and Conference Opinions* (USFWS, 2008), the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species, or destruction or adverse modification of designated or proposed critical habitat.

Reasonable and Prudent Measures

The USFWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the piping plover, loggerhead sea turtle, green sea turtle, and leatherback sea turtle. These nondiscretionary measures include, but are not limited to, the terms and conditions outlined in the *Biological and Conference Opinion*s (USFWS, 2008). They are:

- Piping Plover

  - Avoid disturbing nesting piping plovers.

  - To the extent possible, avoid disturbing foraging and roosting plovers.

  - To minimize the effect of harassment on foraging plovers, provide alternative foraging areas.

  - Avoid or minimize opportunities for avian predator perches.

- Sea Turtles - All Species

  - Avoid disturbing nesting sea turtles, nests, and hatchlings.

  - Educate construction contractors and pertinent NCDOT staff as to the adverse effects of artificial lighting on sea turtles.

  - Minimize the effects of construction lighting on nesting sea turtles and hatchlings.

  - Minimize the effects of vehicle headlights from the completed bridge.

  - Avoid permanent light fixtures.

Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the Endangered Species Act, NCDOT must comply with the following terms and conditions, which implement the reasonable and prudent measures described in the previous section. These terms and conditions are nondiscretionary, included as Project Commitments, and are:

- Piping Plover

  a. All construction equipment and personnel must avoid all bird closure areas within the Seashore and Refuge.

     All future routine maintenance activities of bridge structures that would occur within or adjacent to current or future plover nesting areas must occur outside the nesting season (April 1 to July 15).

     All future repair work on bridge structures that would occur within or adjacent to current or future plover nesting areas must occur outside the nesting season (April 1 to July 15) unless emergency or human safety considerations require otherwise. In this event, the area must be surveyed for nesting plovers and avoided to the extent possible.

  b. During the construction of Phases II, III and IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred), keep all construction equipment and activity within the existing right-of-way.

     Do not moor any construction barges within 300 feet (91.4 meters) of the following islands: Green Island, Wells Island, Parnell Island, Island MN, Island C, the small unnamed island immediately east of Island C, Island D, and Island G (see Figure 1 in the *Biological and Conference Opinion*s in Appendix E).

  c. All dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission. The point of contact is Sue Cameron at 910-325-3602. If the dredge material is used outside the current defined action area, the action area is assumed to be expanded to cover the beneficial placement of the material.

  d. To the maximum extent practical, while ensuring the safety of the traveling public, limit or avoid the use of road signs or other potential predator perches adjacent to plover nesting or foraging areas. Where signs or other structures are necessary, determine if alternative designs would be less conducive for perching on by avian predators (gulls, crows, grackles, hawks, etc.). For example, minimize or avoid the use of large cantilever signs in favor of smaller and shorter designs.

- Sea Turtles - All Species

  a. All construction equipment and personnel must avoid all marked sea turtle nests.

     Construction material and equipment staging areas must not be located seaward of the artificial dune.

All future routine maintenance activities of bridge structures that would occur within or adjacent to current or future sea turtle nesting habitat, and which would require vehicles or equipment on the beach or the use of night lighting (excluding navigation lights required by the US Coast Guard), must occur outside the nesting season (May 1 to November 15).

All future repair work of bridge structures that would occur within or adjacent to current or future sea turtle nesting habitat, and which would require vehicles or equipment on the beach or the use of night lighting (excluding navigation lights required by the US Coast Guard) must occur outside the nesting season (May 1 to November 15) unless emergency or human safety considerations require otherwise. In this event, the area must be surveyed for sea turtle nests and avoided to the extent possible.

b. Provide an opportunity for the USFWS or an USFWS designee to educate construction contractor managers, supervisors, foremen and other key personnel and resident NCDOT personnel with oversight duties (division engineer, resident engineer, division environmental officer, etc.) as to adverse effects of artificial lighting on nesting sea turtles and hatchlings, and to the importance of minimizing those effects.

c. During turtle nesting season (May 1 to November 15), use the minimum number and the lowest wattage lights that are necessary for construction.

   During turtle nesting season, portable construction lighting must be of the low-pressure sodium-vapor type.

   During turtle nesting season, utilize directional shields on all portable construction lights, and avoid directly illuminating the turtle nesting beach at night.

   During turtle nesting season, all portable construction lights must be mounted as low to the ground as possible.

   During turtle nesting season, turn off all lights when not needed.

d. For Phases II, III and IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred)**,** on the ocean side, design the bridge structure in a manner which will shield the beach on the east side from direct light emanating from passenger vehicle headlights. For the small portion of Phase I over land on Hatteras Island, retrofit the bridge structure at the time that Phase II connects with Phase I. The specific design of the bridge will be developed in consultation with the USFWS prior to re-evaluation of the environmental document for Phase II.

e. Avoid retrofitting the bridges and approach roads with permanent light fixtures in the future (excluding navigation lights required by the US Coast Guard).

Coordination of Incidental Take Statements with Other Laws, Regulations, and Policies

The USFWS will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC 703-712), if such take is in compliance with the terms and conditions (including amount and/or number) specified in the *Biological and Conference Opinion*s (USFWS, 2008).

Conservation Recommendations

Section 7(a)(l) of the Endangered Species Act directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The following non-binding conservation recommendations are discretionary agency activities recommended by USFWS in the *Biological and Conference Opinion*s (USFWS, 2008) to minimize or avoid adverse effects of the proposed project on listed species or proposed critical habitat, to help implement recovery plans, or to develop information:

- Piping plovers

  - FHWA and/or NCDOT could contribute funding to the current Seashore predator removal program or any future Refuge predator removal program.

  - The pond behind the terminal groin at the north end of Hatteras Island has historically provided foraging habitat for plovers whenever NCDOT has mined sand from it. NCDOT could continue to utilize this pond as a source of sand for construction/ maintenance purposes. NCDOT could remove the sand such that the elevation and shape of the mined area is restored to a moist/wet sand habitat conducive to plover foraging. This should be coordinated with the Refuge.

- Sea turtles – all species—FHWA and/or NCDOT could contribute funding to the Network for Endangered Sea Turtles (NEST), a nonprofit organization dedicated to the preservation and protection of sea turtle habitat in the Outer Banks from the Virginia border to Oregon Inlet. NEST monitors this area for nesting activity.

In order for USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, they requested notification on the implementation of any conservation recommendations. FHWA and NCDOT will consider implementation of these recommendations and notify USFWS should they decide to implement one or more of these recommendations.

4.8 Mineral Resources

There are no known mineral resources of economic value within any of the replacement bridge corridor alternatives.

4.9 Air Quality

A microscale air quality analysis was conducted to determine the potential effects of the replacement bridge corridor alternatives on local air quality. The "worst-case" project level carbon monoxide (CO) concentrations were determined for the existing (2002) and design (2025) years.

These CO concentrations were then compared to the National Ambient Air Quality Standards (NAAQS). The maximum one-hour and eight-hour CO levels predicted were below NAAQS maximum levels. Thus, the proposed project would not cause or exacerbate a violation of the NAAQS. The project conforms to the State Implementation Plan (SIP) and the goals set forth in the Clean Air Act Amendments (CAAA) and the Final Conformity Rule.

4.9.1 Regional Air Quality

The proposed project is included as part of a regional transportation network. The NCDOT's 2009 to 2015 TIP (NCDOT, 2008) includes the replacement of Bonner Bridge (TIP Project No. B-2500). The TIP is the basis for the area's regional emissions analysis, which utilizes vehicle miles traveled (VMT) (vehicle kilometers traveled [VKT]) and vehicle hours traveled (VHT) within the region to estimate daily pollutant burden levels. The results of this analysis determine whether an area is in conformity with regulations set forth in the Clean Air Act Final Conformity Rule.

The regional analysis performed for the TIP incorporates the effects of this project and would, therefore, satisfy the requirements set forth in the Final Conformity Rule.

4.9.2 Microscale Air Quality Analysis

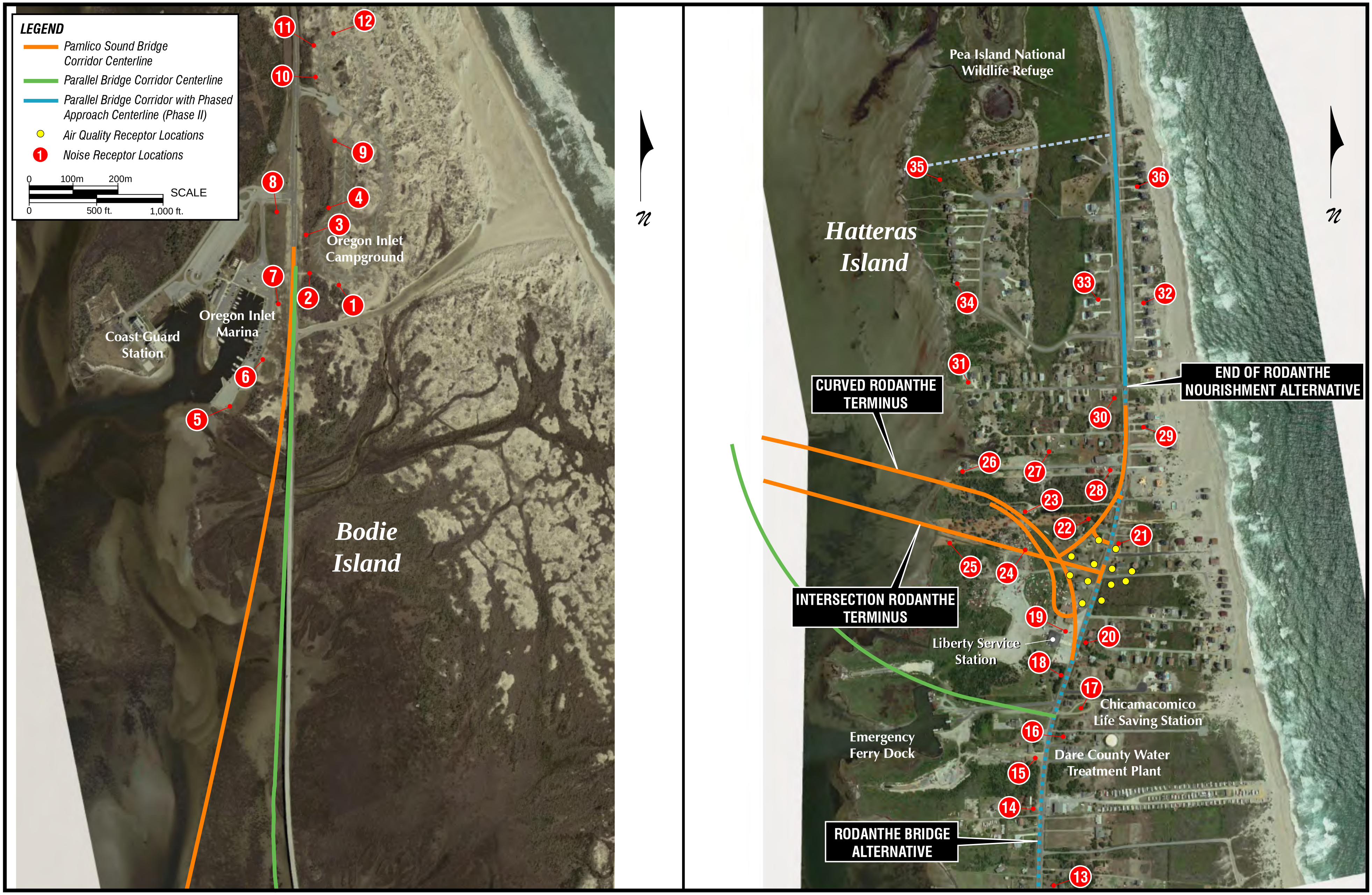
A microscale air quality analysis was performed using the USEPA mobile source emission factor model (MOBILE 5B, the current model at the time of the preparation of the SDEIS) for vehicular emissions and the CAL3QHC version 2 air quality dispersion model for estimating pollutant concentrations near roadway intersections. Guidelines set forth in the USEPA's *Guidelines for Modeling Carbon Monoxide From Roadway Intersections* (USEPA, November 1992) and the NCDENR's *Guidelines for Evaluating the Air Quality Impacts of Transportation Facilities* (NCDENR, October 1999) were followed.

CO levels in the project area were estimated under worst-case conditions for existing traffic, traffic in 2025 assuming Bonner Bridge were to remain in place, and traffic in 2025 with the replacement bridge corridor alternatives. The No-Action Alternative assumes that Bonner Bridge is demolished at the end of its service life and not replaced. This likely would result in a dramatic but unknown decrease in traffic on NC 12, since limited ferry capacity would discourage visitors to Hatteras Island and future growth in the permanent population. Thus, No-Action Alternative CO levels could not be modeled for comparison with the replacement bridge corridor alternatives, as is customary for this type of analysis. CO levels were, however, modeled assuming 2025 traffic on NC 12 if Bonner Bridge were to remain in place.

The worst-case microscale CO analysis was performed for the peak one-hour traffic period. This peak period occurs on a Saturday during the peak tourist season. This period is when the greatest CO emissions are expected to occur.

The intersection of the Pamlico Sound Bridge Corridor's Intersection Rodanthe Terminus with existing NC 12 in Rodanthe as well as the comparable existing NC 12 intersection for the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives, has the potential for the greatest or worst-case CO concentrations. None of the other alternatives would introduce a turning movement into the main flow of NC 12 traffic. Twelve receptor locations were examined at this intersection (see Figure 4-2). The receptors were at locations where the highest CO concentrations could be expected and where the general public would have access. The 12 receptors were placed at various representative points near adjoining property lines where human activity might occur. Their locations were chosen in accordance with USEPA's *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (USEPA-454/R-92-005).

The transport and concentration of pollutants emitted from motor vehicles are influenced by three principal meteorological factors: wind direction, wind speed, and the atmosphere's temperature profile. The values for these parameters were chosen to maximize pollutant concentrations at each receptor site to establish a worst-case situation.



AIR QUALITY AND NOISE ASSESSMENT LOCATIONS

Figure 4-2

The assumptions above presume the simultaneous occurrence of all worst-case parameters (peak-hour traffic conditions, an intersection with the greatest turning movements, low wind speeds, low atmospheric temperature, and worst-case wind direction). Thus, the CO levels estimated by the model are the maximum concentrations that could be expected to occur at each of the 12 receptors.

Model output provided peak 1-hour CO concentrations. Peak 8-hour concentrations were obtained by multiplying the highest peak 1-hour CO estimates by 0.61. This factor is recommended by the NCDENR's Division of Air Quality. It takes into account that over 8 hours (as distinct from a single hour) vehicle volumes fluctuate downwards from the peak, vehicle speeds vary, and meteorological conditions including wind speed and wind direction vary as compared to the very conservative assumptions used for the 1- hour levels.

The model predicts CO concentrations resulting from emissions from motor vehicles using roadways immediately adjacent to the location at which predictions are being made. A CO "background" level must be added to this value to account for CO entering the area from other sources upwind of the receptors. In consultation with the NCDENR's Division of Air Quality, a 1-hour value of 1.8 ppm and an 8-hour value of 1.1 ppm were used as background levels for this analysis.

4.9.3 Potential Air Quality Impacts

The highest 1-hour and 8-hour CO levels predicted at the 12 receptor sites are shown in Table 4-29. The CO levels shown include the modeled contributions of traffic plus the background concentration. The highest predicted 1-hour and 8-hour CO concentrations, 3.2 ppm and 2.0 ppm respectively, do not exceed the NAAQS of 35 ppm (1-hour) and 9 ppm (8-hour). The replacement bridge corridor alternatives would not cause or exacerbate a violation of the NAAQS.

Table 4-29. Predicted Worst-Case 1-Hour and 8-Hour CO Levels (ppm)

Category	Existing 2002	No-Action 2025	Worst-Case Location for the Replacement Bridge Corridor Alternatives 2025
1-Hour	2.4	2.6	3.2
8-Hour	1.5	1.6	2.0

National and state 1-hour standard = 35 ppm
One-hour values include 1-hour background = 1.8 ppm
National and state 8-hour standard = 9 ppm
Eight-hour values include 8-hour background = 1.1 ppm

4.9.4 Air Quality Conformance

The project is in Dare County, which has been determined to comply with the National Ambient Air Quality Standards. The proposed project is in an attainment area; therefore, Title 40 *Code of Federal Regulations* Parts 51 and 93 are not applicable. This project is not anticipated to create any adverse effects on the air quality of this attainment area.

4.9.5 Mobile Source Air Toxics

In addition to the criteria air pollutants for which there are NAAQS (see Section 3.9), the USEPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries). Because changes in vehicle-miles traveled associated with the replacement bridge corridor alternatives would be small, notable changes in the emission of Mobile Source Air Toxics (MSATs) are not expected with the replacement bridge corridor alternatives.

MSATs are a subset of the 188 air toxics defined by the Clean Air Act. MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

The USEPA is the lead federal agency for administering the Clean Air Act and has certain responsibilities regarding the health effects of MSATs. The USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources (Volume 66 of the *Federal Register* on page 17229, March 29, 2001). This rule was issued under the authority in Section 202 of the Clean Air Act. In its rule, USEPA examined the impacts of existing and newly promulgated mobile source control programs, including: its reformulated gasoline (RFG) program; its national low emission vehicle (NLEV) standards; its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements; and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, FHWA projects that involve even a 64 percent increase in VMT, will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and will reduce on-highway diesel particulate matter (PM) emissions by 87 percent, as shown in Table 4-30.

As a result, USEPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs. The agency is preparing another rule under authority of Clean Air Act Section 202(l) that will address these issues and could adjust the full 21 and the primary six MSATs.

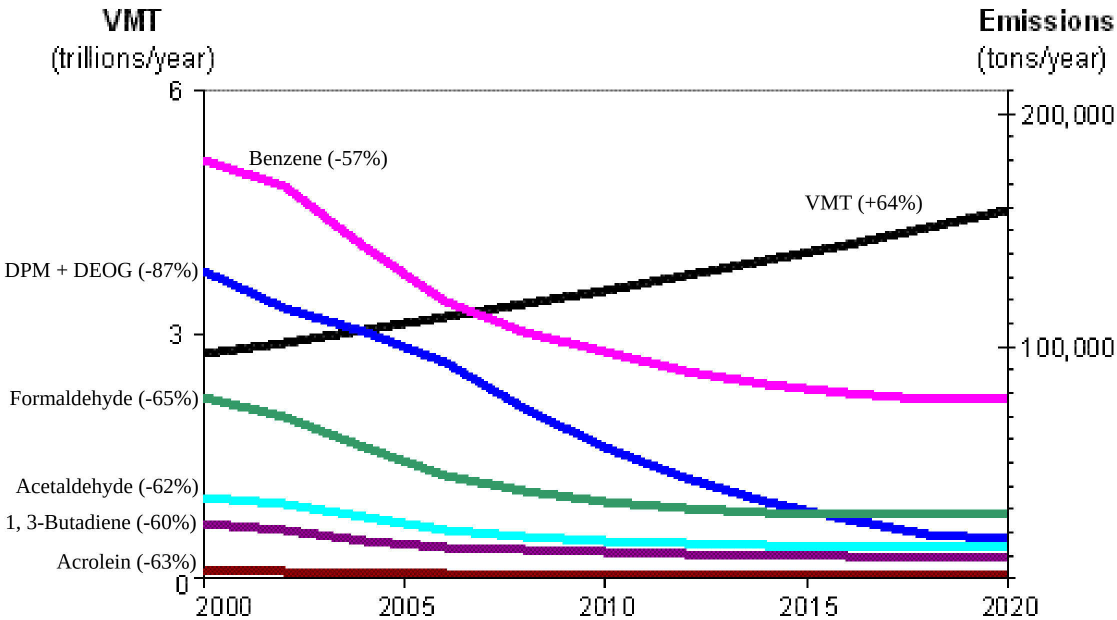
4.9.5.1 Unavailable Information for Project-Specific MSAT Impact Analysis

This document includes a basic analysis of the likely MSAT emission impacts of this project, including all the replacement bridge corridor alternatives assessed in the FEIS. However, available technical tools do not enable prediction of the project-specific health impacts of the emission changes associated with the replacement bridge corridor alternatives. Because of these limitations, the following discussion is included in accordance with President's CEQ regulations (Title 40 CFR Section 1502.22[b]) regarding incomplete or unavailable information.

4.9.5.2 Information that is Unavailable or Incomplete

Evaluating the environmental and health impacts from MSATs on a proposed highway project would involve several key elements, including emissions modeling, dispersion modeling in order to estimate ambient concentrations resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project:

Table 4-30. US Annual Vehicle-Miles Traveled (VMT) vs. Mobile Source Air Toxics Emissions, 2000-2020



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50 percent. Gasoline RVP and oxygenate content are held constant. VMT: Highway Statistics 2000, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns.

- Emissions. The USEPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE 6.2 (i.e., USEPA's updated version of their mobile source emission factor model that also includes particulate matter [PM] and MSATs) is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE 6.2 is a trip-based model. Projected emission factors are based on a typical trip of 7.5 miles (12.1 kilometers), and on average speeds for this typical trip. This means that MOBILE 6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this limitation, MOBILE 6.2 can only approximate the operating speeds and levels of congestion likely to be present on larger projects, and cannot adequately capture emissions effects of smaller projects. For PM, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE 6.2 for both PM and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of PM under the conformity rule, USEPA has identified problems with MOBILE 6.2 as an obstacle to quantitative analysis.

  These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE 6.2 is an adequate tool for projecting emissions trends and for performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.

- Dispersion. The tools to predict how MSATs disperse also are limited. The USEPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of carbon monoxide to determine compliance with the NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time at some location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk. The National Cooperative Highway Research Program (NCHRP) is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also will focus on identifying appropriate methods of documenting and communicating MSAT impacts in the NEPA process and to the public. Along with these general limitations of dispersion models, FHWA also is faced with a lack of monitoring data in most areas for use in establishing project-specific MSAT background concentrations.

- Exposure Levels and Health Effects. Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. There also are considerable uncertainties associated with the existing estimates of toxicity of the various MSATs because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against other project impacts that are better suited for quantitative analysis.

4.9.5.3 Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of MSATs

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show either that some are statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses.

Exposure to toxics has been a focus of several USEPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or State level.

The USEPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The USEPA's Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment (USEPA IRIS web site, 2006). The following toxicity information for the six prioritized MSATs was taken from the IRIS database "Weight of Evidence Characterization" summaries. This information is taken verbatim from USEPA's IRIS database and represents the USEPA's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures:

- Benzene is characterized as a known human carcinogen;
- The potential carcinogenicity of acrolein cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure;
- Formaldehyde is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals;
- 1,3-butadiene is characterized as carcinogenic to humans by inhalation;
- Acetaldehyde is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure;
- Diesel exhaust (DE) is likely to be carcinogenic to humans by inhalation from environmental exposures. DE as reviewed in this document is the combination of diesel PM and diesel exhaust organic gases; and
- DE also represents chronic respiratory effects, possibly the primary noncancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

Other studies address MSAT health impacts in proximity to roadways. The Health Effects Institute, a non-profit organization funded by USEPA, FHWA, and industry, has undertaken a major series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes, particularly respiratory problems. These studies are: *South Coast Air Quality Management District*, *Multiple Air Toxic Exposure Study-II* (2000); *Highway Health Hazards* by The Sierra Club (2004) summarizing 24 studies on the relationship between health and air quality; and NEPA's *Uncertainty in the Federal Legal Scheme Controlling Air Pollution from Motor Vehicles* by the Environmental Law Institute, 35 Environmental Law Regulation (ELR) 10273 (2005) with health studies cited therein. Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. The FHWA cannot evaluate the validity of these studies, but more importantly, they do not provide information that would be useful to alleviate the uncertainties listed above and enable a more comprehensive evaluation of the health impacts specific to this project.

4.9.5.4 Relevance of Unavailable or Incomplete Information to Evaluating Reasonably Foreseeable Significant Adverse Impacts on the Environment, and Evaluation of Impacts Based Upon Theoretical Approaches or Research Methods Generally Accepted in the Scientific Community

Because of the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be made at the project level. While available tools do allow reasonable predictions of relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from each of the replacement bridge corridor alternatives and MSAT concentrations or exposures created by each of the replacement bridge corridor alternatives cannot be predicted with enough accuracy to be useful in estimating health impacts. (As noted above, the current emissions model is not capable of serving as a meaningful emissions analysis tool for smaller projects.) Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether any of the replacement bridge corridor alternatives would have "significant adverse impacts on the human environment."

In this FEIS, FHWA has provided a quantitative analysis of MSAT emissions relative to the replacement bridge corridor alternatives, (or a qualitative assessment, as applicable) and has acknowledged that the project may result in increased exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be estimated.

As discussed above, technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of this project. However, even though reliable methods do not exist to accurately estimate the health impacts of MSATs at the project level, it is possible to qualitatively assess the levels of future MSAT emissions under the project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the replacement bridge corridor alternatives. The qualitative assessment presented below is derived in part from a study conducted by the FHWA entitled *"A Methodology for Evaluating Mobile Source Air Toxic Emissions among Transportation Project Alternatives"* (FHWA Environment web site, 2006).

For each replacement bridge corridor alternative in the FEIS, the amount of MSATs emitted would be proportional to the vehicle-miles traveled, or VMT, assuming other variables such as fleet mix are the same for each alternative. The VMT for each replacement bridge corridor alternative would vary by its length in comparison to that of the existing road configuration. The replacement bridge corridors alternatives would all have two through lanes, as such the capacity of NC 12 and the forecast traffic volumes are not expected to be affected by their implementation. The lengths of the various replacement bridge corridor alternatives measured from a common starting point in Rodanthe and ending point on Bodie Island would be:

- Pamlico Sound Bridge Corridor—18.7 miles (30.1 kilometers);

- Parallel Bridge Corridor with Road North/Bridge South—16.2 miles (26.1 kilometers);

- Parallel Bridge Corridor with Nourishment, Phased Approach (including the Preferred Alternative), and All Bridge—16.1 miles (25.9 kilometers); and

- Existing Road Configuration—16.0 miles (25.7 kilometers).

The VMT and potential MSAT emissions for most of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would be nearly identical to the existing road configuration, because their lengths are nearly identical and no change in forecast traffic volumes is expected. The VMT and potential MSAT emissions would be 17 percent higher with the Pamlico Sound Bridge Corridor compared to the existing road configuration because of its longer length.

Regardless of the replacement bridge corridor alternative chosen, emissions will likely be lower in the design year than present levels, as a result of USEPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent between 2000 and 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the USEPA-projected reductions is so great (even after accounting for VMT growth with the Pamlico Sound Bridge Corridor) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

The relocated sections of NC 12 contemplated as part of the replacement bridge corridor alternatives would have the effect of moving some traffic closer to nearby homes, businesses, and recreational trails; therefore, under each alternative (except the Parallel Bridge Corridor with Nourishment Alternative) there may be localized areas where ambient concentrations of MSATs could be higher than the existing road configuration. The localized increases in MSAT concentrations would likely be most pronounced along new roadway sections in Rodanthe. However, as discussed above, the magnitude and the duration of these potential increases compared to the existing road configuration cannot be accurately quantified because of the inherent deficiencies of current models. In sum, when NC 12 is relocated and, as a result, moves closer to receptors, the localized level of MSAT emissions for the replacement bridge corridor alternatives could be higher relative to the existing road configuration, but this could be offset by MSATs being lower in other locations when traffic shifts away from them. However, on a regional basis, USEPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be substantially lower than today.

4.10 Noise

The noise level and abatement analysis for the replacement bridge corridor alternatives were conducted at 36 receptors on Bodie and Hatteras Islands. The results of this analysis indicate that FHWA's NAC would be approached or exceeded at three or four residences depending on the Pamlico Sound Bridge Corridor Rodanthe terminus option implemented. The NAC would be approached or exceeded at four residences with the Parallel Bridge Corridor with Nourishment Alternative and the Phased Approach/Rodanthe Nourishment Alternative. The NAC would be approached or exceeded at two residences with the other Parallel Bridge Corridor alternatives. A substantial increase in noise levels would occur at two residences with either Pamlico Sound Bridge Corridor terminus option. No reasonable or feasible opportunities exist to reduce noise levels at any of these residences.

The No-Action Alternative assumes that Bonner Bridge is demolished at the end of its service life and not replaced. This likely would result in a dramatic but unknown decrease in traffic on NC 12, since limited ferry capacity would discourage visitors to Hatteras Island and future growth in the permanent population. Thus, No-Action Alternative noise levels could not be modeled for comparison with the replacement bridge corridor alternatives, as is customary for this type of analysis. Noise levels were, however, modeled assuming 2025 traffic on NC 12 if Bonner Bridge were to remain in place.

4.10.1 Traffic Noise Model

Traffic noise predictions were performed using the FHWA's Traffic Noise Model (TNM), Version 2.5 (2004). The TNM takes into account factors such as ground absorption, roadway geometry, receptor distance, operating speed, and traffic volumes.

Noise from existing traffic, traffic in 2025 (assuming Bonner Bridge was to remain in place), and traffic in 2025 with the replacement bridge corridor alternatives were modeled. Three vehicle classifications were assumed: cars (all vehicles with two axles and four tires), medium trucks (all cargo vehicles with two axles and six tires), and heavy trucks (all cargo vehicles with three or more axles). Peak-hour traffic noise was determined. In order to depict worst-case conditions peak season, Saturday traffic volumes were used.

Assessment of traffic noise impact requires the following three comparisons:

- The change in noise levels from existing conditions to future conditions with the proposed project and whether that difference is substantial;
- The difference in future noise levels with and without the project; and
- Whether noise levels with the proposed project would exceed the FHWA's NAC.

The FHWA's NAC and the definition of what constitutes a substantial increase were presented in Section 3.10.2.

4.10.2 Predicted Noise Levels

Thirty-six noise-sensitive receivers were modeled for the replacement bridge corridor alternatives. Their locations are shown in Figure 4-2. The predicted noise levels are presented in Table 4-31.

4.10.3 Noise Analysis

Receptors at which the FHWA's NAC would be exceeded are:

- Parallel Bridge Corridor
  - Nourishment: 14, 15, 18, 20
  - Road North/Bridge South: 14, 15
  - All Bridge: 14, 15
  - Phased Approach/Rodanthe Nourishment: 14, 15, 18, 20
  - Phased Approach/Rodanthe Bridge (Preferred): 14, 18
- Pamlico Sound Bridge Corridor
  - Curved Rodanthe Terminus: 14, 15, 18
  - Intersection Rodanthe Terminus 14, 15, 18, 20

Table 4-31. Predicted Existing and Future Noise Levels

Receptor[1]	Description	NAC (dBA)[2]	Leq(h) (dBA)								
			2002	2025							
					Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
			Existing	Assuming Bonner Bridge Remains in Place	Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge Alternative *	Phased Approach/ Rodanthe Nourishment Alternative
1	Campground	66	53	52	54	54	54	54	54	54	54
2	Campground	66	62	60	62	62	61	61	61	61	61
3	Campground	66	61	59	61	61	60	60	60	60	60
4	Campground	66	56	54	56	56	55	55	55	55	55
5	Fishing Center	71	52	50	55	55	56	56	56	56	56
6	Fishing Center	71	58	56	61	61	60	60	60	60	60
7	Fishing Center	71	62	60	65	65	67	67	67	67	67
8	Fishing Center	71	62	60	62	62	65	65	65	65	65
9	Campground	66	54	53	55	55	55	55	55	55	55
10	Campground	66	61	60	62	62	63	63	63	63	63
11	Campground	66	62	60	62	62	63	63	63	63	63
12	Campground	66	56	54	57	57	57	57	57	57	57
13	Residential	66	60	62	63	62	62	62	62	62	62
14	Residential	66	64	67	67	67	67	67	67	68	67
15	Residential	66	63	66	66	66	66	66	66	65	66
16	Historic District Home	66	60	62	62	62	62	64	64	62	62
17	Historic Resource Chicamacomico Life Saving Station	71	56	58	59	58	58	59	59	60	58

*Preferred Alternative

Table 4-31 (concluded). Predicted Existing and Future Noise Levels

Receptor[1]	Description	NAC (dBA)[2]	Leq(h) (dBA)								
			2002	2025							
			Existing	Assuming Bonner Bridge Remains in Place	Pamlico Sound Bridge Corridor		Parallel Bridge Corridor				
					Curved Rodanthe Terminus	Intersection Rodanthe Terminus	Nourishment	Road North/ Bridge South	All Bridge	Phased Approach/ Rodanthe Bridge Alternative*	Phased Approach/ Rodanthe Nourishment Alternative
18	Historic District Home	66	67	69	69	69	69	64	64	67	69
19	Commercial	71	59	61	64	61	61	56	56	62	61
20	Residential	66	64	67	64	67	67	60	60	65	67
21	Residential	66	62	65	53	60	65	58	58	64	65
22	Residential	66	56	59	displaced	56	59	52	52	60	59
23	Residential	66	44	47	displaced	59	47	47	47	50	47
24	Residential	66	45	48	displaced	displaced	48	48	48	49	48
25	Residential	66	41	43	56	displaced	43	52	52	46	43
26	Residential	66	41	43	64	56	43	47	47	45	43
27	Residential	66	47	49	53	51	49	45	45	52	49
28	Residential	66	60	62	57	56	62	55	55	61	62
29	Residential	66	59	61	56	55	61	55	55	61	61
30	Residential	66	63	65	59	59	65	59	59	63	65
31	Residential	66	40	42	51	48	42	45	45	45	42
32	Residential	66	58	60	55	54	60	54	54	60	60
33	Residential	66	58	61	54	54	61	54	54	59	59
34	Residential	66	39	41	43	42	41	45	45	44	42
35	Residential	66	37	40	38	37	40	46	46	42	42
36	Residential	66	60	62	56	56	62	56	56	60	61

[1]Receptor locations are shown in Figure 4-2.
[2]Levels shown are 1 dBA less than the criteria presented in Table 3-26, reflecting the policy to consider noise abatement measures when peak hour noise levels approach the criteria levels.
*Preferred Alternative

These receptors would also approach or exceed the NAC assuming Bonner Bridge remains in place. The increased future noise levels are associated more with the forecast growth in traffic than the implementation of the proposed project in that where the NAC is exceeded the associated noise level is in every case identical to the level that would occur if Bonner Bridge remained in place.

A substantial increase in noise levels would occur at two residences (25 and 26) with the Curved Rodanthe Terminus option and at two residences (23 and 26) with the Intersection Rodanthe Terminus of the Pamlico Sound Bridge Corridor. None of these receptors currently experience traffic noise from existing NC 12. Substantial increases are defined as 15 dBA or more where the existing L_{eq} is 50 dBA or less, or 10 dBA or more where the existing L_{eq} is greater than 50 dBA.

The effect of traffic noise resulting from the Parallel Bridge Corridor was analyzed for the Refuge. The Refuge was assessed in accordance with FHWA's NAC applicable to Activity Category "B" which is 67 dBA (or 66 dBA approaching). Activity Category "B" includes parks, recreation areas, picnic areas, residences, hospitals, and schools. The results of the analysis indicate that the 66 dBA contour in 2025 would be approximately 117 feet (35.7 meters) and the existing 66 dBA contour is 96 feet (29.3 meters) from the centerline of the Parallel Bridge Corridor alternatives exclusive of dunes along the shoreline, which can serve to reduce noise levels on the beach. The difference reflects traffic growth from 2002 to 2025. With the Pamlico Sound Bridge Corridor, traffic would drop within the Refuge in that through trips (trips without a destination within the Refuge) in the Refuge would be eliminated. See Table 3-26 for more information on noise abatement criteria.

4.10.4 Project Noise Abatement

The feasibility and reasonableness of noise abatement measures were evaluated for the affected sensitive sites (14, 15, 18, 20, 23, 25, and 26). Feasibility of an abatement measure deals primarily with design and engineering considerations. Reasonableness is a more subjective measure and demonstrates that good judgment and common sense are used in making a decision with respect to the abatement measure.

As outlined in 23 CFR 772, abatement can include the following mitigation measures: noise barriers, transportation system management, alignment modifications, and land use control. When noise abatement measures are being considered, every effort should be made to obtain substantial noise reduction at the affected receivers. The design goal of an abatement measure is a reduction of 8 dBA or more. If a minimum reduction of 5 dBA cannot be achieved, an abatement measure is not considered feasible.

The sections that follow discuss the noise abatement measures that were investigated to reduce noise levels at the seven receptors.

4.10.4.1 Noise Barriers

Noise barriers reduce noise levels by blocking the sound path between the roadway and noise sensitive sites. To be effective in reducing traffic noise impacts, a noise barrier must have certain characteristics:

- Long (the barrier should extend four times as far in each direction as the distance from the receiver to the barrier);

- Continuous (with no gaps or discontinuities in the design whether they be for pedestrian access, cross-street penetration, or access to the roadway for maintenance purposes); and

- Sufficiently high to provide the necessary reduction in noise levels at an affected site.

In order for a barrier to be considered feasible and reasonable, it must meet the following minimum criteria:

- Provide a minimum insertion loss (noise reduction) of 5 dBA to all of the affected sites, with a design goal of 8 dBA for the receivers immediately behind the barrier.

- The cost to construct the barrier should not exceed $35,000 per benefited receptor plus an incremental increase of $500 per dBA average increase in the predicted exterior noise levels of the affected receptors of the area. For purposes of this determination, benefited receptors are those that would experience a reduction of 5 dBA or more in the level of traffic noise as a result of the noise barrier.

Barrier analyses were conducted at receptors where predicted noise levels would approach or exceed the NAC. The TNM computer program was utilized to evaluate the cost-effectiveness and acoustic-effectiveness of noise barriers. Noise barriers of varying heights and lengths were modeled at each location considered. The results of the noise barrier analyses were compared to the minimum criteria.

After review of the noise level results and geometry of the project, it is not considered reasonable or feasible to construct noise barriers at any affected sensitive receptor for the following reasons:

- The noise-sensitive sites in Rodanthe are low-density residences. The four sites where NAC levels would be approached or exceeded are separated from each other by other development, and one is on the opposite site of NC 12 from the other three. The three homes where a substantial increase would occur with the Curved Rodanthe Terminus and the Intersection Rodanthe Terminus are isolated receptors. Noise barriers would not be cost-effective (less than $35,000 per benefited receptor plus an incremental increase of $500 per dBA average increase) in such settings. The NCDOT does not provide noise abatement for isolated receptors.

- For the noise-sensitive areas along NC 12, acoustically effective noise barriers would block or limit the access of residents to NC 12 by blocking driveways and side streets.

For the four homes planned or under construction near Pamlico Sound, acoustically effective noise barriers likely would block or limit the access of residents with the Curved Rodanthe Terminus. A barrier likely would be effective at the two homes remaining near the Sound with the Intersection Rodanthe Terminus.

4.10.4.2 Transportation System Management Measures

Transportation system management measures that limit motor vehicle speeds and reduce traffic volumes can be effective noise mitigation measures. However, these measures also negate a project's ability to accommodate forecasted traffic volumes.

4.10.4.3 Alignment Modifications

Alignment modifications generally involve orienting and/or siting the proposed project at sufficient distances from noise-sensitive areas to minimize noise impacts. As discussed in Sections 2.2 to 2.6, the study team evaluated numerous locations for the proposed project. The locations of the alternatives under consideration offer the best set of alternatives that balance engineering criteria, limitations imposed by terrain and the various community, cultural resource and natural resource impacts.

4.10.4.4 Land Use Controls

Another noise abatement measure is the use of land use controls to minimize impacts to future development. Dare County, the NPS, and the USFWS could consider anticipated noise level changes along the Phased Approach/Rodanthe Bridge Alternative (Preferred) so that new homes and other sensitive uses are set back from the Preferred Alternative sufficiently to avoid noise impact. In Rodanthe, a setback distance of 100 feet (30 meters) from the center of the nearest travel lane of the replacement bridge corridor alternatives to the 66 dBA noise level was calculated. Traffic noise levels should not exceed 66 dBA at new homes set back at least 100 feet (30 meters) from the road.

The 66 dBA contour in 2025 within the Refuge and Seashore would be approximately 117 feet (35.7 meters) from the centerline of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) exclusive of dunes along the shoreline.

4.11 Energy

Energy use by the replacement bridge corridor alternatives and the No-Action Alternative can be characterized as follows:

- Construction. Energy would be used for the manufacturing of bridge components and by the heavy equipment needed to build the replacement bridge corridor alternatives. For the No-Action Alternative, energy would be used to build the facilities and boats for the small ferry service that would be a part of that alternative.

- Maintenance. All of the bridges associated with the replacement bridge corridor alternatives would require routine maintenance for 40 years, after which a major rehabilitation program would be expected. The road components would require routine maintenance annually and major maintenance every 12 years. Dunes would lose half their volume and would be restored every 12 years. Nourishment would be repeated every four years. The No-Action Alternative would necessitate use of energy to repair Bonner Bridge until it is demolished because of continuing spalling and scour problems. After storms, dune and road restoration along NC 12 would be expected. The No-Action Alternative’s small-scale ferry service would require maintenance of ferry facilities and regular dredging of a ferry channel across Oregon Inlet.

- Demolition and Removal. Both of the replacement bridge corridor alternatives would require demolition and removal of Bonner Bridge (which would occur under a separate contract than for the construction of the proposed project with the Pamlico Sound Bridge Corridor). The energy use by equipment would be the same.

- Motor Vehicle or Ferry Use. The replacement bridge corridor alternatives would allow traffic volumes across Oregon Inlet and down Hatteras Island to continue to grow. Fuel usage would increase. Traffic volumes and related energy use, however, would not be greater than would be expected if Bonner Bridge could remain in service. The No-Action Alternative would reduce accessibility greatly to Hatteras Island and, therefore, reduce the amount of energy being spent in travel to this destination. The overall difference in energy from the operational (traffic) perspective of the No-Action Alternative and the replacement bridge corridor alternatives would be minimal, however, since the tourist traffic now going to Hatteras Island likely would go to another tourist location. There is no reason to believe that the reduction of access to Hatteras Island would cause a substantial number of motorists to eliminate their plans to travel. They likely would travel somewhere, just not necessarily to Hatteras Island or Dare County. The No-Action Alternative also would require additional energy use by ferries.

- Motor Vehicle or Ferry Manufacture and Maintenance. Energy also would be used to manufacture and maintain the motor vehicles that would use the replacement bridge corridor alternatives and travel on Hatteras Island. This use of energy would not be substantially different with the No-Action Alternative for the same reasons motor vehicle fuel usage would not differ substantially between the replacement bridge corridor alternatives and the No-Action Alternative. Energy also would be required to manufacture and maintain the No-Action Alternative ferries.

Differences in energy use related to the construction and maintenance of the replacement bridge corridor alternatives are reflected in differences in their cost. The higher the cost, the more energy is expended. The cost information in Tables 2-9 and 2-10 indicates that the relative energy use of the replacement bridge corridor alternatives from greatest to least use would be:

1. Either Pamlico Sound Bridge Corridor (2.2 to 2.4 times the energy use of the least use alternative);

2. Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative (1.9 to 2.0 times the energy use of the least use alternative);

3. Parallel Bridge Corridor with All Bridge (1.8 to 2.0 times the energy use of the least use alternative);

4. Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) (1.8 to 1.9 times the energy use of the least use alternative);

5. Parallel Bridge Corridor with Nourishment (1.1 to 1.3 times the energy use of the least use alternative); and

6. Parallel Bridge Corridor with Road North/Bridge South (the least energy use alternative).

Without a detailed analysis of energy usage, a numeric difference in energy use between the replacement bridge corridor alternatives and the No-Action Alternative cannot be presented. Such an analysis is not considered necessary to making a sound decision regarding whether to implement one of the replacement bridge corridor alternatives and how to mitigate its impacts. The following can be observed, however, from the discussion above:

- Undoubtedly, the energy used in constructing one of the replacement bridge corridor alternatives would be greater than that required to build the small-scale ferry service associated with the No-Action Alternative. This benefit, however, would be offset, at least in part, by the higher maintenance and operation energy use of the No-Action Alternative.

- A substantial difference in motor vehicle energy use would not be expected between the replacement bridge corridor alternatives and the No-Action Alternative. The No-Action Alternative, however, would involve the use of energy to manufacture and operate ferries.

4.12 Indirect and Cumulative Impacts

The President's CEQ regulations for environmental impact documentation (CFR, Title 40, Section 1508(1)) includes definitions for indirect and cumulative impacts (ICI). These definitions are:

> Indirect effects are those "which are caused by the [proposed] action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include induced growth and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." (40 CFR 1508.8(b))
>
> "Cumulative impact is the impact on the environment which results from the incremental impact of the [proposed] action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR 1508.7)

This assessment of indirect and cumulative impacts is based on the guidance contained in the NCDOT's and the NCDENR's *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina* (The Louis Berger Group, 2001). Impacts directly associated with the construction and operation of each of the alternatives, whether they occur within the project right-of-way or easement (such as biotic community use) or outside the project right-of-way or easement (such as noise), are assessed in the other topical sections of this FEIS.

Because the proposed project would consist of the replacement of an existing bridge, as well as an existing road in the case of the Parallel Bridge Corridor, indirect and cumulative impacts would be minimal. The replacement bridge corridor alternatives would not alter area development trends. The Pamlico Sound Bridge Corridor would complement the goals of the Outer Banks Task Force, including its efforts to develop both short-term and long-term plans for maintaining a transportation system on the Outer Banks in light of recent trends of shoreline erosion and highway overwash on NC 12. The Parallel Bridge Corridor would address long-term NC 12 needs, but would be less supportive of the natural resource protection goals of the Task Force than the Pamlico Sound Bridge Corridor.

The Pamlico Sound Bridge Corridor, given that it would bypass the Refuge, could affect future decision-making related to:

- Activities associated with NC 12 maintenance in the Refuge;

- Access within the Seashore north of Rodanthe and the Refuge;

- Oregon Inlet dredging and associated impacts to the bottom of Pamlico Sound;
- The preservation and re-use of the (former) US Coast Guard Station at the north end of Hatteras Island; and
- The disposition of the terminal groin at the north end of Hatteras Island.

The specific direction these future decisions might take is not foreseeable. In all cases, however, planning and environmental studies would be conducted before any final decisions are made. The NCDOT will participate in those studies.

The Parallel Bridge Corridor, which leaves NC 12 within the Refuge, also would influence future Outer Banks Task Force activities associated with NC 12 maintenance in the Refuge and access within the Seashore north of Rodanthe and the Refuge. The Parallel Bridge Corridor would influence future dredging decisions from two perspectives:

1. The longer navigation zone of the Oregon Inlet bridge would allow the dredged channel to move with the natural gorge.
2. Some dredging spoils could be used as a part of the Parallel Bridge Corridor with Nourishment Alternative.

The terminal groin would be retained with the Parallel Bridge Corridor, although an opportunity could exist for the groin's removal with the All Bridge Alternative and upon completion of Phase II of the Phased Approach alternatives (including the Preferred Alternative). These alternatives would bridge the area affected as Oregon Inlet resumes its movement south after the groin is removed. The retention of the groin would allow the (former) US Coast Guard Station to remain in its current location with access to NC 12, if desired by its owners.

4.12.1 Study Area

The boundaries of the indirect and cumulative impacts study area encompass:

- The area where the implementation of the project could potentially influence decision-making associated with other actions;
- The area of influence of the proposed project on Oregon Inlet navigation;
- The boundaries of the Refuge, the Seashore on Hatteras Island, and the communities on Hatteras Island;
- The (former) US Coast Guard Station at the north end of Hatteras Island;
- The area of potential NC 12 long-term relocation options on Hatteras Island;
- The Bonner Bridge replacement study's project area as defined in Section 1.3.1; and
- The North Carolina northern Outer Banks.

These parameters encompass the potential area of influence of the proposed project in terms of the potential to affect growth trends, interact with other proposed actions, affect other activities in the region, and the affect of habitat loss, degradation, and fragmentation on the diversity, biological integrity, and ecological integrity of the northern Outer Banks. These parameters define an area that includes:

- All of Hatteras Island;
- The southern end of Bodie Island in the vicinity of the northern terminus of Bonner Bridge and the proposed project;
- Oregon Inlet;
- Pamlico Sound as far west of Hatteras Island as the path of the Pamlico Sound Bridge Corridor; and
- The North Carolina northern Outer Banks.

The features of this study area are shown on Figure 1-1 and Figure 3-3 (the (former) US Coast Guard Station). The Pamlico Sound Bridge Corridor is shown on Figure 2-11. The three alternatives associated with the Parallel Bridge Corridor are shown on Figure 2-18 to Figure 2-20.

4.12.2 Directions and Goals

The ICI study area is within the jurisdiction of Dare County's land use plan, the 1974 CAMA, and the NPS's plans for the Seashore. These plans are described in detail in Section 3.1.3 and are summarized in the sections that follow.

4.12.2.1 Dare County Land Use Plan

The *Dare County Land Use Plan, 2003 Update* provides a set of guidelines to manage growth and development in unincorporated Dare County over the next five years. The land use plan recognizes the priority of the transportation needs in Dare County and contains specific policies for the protection of NC 12 and coordination with the NCDOT for a replacement of Bonner Bridge. One goal of the land use plan is to maintain the "coastal village" atmosphere of the County. It supports the re-use of historic residential structures for business or commercial purposes. One of the major changes in the 2003 plan from the 1994 plan is the relaxation of wetland mitigation. Because of the strict language in the 1994 plan, some public projects in Dare County experienced problems. The policy in the 2003 plan is intended to provide more flexibility so as not to preclude projects that would benefit Dare County and its citizens. The 2003 plan also supports beach nourishment to maintain the shoreline.

4.12.2.2 Coastal Area Management Act

The 1974 CAMA calls for the identification of certain environmentally fragile and important land and water areas that are judged to be of greater-than-local significance. The NCCRC, in cooperation with local governments in a 20-county coastal area, has developed a program of permit review and coordination within these AEC. Dare County has substantial amounts of environmentally fragile areas and much of these lands have been designated as AECs. The Seashore and the Refuge are protected by an AEC designation. Thus, the entire ICI study area is protected, except for the communities scattered along Hatteras Island (see Figure 1-1).

The NCDENR's Division of Coastal Management (DCM) uses the Dare County land use plan when making CAMA permit decisions. Proposed development must be consistent with the local land use plan, or the DCM will not permit a planned development to be implemented.

4.12.2.3 National Park Service Plans

The NPS's *Management Policies* (NPS, 2001) is the basic Service-wide policy document of the NPS. The *General Management Plan and Amended Environmental Assessment for Cape Hatteras National Seashore* (NPS, 1984) and the *Draft Revised Statement for Management* (NPS, 1991) serve as the NPS plans for the Seashore. These documents provide for the preservation of the cultural resources and the flora, fauna, and natural physiographic conditions, while allowing appropriate recreational use and public access to the oceanside and soundside shores. Impairment of park resources and values by projects such as the proposed project is prohibited by law. It is the desire of the NPS to no longer attempt to stabilize the Outer Banks artificially, but rather to let natural processes take their course. No new Seashore facilities are planned in the ICI study area. The plans for the Seashore focus on restoration and maintenance of existing facilities.

4.12.2.4 Pea Island National Wildlife Refuge Plan

The USFWS prepared a *Comprehensive Conservation Plan* (USFWS, 2006) to guide the management of the Refuge. The plan, which was published in September 2006, outlines programs and corresponding resource needs for the proceeding 15 years, as mandated by the National Wildlife Refuge System Improvement Act of 1997. The purpose of the plan is to identify the role that the Refuge will play in support of the mission of the National Wildlife Refuge System and to provide long-term guidance to the Refuge's management programs and activities.

4.12.3 Notable Features

Notable features in the ICI study area are defined in Chapter 3 and Chapter 5. They are:

- Cape Hatteras National Seashore, as described in Section 3.5 and Section 5.1.1;
- The communities scattered along Hatteras Island, as described in Sections 3.1.2, 3.1.6, 3.1.7, and 3.1.8;
- Oregon Inlet, including its natural features and its use for navigation, as described in Sections 3.1.9, 3.6, 3.7.2, 3.7.3.1, and 3.7.6.1;
- Several historic resources, as described in Sections 3.4.1, 5.1.3, and 5.1.4;
- Pea Island National Wildlife Refuge, including its recreational and natural features as described in Sections 3.4.1.1, 3.5, 3.7.5, 3.7.6.5, and 5.1.2; and
- Pamlico Sound, as described in Sections 3.7.2, 3.7.3.1, and 3.7.6.1.

4.12.4 Other Potential Impact Causing Activities

Other potential impact causing activities in the ICI study area are:

- Future development and redevelopment on privately held lands on Hatteras Island;
- Actions associated with the goals of the Outer Banks Task Force;
- Potential changes in access within the Refuge and the Seashore north of Rodanthe that could result from moving the southern terminus of the bridge over Oregon Inlet from the north end of Hatteras Island (with Bonner Bridge) to Rodanthe (with the Pamlico Sound Bridge Corridor);
- Dredging for navigation of Oregon Inlet by the USACE;
- Preservation and re-use of the (former) US Coast Guard Station at the north end of Hatteras Island;
- Future disposition of the terminal groin at the north end of Hatteras Island;
- Relocation of utilities in response to shoreline erosion; and
- Past and future development and redevelopment on privately held lands on the Outer Banks and the disturbance of beaches on public and privately held lands on the Outer Banks.

4.12.4.1 Future Development and Redevelopment

The *Dare County Land Use Plan* indicates that new development, particularly national retail franchises and "chains," should maintain the look and feel of the surrounding community. The plan anticipates that future development will shift from new development toward redevelopment of land. It supports the re-use of historic residential structures for business or commercial purposes. The plan also predicts that the limited number of commercial enterprises in the County will move toward serving the needs of year-round residents rather than seasonal visitors.

4.12.4.2 Relocation or Protection of Portions of NC 12

The Outer Banks Task Force is a partnership that includes representatives from the NCDOT, the FHWA, the USACE, the NPS, the USFWS, the National Marine Fisheries Service, the NCDENR, and other state and federal environmental resource and regulatory agencies. Its overall purpose under its now expired Memorandum of Agreement was to develop both short-term and long-term protection and maintenance plans for the transportation system on the Outer Banks. Its goals include:

- Preserving the natural barrier island system;
- Minimizing impacts to Hatteras and Ocracoke islands; and
- Maintaining access to and on the islands so that the transportation system is safe, efficient, and has minimal impact on the environment.

One objective of the work of the Outer Banks Task Force was to develop both short-term and long-term plans for maintaining a transportation system on the Outer Banks in light of recent trends of shoreline erosion and highway overwash along NC 12. The five replacement bridge corridor alternatives all would provide a long-term solution to highway overwash along NC 12.

4.12.4.3 Changes in Access within Pea Island National Wildlife Refuge/Cape Hatteras National Seashore

A bridge in the Pamlico Sound Bridge Corridor would provide transportation access between Bodie Island and Rodanthe instead of the existing road that passes through the Seashore north of Rodanthe, as well as the Refuge. The Parallel Bridge Corridor would leave NC 12 at or near its current location. In 1973, the NPS—realizing the problems that a managed dune system caused—decided to no longer attempt to stabilize the Outer Banks artificially. Their current desire is to let natural processes take their course. In its 1991 *Draft Revised Statement for Management*, the Park Service affirmed a desire to manage the Seashore in ways "that support the natural processes of barrier island dynamics..." (NPS, 1991). This long-term desire has not changed despite recent threats to existing NC 12 within the Seashore. The USFWS, which is responsible for the Refuge, affirms this desire. Dune restoration and beach nourishment efforts by the NCDOT to protect NC 12 are an exception to that desire. Given the location of the Pamlico Sound Bridge Corridor and Seashore/Refuge policies, officials of the Refuge and Seashore planned to reassess their approach to access within the Seashore north of Rodanthe and the Refuge if that Corridor had been selected as the Preferred Alternative.

4.12.4.4 Dredging for Navigation of Oregon Inlet by the US Army Corps of Engineers

The USACE intends to continue dredging in the Oregon Inlet area to provide for navigation between Pamlico Sound and the Atlantic Ocean for commercial and recreational boats.

4.12.4.5 (Former) US Coast Guard Station Preservation

The North Carolina Aquarium Society, a division of NCDENR, manages the (former) US Coast Guard Station at the north end of Hatteras Island (see Figure 3-3). They intend to restore it and use it as a part of their educational programs. The SHPO does not object to this intent. Although no specific plans or funding for the restoration of the station are finalized, the Aquarium Society let a project for bidding in July 2008 to stabilize the structure, remove its modern dormitory, and restore the exterior. The objective of this contract would be to stabilize the structure until final decisions are made regarding the Bonner Bridge replacement project. Additional options discussed in the past for the future disposition of the station include leaving it at its present site or moving it to another location near the ocean.

4.12.4.6 Future Disposition of the Terminal Groin

The continued migration of Oregon Inlet threatened the southern terminus of Bonner Bridge and the north end of Hatteras Island in the late 1980s. Thus, the NCDOT built a terminal groin to protect the bridge. Construction of the terminal groin began in October 1989, and it was completed in March 1991. The groin was designed by the USACE Wilmington District. With the construction of the terminal groin, Hatteras Island migration to the south was halted. The NCDOT has no current plans to remove the terminal groin on Hatteras Island after Bonner Bridge is demolished. The terminal groin is not needed in order to build and maintain a bridge in the Pamlico Sound Bridge Corridor, and neither is its removal. The groin is necessary for construction and maintenance of a bridge in the Parallel Bridge Corridor. The performance of the terminal groin would not be affected by the construction of a bridge within either replacement bridge corridor alternative.

If a bridge in the Pamlico Sound Bridge Corridor is built, the terminal groin could serve parties other than the NCDOT and other immediate needs besides protecting Bonner Bridge. It is conceivable, however, that circumstances could change at some time in the future such that it could prove prudent to remove the terminal groin. In addition, the permit from the Refuge that allowed the construction of the terminal groin states that the purpose of the terminal groin is to: "…protect the southern segment of the existing Herbert C. Bonner Bridge and its southern approach of North Carolina Highway 12." The permit also states that the NCDOT can use the lands and waters occupied by the terminal groin for as long as they "are used for the purpose granted." Whichever replacement bridge corridor alternative is selected as the preferred alternative, a new permit would need to be obtained from the USFWS in order for the groin to remain after Bonner Bridge is taken out of service and demolished. If USFWS officials ask the NCDOT to remove the groin following completion of the demolition and removal of Bonner Bridge, the NCDOT and representatives of the USFWS would assess the impacts of groin removal in a separate environmental study, as needed, prior to any final decision to remove the terminal groin.

4.12.4.7 Relocation of Utilities

As the shoreline erodes west on Hatteras Island with all alternatives under consideration except when nourishment is a component, telephone and electrical lines will have to be moved west. These lines roughly parallel NC 12, on poles and on Bonner Bridge. Like NC 12, these utility lines also are placed in jeopardy by shoreline erosion. Thus, it is reasonably foreseeable that these lines would need to be moved one or more times between now and the design year of this analysis, 2060. Costs for such relocations are included in the non-highway and potential non-highway costs discussed in Section 2.12.3. How such relocations might occur is not known.

4.12.4.8 Outer Banks Shoreline Development and Use

Prior to human disturbance, the project area most likely consisted of beach, wetlands, low dunes, and maritime shrub/forest communities. Much of the Outer Banks, outside of state and federal lands, has been developed for residential and commercial use. Although largely "undeveloped," most of the project area was occupied by natural vegetation communities that have been altered by past or current human-influenced disturbances. Disturbances in the project area include the construction of NC 12, construction and maintenance of primary dunes designed to prevent natural, landward migration of Hatteras Island, and construction of man-made impoundments on the Refuge. Except for activities associated with the maintenance of NC 12, the shoreline in the project area is generally not disturbed as most of it is on Hatteras Island within the Refuge. Table 4-32 gives linear measurements describing the nature of the project area as it compares to the Outer Banks as a whole. In general, federal and state lands are undeveloped and include natural beach, while private lands are developed, adjacent to development, or potentially developed in the future. Natural shoreline, and the coastal habitat created by natural shoreline movement, is essential for imperiled species such as the piping plover, seabeach amaranth, and sea turtles.

Table 4-32 indicates that approximately 76.8 miles of 126.7 miles (123.6 to 203.9 kilometers) or 61 percent of the length of the Outer Banks remains in state and federal ownership and as such is generally not developed. The project area includes 14.5 miles (23.3 kilometers) or 19 percent of that length. When one focuses on undisturbed shoreline, Table 4-32 indicates that of the Outer Banks shoreline, only 10 percent can be considered undisturbed or potentially undisturbed by development and beach driving. Almost all of that area (92 percent) is in the project area.

Table 4-32. Disturbance of the Outer Banks

	Land Ownership[1]			Total Miles
	Federal	State	Private	
Miles (kilometers) of the Outer Banks (measured along the shoreline)				
• In the Outer Banks	76.2 (122.6)	0.6 (1.0)	49.9 (80.3)	126.7 (203.9)
• In the Project Area	14.5 (23.3)	0.0 (0.0)	1.4 (2.3)	15.9 (25.6)
• Percent of the Outer Banks Shoreline Occupied by the Project Area	19%	0%	3%	13%
Miles (kilometers) of Drivable Beach[2]				
• In the Outer Banks	63.1 (101.6)	0.6 (1.0)	36.7 (59.1)	100.5 (161.7)
• In the Project Area	2.4 (3.9)	0.0 (0.0)	1.4 (2.3)	3.8 (6.1)
• Percent of Drivable Beach Miles Occupied by the Project Area	4%	0%	4%	4%
Miles (kilometers) of Undisturbed Shoreline (Non-Drivable Beach Without Adjoining or Potential Adjoining Development)				
• Total in the Outer Banks	13.1 (21.1)	0	0	13.1 (21.1)
• Total in the Project Areas	12.1 (19.5)	0	0	12.1 (19.5)
• Percent in the Project Areas	92%	0%	0%	92%
Percent Undisturbed Beach in the Entire Outer Banks	17%	0%	0$	10%

[1]Indicates ownership of the shoreline along particular segments of the Outer Banks. Federal and state land boundary shapefiles obtained from NC OneMap, 2007. The Outer Bank includes the North Carolina barrier islands from the Virginia line to Ocracoke, inclusive of Bodie, Hatteras, and Ocracoke islands.
[2]Areas where driving is allowed at some time during the year. Only Duck, Southern Shores, Kitty Hawk, the Refuge, and approximately 1 mile (1.6 kilometers) of Hatteras Point were considered off-limits to beach driving. There may be other small sections where driving is restricted.

4.12.5 Potential Indirect Impacts

Indirect effects include induced growth and other effects related to induced changes in the pattern of land use, population density, or growth rate. Construction of a project within the replacement bridge corridor alternatives would not induce changes in development trends because it:

- Does not have an economic development purpose other than to allow the economic benefits offered by the existing Bonner Bridge to continue. The need for a crossing of the Oregon Inlet will continue past the end of the service life of Bonner Bridge. Continued demand for convenient daily and emergency access across Oregon Inlet is expected to occur. The purpose of the proposed project is to replace an existing bridge before the end of its reasonable service life.

- Would be consistent with local area land use goals and directions as they are depicted in the *Dare County Land Use Plan* and, from the perspective of development trends on Hatteras Island, the requirements of the CAMA.

Does not serve a specific land development, would be unlikely to stimulate land development having complementary functions, and would be unlikely to influence substantial intraregional land development location decisions. The project would replace an existing two-lane bridge and road or bypass a portion of existing NC 12 with a new two-lane bridge. As such, it is a replacement in kind. Road capacity, accessibility, and travel time to the developed section of the Outer Banks would not change noticeably. Thus, the project would not be expected to result in changes in development rates or patterns on Hatteras Island, nor would it generate changed or increased development-related impacts. Its influence on land use decisions would be confined to the Rodanthe terminus (except the Nourishment Alternative, which does not relocate NC 12 in Rodanthe) where the presence of the bridge terminus and associated noise could influence decisions on how that land might develop in the future. Much of the land in the area of the terminus is presently used for an automobile junkyard, although a portion of that junkyard was cleared and some of the land developed between 2003 and 2004. Both commercial and residential development also exists in the area.

- Is not being introduced to an area with notable natural features that could be lost to development, as described in the previous bullet point and in Section 3.1.2.

Therefore, a project in either the Pamlico Sound Bridge Corridor or the Parallel Bridge Corridor would be unlikely to generate additional development in the ICI study area or development that is not consistent with local goals for developable areas. New or changed use of environmental resources that can be associated with changes in development trends would not occur.

4.12.6 Potential Cumulative Impacts

Cumulative impact is the impact on the environment which results from the incremental impact of a proposed action when added to other reasonably foreseeable future actions. The following sections describe the potential for cumulative impacts from the perspective of the replacement bridge corridor alternatives and their interaction with other proposed actions in the ICI study area.

4.12.6.1 Impacts Associated with Outer Banks Task Force Goals

The proposed bridge in the Pamlico Sound Bridge Corridor would complement the Outer Banks Task Force goals by bypassing three locations on NC 12 (hot spots) where shoreline erosion and ocean overwash of the highway during storms is a particular problem. The proposed bridge in the Pamlico Sound Bridge Corridor would meet all three goals of the Outer Banks Task Force (see Section 2.3) for the area it serves. It would provide safe transportation access to Hatteras Island that would allow for future natural movement of the island north of Rodanthe, while minimizing impacts to the island and preserving the natural barrier island system.

The Parallel Bridge Corridor would provide safe transportation access to Hatteras Island north of Rodanthe. However, the Parallel Bridge Corridor alternatives would affect the Refuge via nourishment and artificial dunes (Nourishment and Phased Approach/Rodanthe Nourishment alternatives), construction of an aerial structure (All Bridge Alternative and both Phased Approach alternatives), or new road construction (Road North/Bridge South Alternative). The Phased Approach alternatives (including the Preferred Alternative) would be 15 feet (4.6 meters) higher than the height assumed for the All Bridge Alternative (see Section 2.2.2). The nourishment component of the Phased Approach/Rodanthe Nourishment alternative would affect only the southern end of the Refuge. As such, the Parallel Bridge Corridor alternatives (in particular, the Phased Approach alternatives) would be less supportive of task force goals of preserving the natural barrier island system, minimizing impacts to Hatteras Island, and maintaining access in a manner that has minimal impact on the environment.

Additional NC 12 hot spots are located south of Rodanthe. The selection of any of the replacement bridge corridor alternatives as the preferred alternative would not preclude any alternatives at the other hot spots, nor necessitate the development of additional alternatives.

4.12.6.2 Impacts Associated with Changed Access within the Pea Island National Wildlife Refuge and Cape Hatteras National Seashore

With a replacement bridge within the Pamlico Sound Bridge Corridor, the officials of the Refuge and the Seashore plan to reassess their approach for access within the Seashore north of Rodanthe and the Refuge. Dare County officials view highway access within the Refuge as an important contributor to the Dare County economy. As described in Section 3.5, visitors rely on NC 12 to reach various recreational activities within the Seashore and the Refuge on the 11.8 miles (19.0 kilometers) of Hatteras Island that is north of Rodanthe. These activities include fishing, cycling, hiking, walking, and birding. A replacement bridge within the Parallel Bridge Corridor would leave a paved road or bridge the full length of the Refuge north of Rodanthe. The Nourishment Alternative would result in no changes in access. The Road North/Bridge South Alternative would alter access by virtue of its new location; however, access from NC 12 to any part of the Refuge would be available except at the southern end of the project where a bridge would take NC 12 out of the Refuge and into Pamlico Sound. The bridges associated with the All Bridge Alternative would limit access to three access points. The bridges associated with the two Phased Approach alternatives (including the Preferred Alternative) would limit access to the Refuge to a greater extent than any of the other Parallel Bridge Corridor alternatives. Two access points would be provided (see Section 4.5.3.1).

Although the Pamlico Sound Bridge Corridor would bypass the portion of the Seashore north of Rodanthe and the Refuge, some type of access to this portion of the Seashore would be maintained for recreational users by the Refuge.

4.12.6.3 Impacts Associated with US Army Corps of Engineers Dredging

A replacement bridge within the Pamlico Sound Bridge Corridor would make navigation channel dredging operations easier to undertake and could reduce the frequency and size of dredging operations from what is required today. The proposed bridge in the Pamlico Sound Bridge Corridor and its navigation zone would be west of Oregon Inlet in Pamlico Sound where sand movement is less. This change alone could reduce both the amount of dredging required to maintain a channel through Oregon Inlet, as well as the associated impacts to the bottom of Oregon Inlet and Pamlico Sound.

The USACE currently maintains the Oregon Inlet Channel/Old House Channel. Movement of Oregon Inlet over the life of the proposed bridge in the Pamlico Sound Bridge Corridor could shift the natural channel gorge (i.e., the deepest location) to the Davis Channel area. This eventuality, and its effects on channel dredging in the long-term, would be addressed in conversations with the USACE as it relates to the Pamlico Sound Bridge Corridor. The NCDOT's goal is to place the navigation zone of a bridge in the Pamlico Sound Bridge Corridor in a location that facilitates channel maintenance over the full life of the proposed bridge, which could be up to 100 years.

A replacement bridge within the Parallel Bridge Corridor also would make navigation dredging operations easier to undertake. With most Parallel Bridge Corridor alternatives' crossing of Oregon Inlet, the proposed bridge's navigation zone would include a series of navigation spans across Oregon Inlet for a distance of up to approximately 5,000 feet (1,524 meters). The long navigation zone would allow the dredged channel to move with the natural inlet gorge under the bridge. The navigation zone across Oregon Inlet would be 3,300 feet (1,006 meters) with the two Phased Approach alternatives (including the Preferred Alternative), thus offering less flexibility for the USACE to move the dredged channel as the natural channel moves south, which it tends to do. The shorter distance is necessitated by the inclusion of ramps down to the north end of Hatteras Island from the Phased Approach alternatives' bridges. Since the Parallel Bridge Corridor is in Oregon Inlet and the terminal groin would remain in place, the long navigation zone also would take into account the possible shift of the natural channel gorge to the Davis Channel area.

4.12.6.4 Effect to (Former) US Coast Guard Station Preservation

A replacement bridge in the Pamlico Sound Bridge Corridor has raised questions regarding the effect of this change on access to the (former) US Coast Guard Station at the north end of Hatteras Island. Refuge officials intend to maintain some type of public access within the Refuge, including access to the (former) US Coast Guard Station. The NCDOT would be willing to participate in the development of alternate access plans, and it would invite the SHPO to participate. If the alternate access provided by the USFWS and the NPS is found by the SHPO to contribute potentially to the further neglect of the (former) US Coast Guard Station, the NCDOT would help ensure this potential impact is adequately mitigated. With the Pamlico Sound Bridge Corridor, such mitigation would not include retaining NC 12 through the Refuge.

The proposed demolition and removal of Bonner Bridge has raised the question of whether the demolition would limit opportunities for relocating the (former) US Coast Guard Station to a site north of Oregon Inlet (should that be preferred over relocating it to the south), since no easy way to move the structure to a site north of Oregon Inlet would remain. If the Pamlico Sound Bridge Corridor had been selected as the Preferred Alternative, NCDOT would not plan to demolish Bonner Bridge until the future disposition of the (former) US Coast Guard Station was resolved. However, given the poor condition of Bonner Bridge, consideration would have had to be given to whether the weight of the (former) US Coast Guard Station could be safely borne by Bonner Bridge before relocation across the bridge could take place.

A replacement bridge in the Parallel Bridge Corridor would retain NC 12 through the Refuge and, if relocated to a site north of Oregon Inlet, the (former) US Coast Guard Station could be moved either across the replacement bridge or by barge as discussed in Section 4.4.1.2 under "(Former) Oregon Inlet US Coast Guard Station." The retention of the terminal groin, required by all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative), would allow the Station to remain on its current site, if desired by its owners. If it remains at its current site, road access to the (former) US Coast Guard Station would remain with all of the Parallel Bridge Corridor alternatives.

4.12.6.5 Future Disposition of the Terminal Groin

With a replacement bridge in the Pamlico Sound Bridge Corridor, the terminal groin would no longer be needed for bridge protection, since the southern bridge terminus would no longer be at the north end of Hatteras Island. If future circumstances—in association with the USFWS permit for the terminal groin or trends in Oregon Inlet and Hatteras Island movement—were to deem it prudent to remove the terminal groin, Oregon Inlet would be expected to revert to historical migration trends (see Section 3.6.3). For example, it is anticipated that if the terminal groin were removed three years after a bridge in the Pamlico Sound Bridge Corridor opens, and the inlet began to migrate in the same linear fashion as it did before the groin was built, then 50 years after the proposed bridge opens, Oregon Inlet would migrate between 4,600 and 8,000 feet (1,400 and 2,440 meters) south. After 75 years, the inlet would have migrated between 6,900 and 10,300 feet (2,100 and 3,140 meters) south. This example likely represents a “worst-case” situation. Such a change would affect Oregon Inlet channel maintenance strategies, result in the loss of the site of the (former) US Coast Guard Station, and the loss of wildlife habitat. It would be consistent with the desire of officials of the Seashore and the Refuge, who oversee the area and its habitat, to let natural processes take their course. NCDOT has no current plans to remove the terminal groin if a replacement bridge in the Pamlico Sound Bridge Corridor is constructed. If USFWS officials ask the NCDOT to remove the groin following completion of the demolition and removal of Bonner Bridge, the NCDOT and representatives of the USFWS would assess the impacts of groin removal in a separate environmental study, as needed, prior to any final decision to remove the terminal groin.

With the Parallel Bridge Corridor, the terminal groin would be necessary to protect the southern terminus of the new bridge from the natural southward movement of Oregon Inlet. In the case of the Phased Approach alternatives (including the Preferred Alternative), the groin would be needed at least until Phase II of the project is completed. The NCDOT would seek a new permit from the Refuge to protect the new bridge. The current permit for the terminal groin is only for “the existing Herbert C. Bonner Bridge.” The groin would need to remain in place for the life of the new bridge in the Parallel Bridge Corridor, except with the Phased Approach alternatives. The USFWS has indicated that the selection of a Parallel Bridge Corridor alternative as the Preferred Alternative will not guarantee the issuance of the new permit.

4.12.6.6 Relocation of Utilities in Response to Shoreline Erosion

Telephone and electrical lines are present in the project area and roughly parallel NC 12. Like NC 12, these utility lines also are placed in jeopardy by shoreline erosion. Thus, it is reasonably foreseeable that these lines would need to be moved one or more times between now and the design year of this analysis, 2060. This section discusses in general terms potential utility relocation scenarios and how they might add to the impacts assessed for the replacement bridge corridor alternatives. (Also see Section 4.1.6.8 and Section 4.1.6.10.)

Pamlico Sound Bridge Corridor Alternatives

These alternatives would not provide a connection to the north end of Hatteras Island. In this case, telephone and electrical lines would be placed on the new bridge or adjacent to the new bridge in Pamlico Sound. The costs reflected in Table 2-11 and Table 2-12 and listed in Section 4.1.6.8 and Section 4.1.6.10 assume that the telephone lines are placed on the Pamlico Sound Bridge Corridor bridge, and electrical lines are placed on poles adjacent to the bridge, which is expected to be the least expensive approach. Bottom disturbance would be associated with placing electrical line poles in the sound. These utility lines would connect back into Hatteras Island at Rodanthe. Lines in Rodanthe along NC 12 would likely be moved back as needed as a result of shoreline erosion. Given the developed nature of Rodanthe, substantial environmental impacts would not be expected from pole and line relocation in Rodanthe. Lines would be removed from the Refuge except as needed for Refuge facilities. The extent of the lines remaining in the Refuge would be up to Refuge officials. Given that Refuge facilities using telephone and electricity also would be lost to future beach erosion, the extent of the relocation of these lines in the Refuge would depend upon where the Refuge chooses to relocate its facilities.

Parallel Bridge Corridor with Nourishment Alternative

This alternative would protect NC 12 from shoreline erosion so that it can remain in its existing easement. Since electrical and telephone lines are west of NC 12 (except for at the southern end of the project area in Rodanthe), the nourishment associated with this alternative also would protect the utility lines. They would not need to be relocated with associated impacts.

Parallel Bridge Corridor with Road North/Bridge South, All Bridge, and Phased Approach Alternatives (Including the Preferred Alternative)

All three of these alternatives would involve building new bridges between Rodanthe and Oregon Inlet. Only the Road North/Bridge South Alternative also would involve road relocation at grade. Because of the high cost of placing electrical lines on bridges (approximately $2.5 million per mile in 2006 dollars) and the comparatively low cost (approximately $123,000 per mile over upland) of relocating electrical lines on poles, it is assumed likely that with these alternatives, the electrical lines would be relocated on poles on land and generally independent of the Bonner Bridge replacement project (with the sole exception of placing both utilities on the new bridge over Oregon Inlet). In the case of telephone lines, the cost per mile on a bridge is approximately $20,000 per mile versus $50,000 per mile on land, so in the case of the telephone lines, relocation on the proposed bridges could be advantages to the telephone company depending on the cost of line maintenance. Utility relocation on land could be accomplished in three ways:

- Moving the Utilities Back from the Ocean Multiple Times on Upland. As the shoreline erodes, sand overwash will fill wetlands near the shore creating new upland. Poles could be moved back as needed without the need for poles or equipment to pass through or use Refuge wetlands. Utility company equipment would have to drive on Refuge uplands to reach their lines to the extent that NC 12 is on bridges or has been relocated on road beyond the forecast 2060 high erosion shoreline as in the case of the Road North/Bridge South Alternative. This approach is assumed in the cost estimates reflected in Table 2-11 and Table 2-12 and are listed in Section 4.1.6.8 and Section 4.1.6.10.

- Moving Utilities Back to a Point Beyond the Forecast 2060 High Erosion Shoreline Once. In this particular case (with the exception of the road sections of the Road North/Bridge South Alternative) utility lines likely would be relocated into wetlands with associated higher relocation costs, construction impacts to wetland and upland habitat associated with bringing in equipment to erect the new lines, and long-term equipment movement impacts associated with inspection and maintenance.

- Erect New Lines in the Road North Easement. In the road section of the Road North/Bridge South Alternative, erecting new lines within the new NCDOT easement so that impacts occur for both activities (road and utility relocation) at the same time, and equipment can use the relocated road for maintenance and inspection access.

Thus, with these three alternatives repeated impacts to uplands and/or wetlands would occur in the Refuge between now and 2060, with associated disturbances to wildlife. In Rodanthe, impacts would be similar to those described above for the Pamlico Sound Bridge Corridor. The exact approach to utility relocation would likely be determined by utility and Refuge preferences, negotiations with the NCDOT for utilities placed on bridges or in an NCDOT easement, total cost to the utilities, and opportunities to spread costs over time.

4.12.6.7 Cumulative Effect of Habitat Loss or Change on the Ecological Integrity of the Outer Banks

The project area includes approximately 13 percent of the length of North Carolina's Outer Banks (see Section 4.12.4.8). Approximately 76.8 miles of 126.7 miles (123.6 to 203.9 kilometers), or 61 percent, of the length of the Outer Banks remains in state and federal ownership and is generally not developed. The project area includes 19 percent of that 76.8-mile (123.6-kilometer) length. From an ecological standpoint, this area is one of the most important portions of the Outer Banks. First, it is a large area of undeveloped habitat. Secondly, the presence of a National Wildlife Refuge provides an extensive area where land use decisions are based on maintaining natural systems.

Total habitat losses associated with the project are described in Section 4.7. General loss of habitat varies from 9.53 acres (3.86 hectares) with the Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative to 91.60 acres (37.07 hectares) with the Parallel Bridge Corridor with Road North/Bridge South Alternative. The majority of the lost area associated with the Phased Approach alternatives (including the Preferred Alternative) is currently occupied by existing NC 12 and Bonner Bridge. Of the Parallel Bridge Corridor alternatives, the Phased Approach alternatives would result in the loss of the least amount of undisturbed Outer Banks habitat when built. The Pamlico Sound Bridge Corridor alternatives would offer both the removal of NC 12 from the Refuge, as well as the removal of the disturbances to Refuge wildlife, including those related to NC 12 storm maintenance and traffic operations.

As indicated in Section 4.12.4.8, only about 10 percent of the Outer Banks shoreline can be considered undisturbed or potentially undisturbed by development and beach driving. Almost all of that area (92 percent) is in the project area. Although undisturbed by development or beach driving, the shoreline in the project area is disturbed by a human made dune system and the maintenance of the system in association with maintaining NC 12. The Pamlico Sound Bridge Corridor would eliminate the current disturbance associated with NC 12 maintenance and allow natural processes to occur. The Parallel Bridge Corridor Alternatives would affect this scarce, undisturbed, and protected beach as follows:

- <u>Nourishment Alternative</u>. The nourishment program and associated dune building would continue to disturb the shoreline (preventing natural erosion and overwash processes from taking place), although the frequency of emergency disturbances would be reduced by a wider beach and a stronger dune line.

- <u>Road North/Bridge South</u>. NC 12 would be moved away from the shoreline as a new paved road or placed on a bridge at a point at least 230 feet (70.1 meters) west of the 2060 high erosion shoreline. The existing dunes along the oceanside of NC 12 would not be rebuilt (i.e., they would be allowed to erode naturally). However, three 10-foot (3-meter) high dunes, totaling 2,100 feet (640 meters) in length would be built east of and near the new road, but not immediately. They would be built as needed as the shoreline erodes towards the relocated road. The first one is expected to be built by 2030. The dunes, once built, would resist or prevent overwash. The relocation of the road, while allowing for natural shoreline movement, would disturb new natural habitat in the refuge (as noted above), particularly wetlands, and associated wildlife. The pavement of existing NC 12 would be removed and the land replanted.

- <u>All Bridge</u>. NC 12 would be moved away from the shoreline and placed on a bridge at a point at least 230 feet (70.1 meters) west of the 2060 high erosion shoreline. The existing dunes along the oceanside of NC 12 would not be rebuilt (i.e., they would be allowed to erode naturally). The relocation of the road, while allowing for natural shoreline movement, would disturb new natural habitat in the refuge (as noted above), particularly wetlands, and associated wildlife. The pavement of existing NC 12 would be removed and the land replanted.

- Phased Approach/Rodanthe Bridge Alternative (Preferred). This alternative would place NC 12 on a bridge in the existing right-of-way resulting in the least initial direct impact to natural habitat. Natural shoreline processes would be allowed to take place. The shoreline would erode underneath the bridge. Ultimately the project would have portions over the beach and in the ocean for distances shown in Table 4-23. The presence of the bridge in this location would adversely impact the shoreline from the perspective of its natural appearance (see Section 4.3.2), recreational use (see Section 4.5.3), the outcome of coastal processes along the beach (see Sections 4.6.8.3 and 4.6.8.5), and wildlife (see Sections 4.7.5.2, 4.7.6.6, and 4.7.6.7), including protected species that use beach habitat (see Section 4.7.9).

- Phased Approach/Rodanthe Nourishment. This alternative would have impacts similar to the Phased Approach/Rodanthe Bridge except in the nourishment area near Rodanthe, where the affects on the shoreline at the southern end of the Refuge would be those of the Nourishment Alternative.

4.13 Construction

Construction in the Pamlico Sound Bridge Corridor or the Parallel Bridge Corridor and demolition and removal of Bonner Bridge would be governed by:

- NCDOT's *Standard Specifications for Roads and Structures* (NCDOT, July 2006, or as current at the time of construction); and

- American Association of State Highway and Transportation Officials' (AASHTO) *Standard Specifications for Highway Bridges* (AASHTO, 2002, or as current at the time of construction).

Separate contracts would be issued for construction of the proposed project and demolition and removal of Bonner Bridge with the Pamlico Sound bridge. With an Oregon Inlet bridge, demolition could be within the same contract as construction. Mechanisms would be put in place to maintain traffic flow; minimize air quality, noise, and construction lighting impacts; manage waste disposal; protect surrounding natural resources; control erosion; and handle any accidental waste spills. Affected geodetic survey markers in the project area would be properly relocated. Specifics related to these construction and demolition issues are presented in the sections that follow.

4.13.1 Traffic Maintenance

Traffic would be maintained on NC 12 and Bonner Bridge throughout the construction of the replacement bridge corridor alternatives. With two exceptions described below, the only opportunity for construction to interfere with NC 12 traffic would be when new bridges or roads are connected into existing NC 12. If this part of the construction process coincides with the peak visitation period, two lanes of traffic would be maintained during the connections. In order to maintain traffic with the Parallel Bridge Corridor with All Bridge Alternative, a construction easement adjacent to NC 12 would be obtained and temporary pavement built south of the Refuge's ponds where the new NC 12 bridge would be built within the existing NC 12 easement for approximately 0.9 mile (1.4 kilometers).

The greatest challenge to maintaining traffic on NC 12 would be at the southern terminus of the Oregon Inlet bridge with the Parallel Bridge Corridor with Nourishment and with Phased Approach alternatives (including the Preferred Alternative). It is anticipated that the southern end of the existing Bonner Bridge would be partially removed for the purposes of constructing a temporary traffic maintenance bridge. The two phased approach alternatives also would be built with the existing NC 12 easement for their full length on Hatteras Island. A new easement permit, therefore, likely would not be needed from the USFWS.

With the Nourishment Alternative, the last two or three spans of the new bridge would be built over the final spans of Bonner Bridge so that the Bonner Bridge easement in the Refuge can be used by the new bridge. During construction, periodic short-term closings of NC 12, presumably at night and in the off-season, would be needed at a minimum as new precast bridge components are maneuvered into position over or adjacent to Bonner Bridge. Once a component is placed, Bonner Bridge would be reopened to traffic until contractors are ready to place the next component. On land, where Bonner Bridge ends and the approach road to Bonner Bridge begins, a temporary detour would divert NC 12 traffic out of the existing easement.

With the two Phased Approach alternatives (including the Preferred Alternative), two lanes of traffic would be maintained on NC 12 via temporary roads and a short bridge, as described in Section 2.10.

Brief periods of delay and disruption that result from construction vehicles operating on NC 12 could be encountered by motorists. Most of the bridge components with the replacement bridge corridor alternatives would be brought to the construction site by barge. The construction contractor would be required to meet the traffic maintenance requirements of NCDOT's *Standard Specifications for Roads and Structures* (NCDOT, July 2006, or as current at the time of construction). A traffic control plan would be developed, and special care would be taken to clearly delineate a safe travelway for traffic.

4.13.2 Air Quality

During construction, all materials resulting from clearing and grubbing and demolition would either be removed from the project site, burned, or otherwise disposed of by the contractor. Any burning would be done in accordance with applicable local laws and ordinances and regulations of the North Carolina SIP for air quality in compliance with 15 NCAC 2D.0520. Burning would be conducted only away from nearby buildings and only when atmospheric conditions do not create a hazard to the public. Any burning activities would be supervised at all times. In addition, appropriate measures would be taken to reduce dust generated by construction activities. The contractor would ensure that fugitive dust would be controlled at all times for the protection and comfort of motorists and area residents.

4.13.3 Noise

Construction noise varies greatly with the type of equipment in use and the phase of construction activity. Noise levels near a construction project therefore fluctuate greatly from day to day and hour to hour. The primary noise effect would be from the operation of construction equipment. Construction noise sources include truck and equipment engines; equipment noise from scraping, ripping, and excavating; back-up alarms; the slam of truck tailgates as asphalt truckers knock the last bit out of their dump beds; impact wrenches on structural bolts for bridges; rock drilling; pile driving; and blasting.

High noise levels of impact pile driving and combustion-engine-powered equipment usually are the main contributors to bridge construction equipment noise levels. It has been documented that the typical noise levels produced by pile driving operations range from 82 to 105 dBA regardless of the pile driving technique implemented. For proposed bridge substructures (foundation and support for the superstructure), precast piles are planned. Over water, these piles could be jetted (high-pressure water is used to move sand aside so the pile can drop into place) or, in some cases, driven (hit with a large hammer or vibrated to drive the piles into the ground). With jetted piles, it is common to use a pile driver to seat the pile (to bring it to its final stopping point). Over land, bridge piles could be driven or inserted into drilled shafts. In general, construction noise impacts within the Pamlico Sound Bridge Corridor and for the Oregon Inlet bridge in the Parallel Bridge Corridor would be minimal, since much of the effort would occur in open water, away from human activities. Bridge construction operations could take place 24 hours a day so that the proposed bridge could be opened to traffic within the construction timeframe as discussed in Section 2.10.1.3. Noise impact would be greatest at:

- The campground and fishing center at the northern terminus of the proposed Pamlico Sound and Oregon Inlet bridges (on Bodie Island);

- In the community of Rodanthe: at the southern terminus of the Pamlico Sound Bridge Corridor; at the southern terminus of the Rodanthe area bridge associated with the Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives; and along the length of the Phased Approach alternatives (including the Preferred Alternative); and

- Bridge foundation construction locations on Hatteras Island for the Parallel Bridge Corridor with All Bridge and Phased Approach alternatives (including the Preferred Alternative), where there would likely be disturbances to Refuge users and waterfowl, particularly if bridge piles are driven.

Control of construction noise at the source is the most effective approach to reducing noise. Several measures can be utilized in order to minimize noise resulting from construction activities. Such measures include, but are not limited to, the following:

- Minimizing the use of impact hammers to drive bridge piles into place;

- Requiring that construction equipment comply with noise standards adopted by the Occupational Safety and Health Administration (OSHA);

- Requiring construction equipment to have effective mufflers, have efficient silencers on air intakes of equipment, and to be properly maintained; and

- Placing continuously operated diesel-powered equipment, such as compressors and generators, in areas as far as possible from or shielded from noise-sensitive locations.

Other noises are best handled by indirectly managing the activities through decibel restrictions. Construction operations and associated noise generally would be restricted to daytime hours when near noise-sensitive receptors.

4.13.4 Lighting

Because construction activities could occur 24 hours a day, construction areas could be lit to daylight conditions at night. Night lighting would not occur near turtle nesting areas with any of the replacement bridge corridor alternatives.

The NCDOT would work with the NCDENR Division of Marine Fisheries and the National Marine Fisheries Service to determine if there are areas in the Pamlico Sound and Oregon Inlet where night lighting would need to be avoided or limited. Night lighting would not be used close to areas where people sleep, including the campground at the northern terminus of the project and in the Rodanthe area.

4.13.5 Waste Disposal

Excavated, dredge, and fill waste material generated by the replacement bridge corridor alternatives generally would be disposed of using one or more of the techniques that have been used regularly in the Oregon Inlet area in past years: open water disposal, diked as well as undiked disposal areas, and beach nourishment. Different disposal methodologies, as well as the type of material to be deposited, would have different potentials for environmental impact. The USACE has found that material dredged from the Ocean Bar channel at Oregon Inlet is more than 95 percent sand (USACE, 1980c) and has indicated that this would be the case for material dredged in connection with the replacement bridge corridor alternatives. A representative of the USACE has expressed interest in having suitable sand pumped onto Hatteras Island as a part of beach stabilization efforts. (Personal communication, August 15, 1991, and October 24, 2003, Howard Varnam, USACE Navigation Branch, Wilmington, NC.) If suitable (e.g., proper particle size, mineralogical composition, etc.) for beach nourishment, dredged material could be used a part of the first round of beach nourishment with the Parallel Bridge Corridor with Nourishment Alternative.

The advantages and limitations of these different scenarios are:

- Open Water Disposal. In the past, open water disposal has been used to remove sediments from dredging sites, including the Ocean Bar channel at Oregon Inlet. This type of disposal involves the discharge of slurry into surrounding waters. It is used most often in areas where no upland site is available. This method potentially would produce the most visible and greatest impact to water quality, especially when disposal sites are near critical habitats (i.e., SAV, oyster beds, and nursery areas). Critical habitats would be avoided. If dredged materials are compatible with the sediments of the disposal site, the site should revert back to its original state. The material to be dredged in connection with the replacement bridge corridor alternatives is expected to be suitable for open water disposal. Thus, it can be recycled back into the system.

- Undiked Disposal Area. The practice of undiked disposal has been used commonly throughout the coastal region over the years. With this method, dredged material is placed in unconfined disposal areas. When dredged materials are mostly sands (as is the case in the project area), the material can be directed roughly into defined areas within the site. When materials are of smaller fractions, the confinement is decreased even more, and the dredged material spreads over a greater area. The impacts to the water quality of the site depend on the type of material dredged. Higher sand concentrations cause little or no increase in turbidities, whereas finer sediments remain suspended longer and cause short-term and temporary turbidity-related impacts.

- Re-nourishment of Dredged Disposal Islands. Dredged materials might be suitable for use in re-nourishment of existing dredged material islands. Dredged material islands exist near the project area (see Figure 3-7) and are used as nesting sites for colonial waterbirds. An interagency coordinating committee has been established to facilitate the cooperation needed to successfully manage North Carolina's colonial waterbirds through activities such as depositing dredged materials in the coastal zone. During disposal of new material, nesting sites might be temporarily or permanently lost, according to the character and placement of dredged material. Additional dredged material islands exist west of the project site. They have unused capacity and might be available for placement of some dredged material. (Personal communication, August 15, 1991 and October 24, 2003, Howard Varnam, USACE Navigation Branch, Wilmington, NC.)

- Beach Nourishment. Beach nourishment is another alternative to disposal. Dredged material consisting of clean sands of the correct particle size is added to beach deposits to replace sand lost by erosion. The state requires that dredged material taken from close to shore to be deposited back onto the beaches. (Personal communication, October 24, 2003, Howard Varnum, USACE, Navigation Branch, Wilmington, NC.) Suitable material occurs within the project area. The USACE has found that material dredged from the Ocean Bar channel at Oregon Inlet is suitable for beach nourishment. The material along Bonner Bridge also could be suitable for beach nourishment, according to the USACE. (Personal communication, August 15, 1991 and October 24, 2003, Howard Varnam, USACE Navigation Branch, Wilmington, NC.) Currently, the majority of material dredged around Oregon Inlet (1,000,000 cubic yards [760,000 cubic meters] dredged in 2002) is deposited onto Hatteras Island. Special use permits would be required from the USFWS and the NPS if dredged material were used to re-nourish Hatteras Island's beaches or as a part of initial nourishment and dune building activities for the Parallel Bridge Corridor with Nourishment Alternative. Beach compaction would be prevented further by depositing dredged materials below the mean high-tide line. In addition, development activities, which can include nourishment, generally are not allowed during the nesting season from May 1 to November 15 to minimize disturbance to turtles. (Personal communication, October 31, 2003, Matthew Godfrey, State Sea Turtle Coordinator, North Carolina Wildlife Resources Commission.)

- Upland Disposal. Upland areas enclosed by earthwork dikes also have been used for disposal of coastal dredged material. Confinement allows settlement of the solids in the slurry and controls runoff of slurry water. Disposal of dredged material in this fashion usually results in a drastic change in land use. The short-term impacts, a result of diking and filling, involve removal of existing flora and fauna. Upland vegetation is covered by dredged material or killed from the salt. An island does exist near Wanchese (Island H on Figure 3-7) that can be used for diked disposal. The material in this area is not sand, and sand disposed there cannot be allowed to run off into the water. (Personal communication, August 15, 1991 and October 23, 2003, Howard Varnam, USACE Navigation Branch, Wilmington, NC.) During material disposal, nesting sites might be lost temporarily or permanently, according to the character and placement of dredged material.

The nondiscretionary measures outlined in the Biological and Conference Opinions (USFWS, 2008) for the Phased Approach/Rodanthe Bridge Alternative (Preferred) related to piping plovers specify that "all dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission." The NCDOT is committed to implementing this measure. The appropriate location for disposal would be determined based on the character of the materials dredged, the availability of disposal sites, and coastal conditions near the time of construction. The information needed for NCDOT to develop a disposal plan would be obtained during the USACE permit preparation process. The disposal of excess material would be the responsibility of the contractor, who would be required contractually to handle and dispose of the material in accordance with NCDOT's Standard Specifications for Roads and Structures (NCDOT, July 2006, or as current at the time of construction), permit requirements, and local, state, and federal laws.

Any toxic and hazardous materials would be handled and used in accordance with package labels and manufacturers' directions. Wastes would be segregated, labeled, and stored in a manner that would prevent their release into the environment from an accident or spill. The contractor would dispose of these materials and their containers in accordance with applicable state and federal regulations.

4.13.6 Construction Access

4.13.6.1 Dredging

The contractor may elect to use barge-mounted equipment. It is anticipated that, in locations where the water depth is less than 6 feet (1.8 meters) deep, dredging would be required such that sufficient water depth is provided to float and move loaded construction barges. It was assumed that dredging would be to a depth of 8 feet (2.4 meters), which is deeper than absolutely necessary to float and move construction barges, because of the dynamic coastal conditions that exist in the project area. Tidal water movement, potential storm conditions, and complex sediment transport would have the tendency to fill back in dredged channels over a short period of time. Therefore, dredging deeper than absolutely necessary would alleviate the need to frequently re-dredge the channel.

It is assumed that barges could be loaded with crawler cranes along with major bridge components such as piles, formwork, girder sections, and other equipment. These components and equipment would likely be delivered by barge from the fabrication yard to the work barges.

The contractor would coordinate with NCDOT, USACE, USFWS, NMFS, and NCDENR in developing its dredging technique and disposal plan that would minimize harm to natural resources.

General guidelines for developing a detailed dredging plan would be prepared by the contractor and submitted for NCDOT review and approval. The following are dredged channel dimensions and locations:

- Maximum channel width = 120 feet (36.6 meters);
- Maximum channel depth = 8 feet (2.4 meters);
- Channel length shall be kept to the minimum dimension deemed practicable; and
- Dredging is prohibited in areas of SAV.

Dredging techniques also would require approval. The two basic techniques include pipeline or clamshell dredging and hopper dredging. However, hopper dredging would be prohibited.

4.13.6.2 Haul Roads and Work Bridges

The contractor could use haul roads and work bridges for access to facilitate construction of the replacement bridge corridor alternatives. Delivery trucks and crawler cranes would use the haul roads and/or work bridges to deliver and erect major bridge components such as piles, formwork, and girder segments. The potential use of a haul road is anticipated only west of Bodie Island with a Parallel Bridge Corridor alternative. The contractor would coordinate with the NCDOT, the USACE, the USFWS, the NMFS, and the NCDENR in its development of a site access plan that would minimize harm to natural resources. For example, haul roads would be prohibited in SAV areas.

Although a final approach would be developed by the contractor, it is anticipated that haul roads would consist of a main road a maximum of 65 feet (19.8 meters) wide that is aligned parallel to the new Oregon Inlet bridge alignment with pier access roads, or fingers, that are aligned perpendicular to the main road. The pier access roads would be a maximum of 40 feet (12.2 meters) wide and could be at each proposed pier location within the length of the haul road.

The following are requirements would be used for construction and removal of haul roads:

- Haul road material would be approved by the permitting agencies and NCDOT and could consist of fill obtained from the inlet or sound;
- Turbidity curtains or other means would be implemented to minimize disturbance of the sound bottom during placement of fill;
- Fill used for haul road construction would be placed on geotextile fabric;
- Side slopes of haul roads would be constructed with geotextile fabric to minimize erosion;
- Haul roads would be constructed to prevent leakage or seepage of liquid materials associated with construction equipment from entering adjoining waters or wetlands;
- Haul roads would be removed and disposed of in accordance with NCDOT and permitting agency requirements; and
- After a haul road is removed, the entire area covered by the haul road would be re-vegetated as directed by the NCDOT.

As a result of haul roads or dredging not being used in areas of SAV, work bridges would be needed at some locations along the construction of the new bridges in the inlet or sound. Structural and geotechnical design of the work bridge components would be in accordance with the latest edition of the NCDOT Structure Design Manual. The contractor would design the work bridges for actual construction equipment live loads and would coordinate the work bridge design with the proposed bridge erection sequence. A work bridge design also would comply with OSHA requirements. The following are requirements for construction and removal of work bridges:

- Work bridge materials would be coordinated with the permitting agencies and the NCDOT;
- Turbidity curtains or other means would be implemented to minimize disturbance of the sound bottom during placement of work bridge foundations;

- Work bridges would be constructed to minimize or prevent leakage or seepage of liquid materials associated with construction equipment from entering adjoining waters or wetlands; and

- Work bridges, including their foundations, would be removed and disposed of in accordance with NCDOT and permitting agency requirements.

4.13.7 Natural Resource Protection

Protection of the natural resources within the project area would involve implementing environmental safeguards during all stages of the project from planning through construction and demolition. Separate contracts would be issued for construction of the proposed project in the Pamlico Sound Bridge Corridor and demolition and removal of Bonner Bridge. With an Oregon Inlet bridge, demolition could be within the same contract as construction.

The first opportunity for protection of the natural resources and also the most successful is avoidance of sensitive areas. For example, the locations of SAV areas and a 10 foot (3.05 meters) buffer would be identified and delineated for avoidance. These areas would be monitored for changes every other month by the contractor. Updated SAV locations would be submitted by the contractor to NCDOT and the permitting agencies for review. Modifications to the construction plans, such as demolition plans, and site access plans may be required depending on how the SAV locations change over the duration of the construction.

The Pamlico Sound Bridge Corridor would avoid most of the sensitive areas identified in the project area and activities that would produce potentially adverse impacts. A work bridge would be used when construction equipment barges are over SAVs and water is not deep enough to float the barge without dredging. The Parallel Bridge Corridor would affect a much larger area of sensitive natural resources than the Pamlico Sound Bridge Corridor, as documented in Section 4.6.8. Oregon Inlet bridge construction in the Parallel Bridge Corridor would include construction of a temporary haul road, dredging or a work bridge behind Bodie Island. The Road North/Bridge South and All Bridge alternatives include bridges or roads over wetland and upland wildlife habitat in the Refuge for approximately 7 miles (11.3 kilometers). These bridges would be built from a work bridge.

Appropriate BMPs applicable to construction and maintenance for protection of surface waters, wetlands, and upland habitat would be used to control erosion, sedimentation, and stormwater runoff (see Section 4.13.8). All waters in the project area are classified as SA waters (Class A salt waters) with a supplemental classification of HQW. The most stringent application of the BMPs is expected where highway projects affect receiving waters of special designation, such as HQW (NCDOT, August 2003). The NCDOT's design standards for sensitive watersheds are applicable to the project because of the SA/HQW classification. If requested by appropriate agencies, attempts would be made to reduce dredging activities associated with Pamlico Sound or Oregon Inlet bridge construction as much as possible during the spring to avoid minor effects to the fisheries resources. Dredging plans and disposal of dredged material and construction within the Refuge would be coordinated with appropriate agencies to avoid affecting nesting by colonial waterbirds and sea turtles and to minimize other wildlife impacts. The nondiscretionary measures outlined in the *Biological and Conference Opinion*s (USFWS, 2008) for the Phased Approach/Rodanthe Bridge Alternative (Preferred) related to piping plovers specify that "all dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission." The NCDOT is committed to implementing this measure.

For access to Bonner Bridge for demolition equipment, a work bridge likely would be used over wetlands on Bodie Island. Use of a temporary haul road could be requested if it is demonstrated that such access would not result in permanent impacts to marsh communities because these communities do not have an underlying organic subsoil, or if the cost of constructing and dismantling a temporary work bridge is so high that it would not be practicable to employ that methodology.

4.13.8 Erosion Control

North Carolina Administrative Code Title 15A, Chapter 4B entitled "Sedimentation Control" requires approval of a soil erosion control plan before land-disturbing activities can begin. The NCDOT would prepare an erosion control plan.

The control plan must identify critical areas subject to severe erosion, limit the size of the area exposed at any one time, limit the time exposed, control water runoff, prevent off-site sedimentation damage, and manage stormwater runoff. Impacts resulting from erosion and sedimentation likely would be kept to a minimum by employing BMPs such as silt check dams, silt fences, and silt basins. During construction of the proposed project and demolition and removal of Bonner Bridge (which would occur under a separate contract), appropriate improvement techniques would be employed, such as prompt establishment of appropriate grass species, sediment barriers, and proper grading of slopes in order to meet the standards set by the Sedimentation Pollution Control Act of 1973 as amended. These practices would include those in conformance with NCDOT's *Sediment and Erosion Control Program* and *Best Management Practices for Protection of Surface Waters*.

4.13.9 Waste Spill Contingency Planning

In the event of hazardous waste or oil spills, the contractor would follow the emergency response procedures established under the North Carolina Oil Pollution and Hazardous Substances Control Act of 1978, as amended. Immediately after discovery of a spill, the contractor would contact the Dare County Communications Center (911), which would alert the Dare County Emergency Management Office, appropriate fire departments, and other agencies or persons required under the County's emergency management plan and Title 3 of the Superfund Amendment and Reauthorization Act of 1986 (SARA). The contractor then would initiate cleanup of the spill as soon as possible.

The North Carolina Oil Pollution and Hazardous Substance Control Act applies to spills of oil and those chemicals listed in the Federal Clean Water Act, whether on the ground or in water bodies, including off-shore spills.

4.13.10 Geodetic Survey Markers

Geodetic survey markers in the project area would be properly relocated if affected.

4.14 Relationship between Long-Term and Short-Term Uses/Benefits

The local short-term impacts and the use of resources for any of the replacement bridge corridor alternatives would be consistent with the maintenance and enhancement of long-term productivity for Dare County and the State of North Carolina.

Bonner Bridge provides the only highway connection between Hatteras Island and the mainland; it is the only link between the Bodie Island and Hatteras Island portions of the Seashore. By providing a replacement crossing and maintaining NC 12 to Rodanthe, the replacement bridge corridor alternatives would provide regional benefits to the recreational and business community that outweigh the long-term adverse impacts associated with the construction of the project in a sensitive environment. With the replacement bridge corridor alternatives, direct motor travel service between Hatteras Island and the mainland via Bodie Island would continue uninterrupted, as would the delivery of goods and services from the mainland upon which island residents and visitors depend. The tourist and service-related industries of the region would be hindered by the reduction in access that would result from the No-Action Alternative.

The short-term impacts and use of resources in the construction of a Pamlico Sound Bridge Corridor project would be consistent with the maintenance and enhancement of the long-term productivity of Hatteras Island and the Seashore as defined by area plans. The proposed bridge in the Pamlico Sound Bridge Corridor would be consistent with the Refuge *Master Plan*'s goal of not moving the existing NC 12 alignment within the Refuge as the new alignment would bypass the entire Refuge. The proposed bridge also would be compatible with NPS and USFWS management policies to let natural processes of shoreline change take their course. Paved road access through the Refuge, as preferred by Dare County officials, however, would not likely continue with the Pamlico Sound Bridge Corridor. Refuge officials intend to provide an alternate type of access. The potential economic impact of this change is discussed in Section 4.1.5.

The short-term impacts and use of resources in the construction of a Parallel Bridge Corridor project would not be consistent with the maintenance and enhancement of the long-term productivity of the Refuge and the Seashore from the perspective of the goals of their respective plans discussed in the previous paragraph; however, the NPS and USFWS will be responsible for determining whether or not the Parallel Bridge Corridor alternatives (including the Preferred Alternative) are consistent overall with their respective plans. The Parallel Bridge Corridor alternatives would retain paved road access through the Refuge, as desired by Dare County officials, although the two Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) would provide only two points of access and the All Bridge Alternative would provide three. Although not an objective of Refuge officials, the Parallel Bridge Corridor with Nourishment Alternative would maintain the status quo for Refuge facilities, protecting the Refuge's ponds, Visitor Center, headquarters, and trails from the effects of future beach erosion (see Section 4.5).

4.15 Irreversible and Irretrievable Commitments of Resources

Implementation of any of the replacement bridge corridor alternatives would involve commitment of a range of natural, physical, human, and fiscal resources. Land used in the construction of any of the replacement bridge corridor alternatives would be considered an irreversible commitment during the time period that the land is used for a highway and bridge facility. However, if a greater need arises for use of the land or if the bridge is no longer needed, the land could be converted to another use. At present, there is no reason to believe such a conversion ever would be necessary or desirable.

Considerable amounts of fossil fuels, labor, and highway/bridge construction materials (such as concrete and steel) would be expended. Additionally, large amounts of labor and natural resources would be used in the fabrication and preparation of construction materials. These materials generally are not retrievable. They are not, however, in short supply, and their use would not have an adverse effect on continued availability of these resources. Any construction also would require a substantial one-time expenditure of both state and federal funds, which would not be retrievable.

The commitment of these resources is based on the concept that residents in the immediate area, state, and region, as well as visitors to the area, would benefit by maintaining the quality of the current transportation system. These benefits would consist of continued accessibility, safety, and support of tourism. Such benefits are anticipated to outweigh the commitment of resources.

The No-Action Alternative would require the commitment of materials, labor, and funds to build, operate, and maintain a small-scale ferry operation.

Chapter 5

Final Section 4(f) Evaluation

5.0 Final Section 4(f) Evaluation

Section 4(f) of the Department of Transportation Act of 1966, as amended (49 *United States Code* [USC] 303), states that the US Department of Transportation (USDOT) may not approve the use of land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site, unless a determination is made that the project will have a *de minimis* impact or unless a determination is made that:

1. There is no feasible and prudent avoidance alternative, as defined in 23 CFR (*Code of Federal Regulations*) 774.17, to the use of land from the property; and

2. The action includes all possible planning, as defined in 23 CFR 774.17, to minimize harm to the property resulting from such use.

If the analysis of this section concludes that there is no feasible and prudent avoidance alternative, then the USDOT may approve only the alternative that causes the least overall harm in light of the statute's preservation purpose.

All five of the Parallel Bridge Corridor alternatives, including the Phased Approach/Rodanthe Bridge Alternative (Preferred), as well as the two Pamlico Sound Bridge Corridor alternatives would require land from the Cape Hatteras National Seashore (the Seashore) on Bodie Island at the northern end of the project area. The Seashore is a Section 4(f) property. The Parallel Bridge Corridor with Nourishment Alternative and the Phased Approach/Rodanthe Nourishment Alternative also would use land to varying degrees from the Pea Island National Wildlife Refuge (the Refuge) for beach nourishment. The Refuge, part of the Seashore, also qualifies as a Section 4(f) property given its function as a refuge and its eligibility for the National Register of Historic Places (NRHP). It also serves as a public park and recreational area. The Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives also would use land from both the Refuge and the Rodanthe Historic District. The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would only use land from the Seashore. None of the alternatives would utilize land from the historic (former) Oregon Inlet US Coast Guard Station located on the northern end of Hatteras Island (see the discussion in Section 5.2 and the figures in that section).

This evaluation documents the location and characteristics of Section 4(f) properties in the project area, describes the impacts of the detailed study alternatives to the Section 4(f) properties, discusses why no prudent and feasible avoidance alternatives were identified, discusses the alternatives with regard to the least overall harm determination, discusses why there would be no constructive use of Section 4(f) resources, addresses the measures taken to minimize harm, and describes coordination with officials having jurisdiction over all Section 4(f) properties. The following evaluation was performed in compliance with the new Section 4(f) regulations (23 CFR 774) which became effective April 11, 2008.

5.1 Description of Section 4(f) Properties

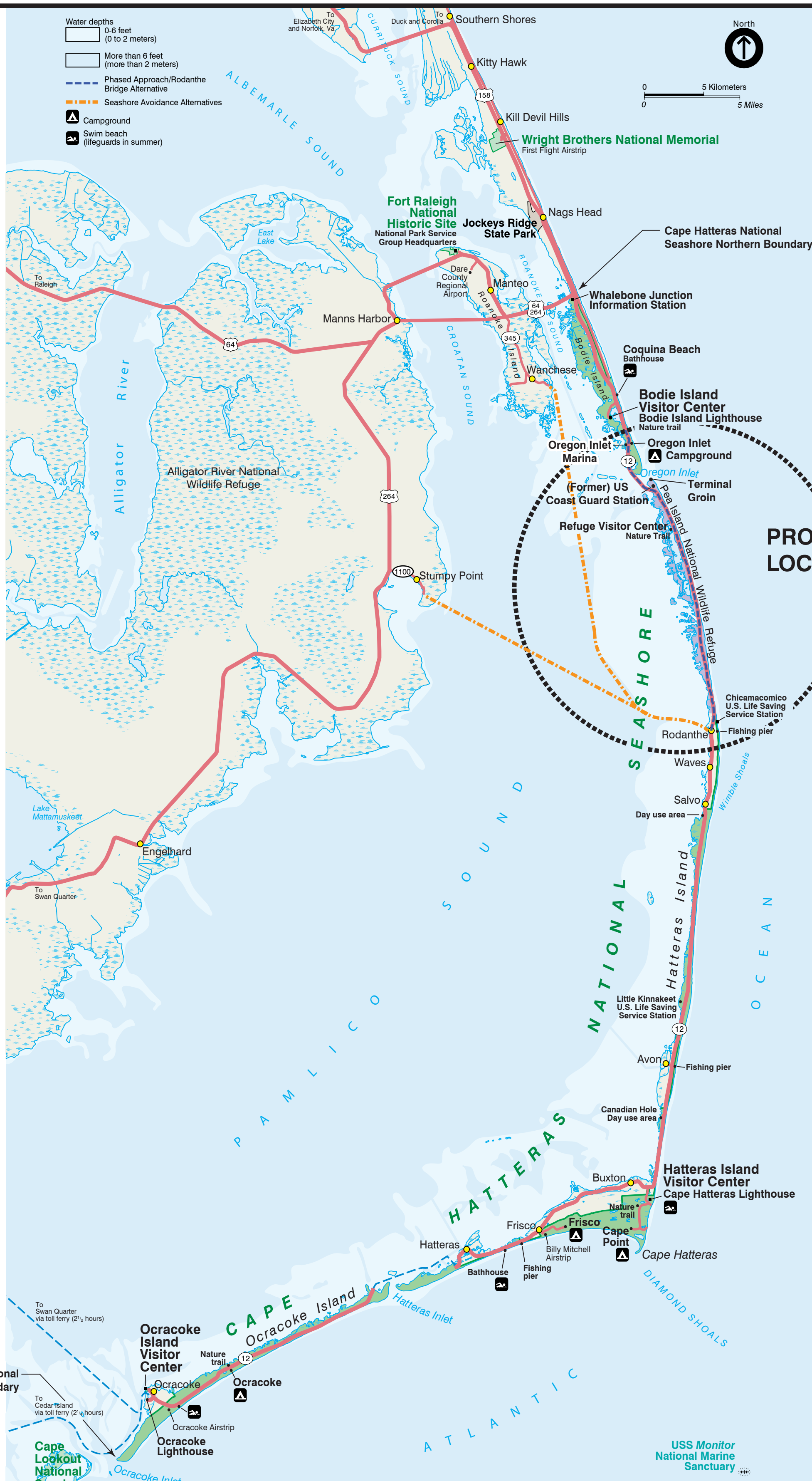
5.1.1 Cape Hatteras National Seashore

The Cape Hatteras National Seashore (the Seashore) in Dare and Hyde counties stretches north to south across three islands: Bodie, Hatteras, and Ocracoke (see Figure 5-1). These barrier islands have a wealth of sand dunes (natural and man-made), marshes, and woodlands. The creation of the Seashore was authorized by Congress in 1937; 21 years later the final parcels were acquired and the Seashore was dedicated. The Seashore has contributed to the area's increase in tourism. It was the first in a series of national seashores established to preserve significant segments of unspoiled barrier islands along the Atlantic and Gulf coasts for the benefit and enjoyment of the people. The Seashore contains 30,319 acres (12,270 hectares) of land and 70 miles (113 kilometers) of open, virtually unspoiled beach. The State of North Carolina donated approximately 10,000 acres (4,047 hectares) of the Seashore's land.

The Seashore is a publicly owned park and recreation area that is owned by the federal government and administered by the National Park Service (NPS). At the south end of Bodie Island, the Seashore boundary follows the mean low water mark along the Atlantic Ocean side. On the Pamlico Sound side, the boundary follows the shoreline until it reaches Oregon Inlet. The Seashore boundary on Hatteras Island, between Oregon Inlet and Rodanthe, extends to the mean low water mark along the ocean-side and extends 150 feet (45.7 meters) from the shoreline into Pamlico Sound on the west side. Figure 5-3 in Section 5.2.1 shows the Seashore boundary in the vicinity of Oregon Inlet. The boundary does not follow the shoreline in the Oregon Inlet area and on southern Bodie Island because it was based on the shoreline location in the 1950s. The NPS and the US Fish and Wildlife Service (USFWS) share management duties where the boundaries of the Seashore overlap with those of the Pea Island National Wildlife Refuge (the Refuge) at the northern end of Hatteras Island. Within the Refuge, the NPS is responsible for visitors and visitor facilities, while the USFWS is responsible for wildlife management.

Eight villages exist within the Seashore's authorized boundaries (seven on Hatteras Island). These villages are neither parklands nor a part of the Refuge and therefore are not protected under Section 4(f). Only one village, Rodanthe, exists within the project area. The villages, the Seashore, and the Refuge are served by NC 12, a hard-surfaced, two-lane road approximately 50 miles (80 kilometers) in length bisecting the Seashore. By act of Congress, the section of the Seashore encompassing the Refuge was to include a road. This road, which connects Rodanthe to Oregon Inlet, was completed in 1953 and was connected to Bodie Island to the north by Bonner Bridge in 1963. The NPS contributed a substantial amount of the funds ($500,000) to construct Bonner Bridge, which was considered a benefit to the Seashore at that time. The roadway, including the bridge, was officially designated as NC 12 in 1963; it is maintained by the North Carolina Department of Transportation (NCDOT) under agreements with the US Department of Interior (DOI). NC 12 is the only road providing motor vehicle traffic through the Seashore. Vehicle access between Bodie Island and Hatteras Island is provided by Bonner Bridge across the Oregon Inlet. The easement for NC 12 is 100 feet (30.5 meters) wide and it is not considered to be a Section 4(f) property.

Access to Ocracoke Island is provided by the Hatteras Inlet ferry between Hatteras Island and Ocracoke Island, as well as by two NCDOT ferry routes operating between Ocracoke Island and the mainland. Ocracoke Island is outside the project area and thus not discussed in detail.



CAPE HATTERAS NATIONAL SEASHORE

Figure 5-1

5.1.1.1 Facilities

Seashore facilities administered by the NPS on Bodie Island are:

- Whalebone Junction Information Station;
- Bookstore;
- Coquina Beach Day Use Facility;
- Bodie Island Visitor Center and Nature Trail;
- Bodie Island Lighthouse;
- Oregon Inlet Campground*; and
- Oregon Inlet Marina and Fishing Center*.

Seashore facilities on Hatteras Island (including those within the Refuge) are:

- Refuge Visitor Center, wildlife trails, and boat ramp*;
- Rodanthe fishing pier;
- Little Kinnakeet US Life Saving Service Station;
- Avon fishing pier;
- Hatteras Island Visitor Center and Nature Trail;
- Cape Hatteras Lighthouse;
- Cape Point Campground and Day Use Facilities;
- Frisco Campground; and
- Frisco area fishing pier.

* Facilities marked with an asterisk (*) are in the project area.

Photographs of several of these facilities are shown in Figure 5-2. The Atlantic Ocean beach south of Whalebone Junction is completely within the Seashore and is open for public use beginning about 5 miles (8 kilometers) south of Whalebone Junction (see Figure 5-1). The Oregon Inlet Marina and Fishing Center, and the Oregon Inlet Campground are the only Seashore facilities near the Parallel Bridge Corridor alternatives (including the Preferred Alternative), the Pamlico Sound Bridge Corridor alternatives, and the Bonner Bridge (see Figure 5-2 and Figure 5-3 in Section 5.2.1). An unpaved beach access road intersects with NC 12 near the Oregon Inlet Marina and Fishing Center. Although not owned or maintained by the NPS, but rather by the NCDOT, catwalks used by fishermen are attached to Bonner Bridge off Hatteras Island. There also are catwalks on the Bodie Island side, but they are now over land and unusable for fishing. A parking lot and a path to the catwalks immediately south of Bonner Bridge are maintained by


1. Oregon Inlet Marina and Fishing Center at Seashore


2. (Former) US Coast Guard Station


3. North Pond in Refuge


4. Refuge Visitor Center


5. North Pond Wildlife Trail in Refuge


6. Refuge Boat Ramp


7. Chicamocomico Life Saving Station


8. Other Buildings at Chicamacomico Life Saving Station

SECTION 4(f) PROPERTIES AND FEATURES

Figure 5-2

the NPS. The Refuge Visitor Center and its associated parking lot, the North Pond Wildlife Trail, and the boat ramp are all located near the Parallel Bridge Corridor alternatives (including the Preferred Alternative) (see also Section 3.5.2, as well as Figure 5-4 in Section 5.2.2).

5.1.1.2 Activities

Visitors to the Seashore enjoy a wide variety of recreational opportunities related to the unique natural, undeveloped, and protected character of the area. The recreational activities on the Seashore lands within the project area include:

- Camping at Oregon Inlet Campground on Bodie Island;
- Ocean fishing excursions from the Oregon Inlet Marina and Fishing Center;
- Surf fishing off Atlantic Ocean beaches;
- Fishing from the catwalks on the south end of Bonner Bridge (owned and maintained by NCDOT);
- Surfing in the Atlantic Ocean;
- Wind-boarding (windsurfing) and kite surfing in Pamlico Sound;
- Walking along the beach;
- Birding and hiking on wildlife trails in the Refuge;
- Visiting the Refuge Visitor Center;
- Cycling along NC 12;
- Fishing from the Rodanthe fishing pier; and
- Driving the "Outer Banks Scenic Byway," which includes NC 12 from Whalebone Junction south through the Seashore.

5.1.1.3 Plans

The *General Management Plan and Amended Environmental Assessment for Cape Hatteras National Seashore* (NPS, 1984) and the *Draft Revised Statement for Management* (NPS, 1991) serve as the NPS plans for the Seashore. These plans are described in Section 3.1.3.3.

5.1.2 Pea Island National Wildlife Refuge

The Pea Island National Wildlife Refuge (the Refuge), located within the Seashore, is a Section 4(f) property. In addition, it also is a significant publicly owned recreation area and a significant historic site eligible for inclusion on the NRHP.

The Refuge was established in 1938 by President Franklin Roosevelt through Executive Order 7864. The Refuge was created in recognition of the importance of the area for wildlife. Executive Order 7864 reserved the area for migratory birds and other wildlife to advance the purposes of the Migratory Bird Conservation Act of 1929. The Refuge was named for the once-abundant dune peas in the area that attracted waterfowl. The Refuge was developed by Civilian Conservation Corps (CCC) projects in the 1930s. The Refuge is owned by the federal government and administered by the USFWS.

The primary purpose of the Refuge is to serve as a refuge and breeding ground for migratory birds and other wildlife. Refuge objectives are to:

- "Provide nesting, resting, and wintering habitat for migratory birds, including the greater snow geese and other migratory waterfowl, shorebirds, wading birds, raptors, and neotropical migrants.

- Provide habitat and protection for endangered and threatened species.

- Provide opportunities for public enjoyment of wildlife and wildlands resources. Public use programs focus on interpretation, environmental education, wildlife observation, wildlife photography, and fishing." (Pea Island National Wildlife Refuge web site, August 18, 2008.)

Executive Order 7864 also established a boundary for the Refuge, which extends to the mean high tide level on both sides of Hatteras Island. The northern boundary of the Refuge extends to Oregon Inlet and the southern boundary is immediately adjacent to private properties in Rodanthe (see Figure 3-1a through Figure 3-1c in Section 3.1.2). The Refuge contains 5,834 acres (2,361 hectares) of land. Proclamation Boundary Waters also were established in 1938 around the Refuge but are not a part of the Refuge. This is an area that extends into Pamlico Sound to protect migratory birds from hunters in areas adjacent to the Refuge. The Proclamation Boundary Waters cover approximately 25,700 acres (10,400 hectares) of Pamlico Sound. The USFWS Refuge has a Memorandum of Agreement (MOA) with the NPS to manage the parking lots and comfort station on Hatteras Island. The USFWS is responsible for the natural resources management within the Refuge.

The Refuge is comprised of ocean beach, dunes, upland, fresh and brackish water ponds, salt flats, and salt marsh (see Figure E-2 in Appendix E). Its bird list boasts more than 365 species; its wildlife list has 25 species of mammals, 24 species of reptiles, and five species of amphibians. Concentrations of ducks, geese, swans, wading birds, shore birds, raptors, and neotropical migrants are seasonally abundant in the Refuge. The Refuge has 1,000 acres (404.7 hectares) of manageable waterfowl impoundments. Several shorebird nesting areas and wading bird rookeries are on the Refuge. Endangered and threatened species include peregrine falcons, loggerhead sea turtles, and piping plovers (Pea Island National Wildlife Refuge web site, August 18, 2008).

The Refuge was also found to be eligible for the NRHP. It is eligible under Criterion A of the National Historic Preservation Act of 1966, as amended, in the areas of conservation and social history. The Refuge is an outstanding example of the national wildlife refuges that were created during the early twentieth century. With its manmade dikes and dunes, the Refuge also illustrates the efforts of the CCC on the Outer Banks to protect and revitalize natural resources. The US Congress established the CCC in 1933 during the Great Depression to employ young men in the conservation and development of natural resources. The original dunes constructed by the CCC no longer exist because of natural processes; however, they have been artificially maintained by NCDOT to protect the road and are still considered by the North Carolina State Historic Preservation Officer (SHPO) to be representative of the activities of the CCC. The original dikes still exist but have been altered over time. The eligibility determination was made by the

NCDOT and affirmed by the SHPO. A letter dated September 17, 2003 from the SHPO that affirms the above finding is contained in Appendix A.

Like for the Seashore, NC 12 provides the primary access to and through the Refuge. NC 12 runs the full length of the Refuge south to north, as decreed by Act of Congress. The length of NC 12 (south to north) within the Refuge between Rodanthe and Oregon Inlet is approximately 11.8 miles (19.0 kilometers). The width of the Refuge ranges from 0.25 mile (0.4 kilometer) to 1 mile (1.6 kilometers) from east to west (see Figure 5-4a and Figure 5-4b in Section 5.2.2).

5.1.2.1 Facilities

Facilities within the Refuge are:

- Salt Flats and North Pond Wildlife Trails*;
- Refuge Visitor Center*;
- Fishing catwalks at Oregon Inlet;
- A boat ramp;
- Seven parking lots; and
- Headquarters buildings*.

*Facilities marked with an asterisk (*) are managed by the USFWS.

Several of these facilities are illustrated in Figure 5-2 and their locations are shown in Figure 5-4a and Figure 5-4b in Section 5.2.2. The beach is open to the public.

5.1.2.2 Visitors and Their Activities

Based on traffic counts, the Refuge receives 2.7 million visitors annually (Pea Island National Wildlife Refuge web site, August 18, 2008). Most vehicles, however, only pass through the Refuge to and from other destinations on Hatteras Island. Refuge management estimated the number of visitors with the Refuge as a destination to be about 420,000 persons in 2003 and 540,000 persons in 2004. The peak-season for visitors to the Refuge is June through October. During the summer peak-season, many families visit the Refuge to participate in typical beach activities. The peak-season for birding is in the fall, but it is also popular in the spring and winter. The peak-season for fishing is also in the fall. All activities in the Refuge during the winter are weather dependent; on many cold and windy days, there is little activity in the Refuge, but nice winter days can be relatively active. Weekends are not necessarily the busiest times in the Refuge because many locals use the Refuge during the week to conduct their activities, including participating in Refuge sponsored programs during the week (Friday is the busiest day for Refuge programs). In particular, retirees and birders visit the Refuge during the week. “Wings over Water” is a program put on by the Refuge staff for birders and other wildlife enthusiasts each fall. It is a large program that visitors come to the Outer Banks specifically to participate in, as opposed to many of the Refuge’s other programs that people tend to find out about and participate in while visiting the Outer Banks for other reasons.

5.1.2.3 Administrative and Management Law

The National Wildlife Refuge System Administration Act of 1966 created and provides for the administration and management of the National Wildlife Refuge System (NWRS). This system includes wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.

The National Wildlife Refuge System Improvement Act of 1997 amends and builds upon the 1966 act to ensure that the NWRS is managed as a national system of related lands, waters, and interests for the protection and conservation of our nation's wildlife resources. The 1997 Act further defines the mission of the NWRS as to "administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." The 1997 Act also requires the US Secretary of the Interior to ensure the biological integrity, diversity, and environmental health of the NWRS is maintained, and it defines compatible wildlife-dependent recreation as "legitimate and appropriate general public use of the System." It establishes hunting, fishing, wildlife observation and photography, and environmental education and interpretation as "priority public uses" where compatible with the mission and purpose of individual national wildlife refuges. The 1997 Act also retained the refuge managers' authority to use sound professional judgment in determining compatible public uses on national wildlife refuges and whether or not they will be allowed, and established a formal process for determining "compatible use." Proposed uses must be concurrently evaluated for compatibility with refuge goals, objectives, and the refuge's establishing legislation. This evaluation, known as a Compatibility Determination, also requires public notice and comment. However, the 1997 Act was not intended "to in any way change, restrict, or eliminate" existing road right-of-ways within refuges.

The USFWS manages the Pea Island National Wildlife Refuge. As a first priority, federal law and regulation require the Refuge manager to ensure that all uses of the Refuge are compatible with Executive Order 7864 and the National Wildlife Refuge System Improvement Act of 1997, and that any allowed use of the Refuge be compatible with the mission ("wildlife first") and purpose of the Refuge.

5.1.2.4 Plan

The USFWS prepared a *Comprehensive Conservation Plan* (USFWS, 2006) to guide the management of the Refuge. The plan, which was published in September 2006, outlines programs and corresponding resource needs for the proceeding 15 years, as mandated by the National Wildlife Refuge System Improvement Act of 1997. The purpose of the plan is to identify the role that the Refuge will play in support of the mission of the National Wildlife Refuge System and to provide long-term guidance to the Refuge's management programs and activities. The plan is further described in Section 3.1.3.4.

5.1.3 (Former) Oregon Inlet US Coast Guard Station

The (former) Oregon Inlet US Coast Guard Station at the northern end of Hatteras Island is listed in the NRHP under Criterion A for maritime and social history and Criterion C for architecture. Built in 1898, the station was part of a 19th century initiative to establish life saving stations along the length of the Outer Banks. Small settlements for the life saving crews and their families grew up around the stations. The Oregon Inlet Station—as it was constructed in 1898—was similar, but not identical, to other stations built along the Outer Banks during that period.

The US Coast Guard no longer uses the structure and does not plan to return to it. The State of North Carolina owns the building, and the North Carolina Aquarium Society (part of the North Carolina Department of Environment and Natural Resources [NCDENR]) oversees its operations and maintenance. The structure today is surrounded by sand on three sides and is in deteriorating condition. The North Carolina Aquarium Society let a project for bidding in July 2008 to stabilize the structure, remove the modern dormitory attached to the building, and restore the exterior. The objective of this contract would be to stabilize the structure until final decisions are made regarding the Bonner Bridge replacement project. If the terminal groin were removed, much of the northern end of Hatteras Island in the vicinity of Oregon Inlet, including the site of the (former) Oregon Inlet US Coast Guard Station, would be threatened by island erosion and likely would be lost to that erosion (see Section 3.6.3.5 for a discussion of the short- and long-term impacts of the removal of the terminal groin on Oregon Inlet and the northern end of Hatteras Island).

5.1.4 Rodanthe Historic District and Chicamacomico Life Saving Station

5.1.4.1 Rodanthe Historic District

The Rodanthe Historic District is eligible for the NRHP under Criterion A for social history. The string of early twentieth century houses originally built by early fisherman and merchants, the Chicamacomico Life Saving Station at Rodanthe, and the fish house on Rodanthe harbor, are rare illustrations of life in the pre-tourism age of the mid- to late-twentieth century. The metamorphosis of Dare County from an area of small, largely isolated, fishing villages to a tourist destination of international renown has almost completely eliminated any vestige of life on the Outer Banks before the late-twentieth century. The Rodanthe Historic District is also eligible under Criterion C for architecture. The contributing elements in the historic district have maintained its architectural integrity commensurate with the original setting of the village. The Rodanthe Historic District was found eligible by the NCDOT and affirmed by the SHPO (see Section 3.4.1.3 for additional information).

The boundaries for this small NRHP-eligible historic district encompass the greatest concentration of substantially intact historic resources in Rodanthe (see Figure 5-5 in Section 5.2.4). The Rodanthe Historic District encompasses approximately 17.1 acres (6.9 hectares). The following six buildings and associated resources were included in the district: the Levene W. (or Levine) Midgett House; the J. Frank Meekins Fish House; the (former) Rodanthe School (non-contributing); the Chicamacomico Life Saving Station; the Cornelius P. Midgett (or Payne) House, on its new site minus its boathouse and cemetery; and the John Allen Midgett House. The components of the district generally line the east and west sides of NC 12, in the Myrna Peters Road and Midgett Drive area. Descriptions of the contributing resources are in Section 3.4.1.3.

5.1.4.2 Chicamacomico Life Saving Station

The Chicamacomico Life Saving Station is illustrative of a property type unique to the Outer Banks (see Figure 5-2). Listed on the NRHP in 1976, Chicamacomico is the most complete of any of the life saving stations built along the North Carolina barrier islands. In addition to its original 1874 board-and batten station and 1911 shingle-style facility, Chicamacomico contains a detached frame kitchen, cisterns, a flag tower, and several frame boathouses, all of which are well-preserved. Surrounding the life saving station are several houses, including the Cornelius P.

Midgett House. The Chicamacomico Life Saving Station site illustrates both the persistence of traditional local architecture and the introduction of nationally popular architectural designs during the early-twentieth century in Dare County.

The Chicamacomico Life Saving Station is owned by the Chicamacomico Historical Association. The station is operated as a museum. It is open from mid-April through November, though the operational months may be extended in the near future. Future plans for the station include: restoration of the 1874 station house; construction of a museum building to house the growing collections; continued research; expansion of the programming, living history displays, and physical facilities; and creation of two separate historic interpretive areas on-site.

5.2 Use of Section 4(f) Properties

There are three types of use: permanent, temporary, and constructive. A Section 4(f) property "use" is defined in regulations (23 CFR 774.17) as:

1. When land is permanently incorporated into a transportation facility;

2. When there is a temporary occupancy of land that is adverse in terms of the statute's preservation purpose as determined by the criteria within 23 CFR 774.13(d); or

3. When there is a constructive use of Section 4(f) property as determined by the criteria within 23 CFR 774.15.

All project alternatives were reviewed to determine if they included one or more of these types of use. All of the Parallel Bridge Corridor alternatives, as well as the Pamlico Sound Bridge Corridor alternatives, include the permanent incorporation of Seashore land at the site of the new bridge over Oregon Inlet. All of the replacement bridge corridor alternatives, except for the Phased Approach/Rodanthe Bridge Alternative (Preferred) and the Pamlico Sound Bridge Corridor alternatives, would include additional uses of Section 4(f) properties. There are no adverse temporary uses of Section 4(f) properties with any of the alternatives; construction activities would occur within existing or acquired right-of-way/easement. Also, it was determined that there is not a constructive use of any Section 4(f) properties with the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) (see Section 5.5 for additional discussion of constructive use). Additional discussion on the use of Section 4(f) properties follows.

5.2.1 Cape Hatteras National Seashore on Bodie Island

5.2.1.1 Parallel Bridge Corridor Alternatives – Including the Phased Approach/Rodanthe Bridge Alternative (Preferred)

The Parallel Bridge Corridor alternatives include five different alternatives:

1. Nourishment;

2. Road North/Bridge South;

3. All Bridge;

4. Phased Approach/Rodanthe Bridge (Preferred); and

5. Phased Approach/Rodanthe Nourishment.

These alternatives are shown in relation to the Seashore on Bodie Island in Figure 5-3.

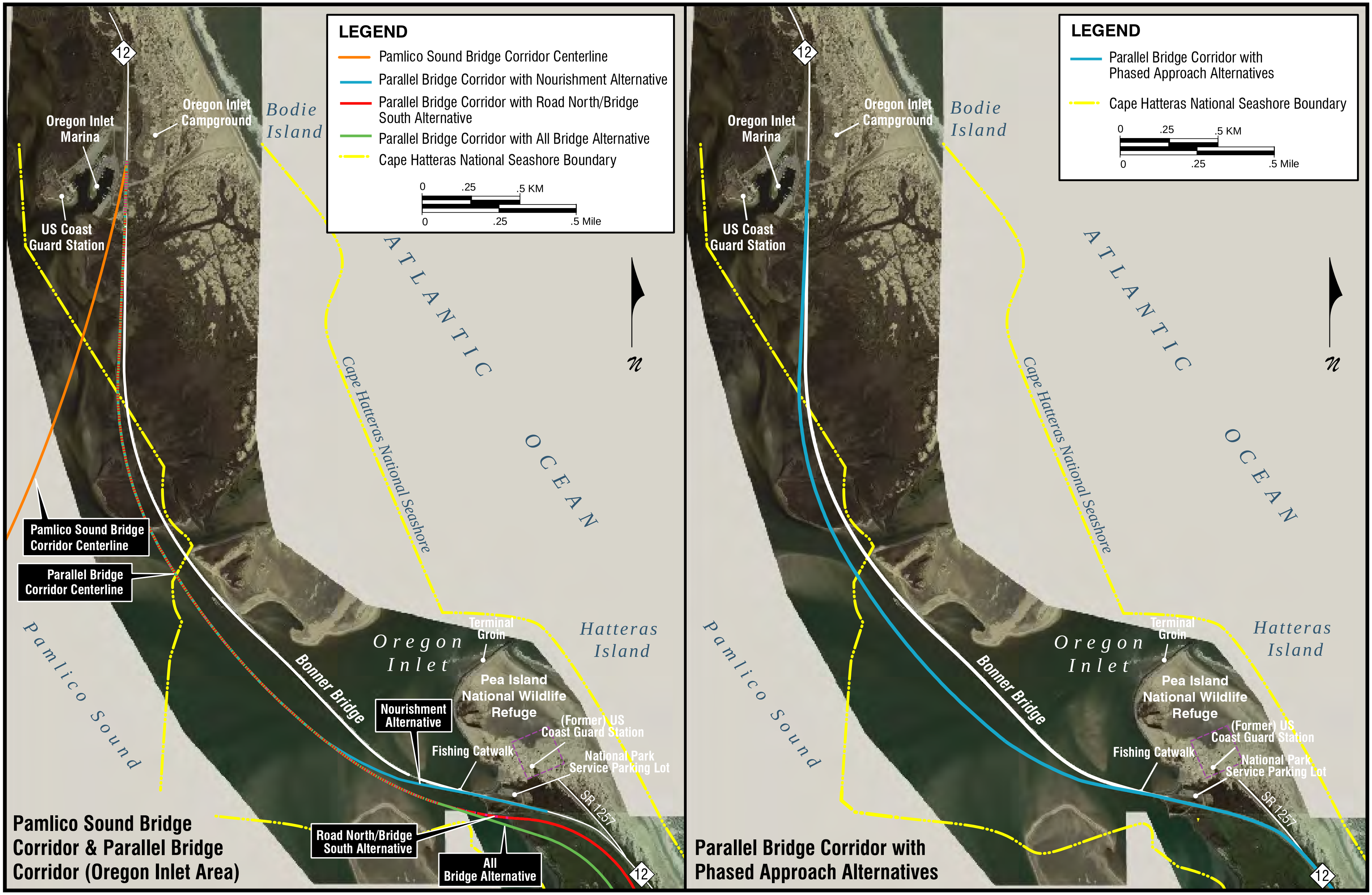
All of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would require the permanent use of land from the Cape Hatteras National Seashore (the Seashore) on Bodie Island, adjacent to Oregon Inlet. Figure 5-3 shows the Parallel Bridge Corridor alternatives (including the Preferred Alternative). All Parallel Bridge Corridor alternatives would use approximately 6.3 acres (2.6 hectares) of Seashore land at the northern terminus of the proposed project on Bodie Island. It is the same 6.3 acres (2.6 hectares) for all of the Parallel Bridge Corridor alternatives. No Seashore land would be used on Hatteras Island (except in the area of the Seashore that also includes the Refuge, which is discussed in Section 5.2.2) or on Ocracoke Island under any of the Parallel Bridge Corridor alternatives.

On Bodie Island, the Bonner Bridge and NC 12 occupy approximately the same amount of land as would be used by any of the Parallel Bridge Corridor alternatives (including the Preferred Alternative). This land would be returned to the Seashore after the bridge is demolished and removed. Thus, the permanent use of approximately 6.3 acres (2.6 hectares) of the Seashore on Bodie Island under any of the Parallel Bridge Corridor alternatives is approximately equal to the 6.3 acres (2.6 hectares) of existing Seashore land that would be returned to the Seashore upon demolition of the existing bridge, resulting in no net gain or loss of Seashore lands by any of the Parallel Bridge Corridor alternatives.

As seen in Figure 5-3, the Oregon Inlet Marina and Fishing Center and the Oregon Inlet Campground are Seashore facilities within the replacement bridge project area on Bodie Island. The existing intersection between NC 12 and the Oregon Inlet Marina and Fishing Center driveway would be retained. As described in Section 4.5.1, with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) NC 12 would be relocated slightly west of its existing location in the vicinity of the driveways to the Oregon Inlet Marina and the Oregon Inlet Campground, but the driveways themselves would not be relocated and access to these facilities would not be affected. There is a septic system leach field used by the Oregon Inlet Marina adjacent to the west side of NC 12 to the south of the Oregon Inlet Marina driveway. The exact location of this leach field is not known, but if it is determined during final design that the proposed project would impact the leach field, it would be moved to an appropriate adjacent location so that Oregon Inlet Marina operations would not be affected. Access to all Seashore facilities on Bodie Island would be retained; additional discussion is in Section 4.5.3.

No substantial changes in views from the Seashore and its activities would occur (see Section 4.3.3). The Parallel Bridge Corridor alternatives (including the Preferred Alternative) would be approximately 26 feet (7.9 meters) to 62 feet (18.9 meters) closer to the Oregon Inlet Marina than the Bonner Bridge, with the lower distance being at the Marina entrance. The change increases to the 62 feet (18.9 meters) as the project proceeds south. Thus, the scale of the proposed project in relation to the marina would be slightly greater than that of Bonner Bridge.

Charter fishing boats operating out of the Seashore's Oregon Inlet Marina and Fishing Center follow an unmarked natural channel known as Bridge to Old House Channel (or known more commonly as the "crack") to reach the navigation span of Bonner Bridge instead of the Oregon Inlet Channel/Old House Channel maintained by the US Army Corps of Engineers (USACE). (Figure 3-7 shows the location of channels in the Oregon Inlet area.) On a peak day,



USE OF AND RELATIONSHIP TO SECTION 4(f) PROPERTIES NEAR OREGON INLET

Figure 5-3

approximately 130 charter vessels travel via “the crack.” Following “the crack” shortens the distance traveled by vessels operating between the fishing center and the Bonner Bridge’s navigation span from approximately 5 miles (8 kilometers) to about 2.5 miles (4.0 kilometers). As illustrated in Figure 3-7, the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would cross “the crack” as the bridge moves south across Oregon Inlet. Since charter fishing boats require as much as 30 feet (9 meters) of clearance, the proposed project would block these vessels from traveling along “the crack” and increase the time it takes for these vessels to travel from the fishing center to the ocean since they would need to follow the Oregon Inlet Channel/Old House Channel maintained by the USACE. The travel time to the ocean from the fishing center would be approximately 30 minutes longer via Oregon Inlet Channel/Old House Channel than via “the crack” according to Marina management. Crossing “the crack” with the Parallel Bridge Corridor alternatives (including the Preferred Alternative) cannot be avoided because “the crack” runs adjacent to and parallel to Bonner Bridge for part of its length. This increased travel time does not constitute a use of a Section 4(f) property, but it does represent an impact on people who travel by boat between the Marina and Oregon Inlet.

Carbon monoxide (CO) levels exceeding the National Ambient Air Quality Standards (NAAQS) would not be generated by the any of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) (see Section 4.9 for further discussion of air quality impacts).

The noise level and abatement analysis for the Parallel Bridge Corridor alternatives (including the Preferred Alternative) is discussed in Section 4.10 and indicates that Federal Highway Administration (FHWA) Noise Abatement Criteria (NAC) would not be exceeded at sensitive receptors in the Seashore on Bodie Island (see also Figure 4-2 and Table 4-31). The analysis also indicates that there would not be a substantial increase in noise levels at these receptors. Therefore, no traffic noise abatement would be needed at park facilities.

No new facilities or activities are planned by the NPS near the Bodie Island end of the Parallel Bridge Corridor alternatives (including the Preferred Alternative).

5.2.1.2 Pamlico Sound Bridge Corridor Alternatives

The Pamlico Sound Bridge Corridor alternatives (see Figure 5-3) would use approximately 7.3 acres (3.0 hectares) of the Seashore on Bodie Island. Like the Parallel Bridge Corridor alternatives, the approximately 6.3 acres (2.6 hectares) of the Seashore currently in use by the Bonner Bridge, would be returned to the Seashore upon the construction of the new bridge and the demolition of the old. This would result in a net use of 1.0 acre (0.4 hectare) of the Seashore lands on Bodie Island.

Other than a larger permanent use of Seashore properties, the impacts to Seashore facilities are similar to those discussed for the Parallel Bridge Corridor alternatives above, and there would be no substantial impact because of noise or carbon monoxide. A replacement bridge in the Pamlico Sound would be visible for a greater distance than Bonner Bridge given its longer length and height; however, it would appear as a thin line on the horizon as it would be located several miles to the west. Access to Seashore facilities would be retained.

No new facilities or activities are planned by the NPS near the Bodie Island end of the Seashore within the project area for the Pamlico Sound Bridge Corridor alternatives.

5.2.2 Pea Island National Wildlife Refuge/Cape Hatteras National Seashore on Hatteras Island

5.2.2.1 Parallel Bridge Corridor Alternatives – Including the Phased Approach/Rodanthe Bridge Alternative (Preferred)

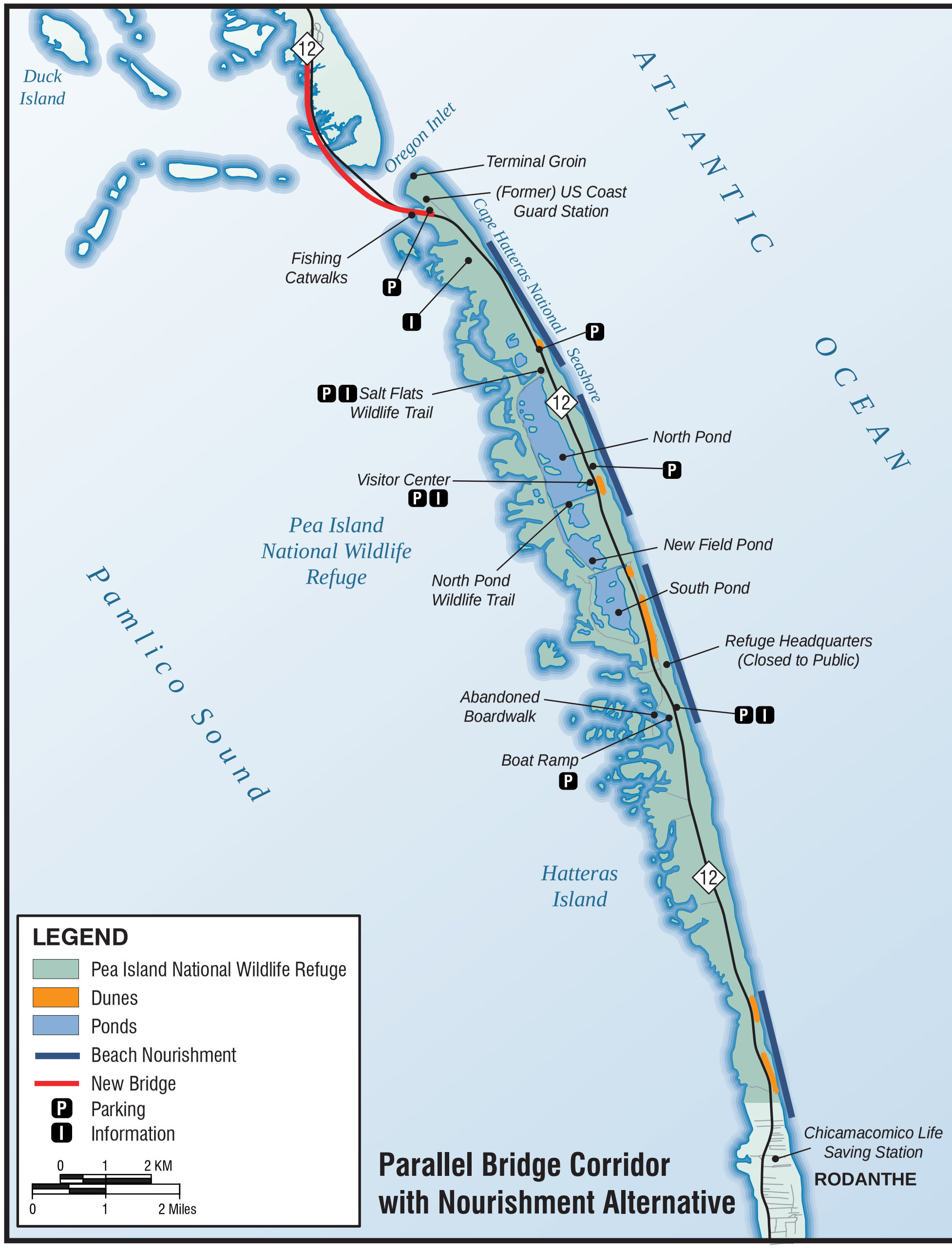
All of the Parallel Bridge Corridor alternatives, except for the Phased Approach/Rodanthe Bridge Alternative (Preferred), would have different uses of property from the Pea Island National Wildlife Refuge (the Refuge) on Hatteras Island. As discussed earlier, the Refuge is also part of the Cape Hatteras National Seashore (the Seashore).

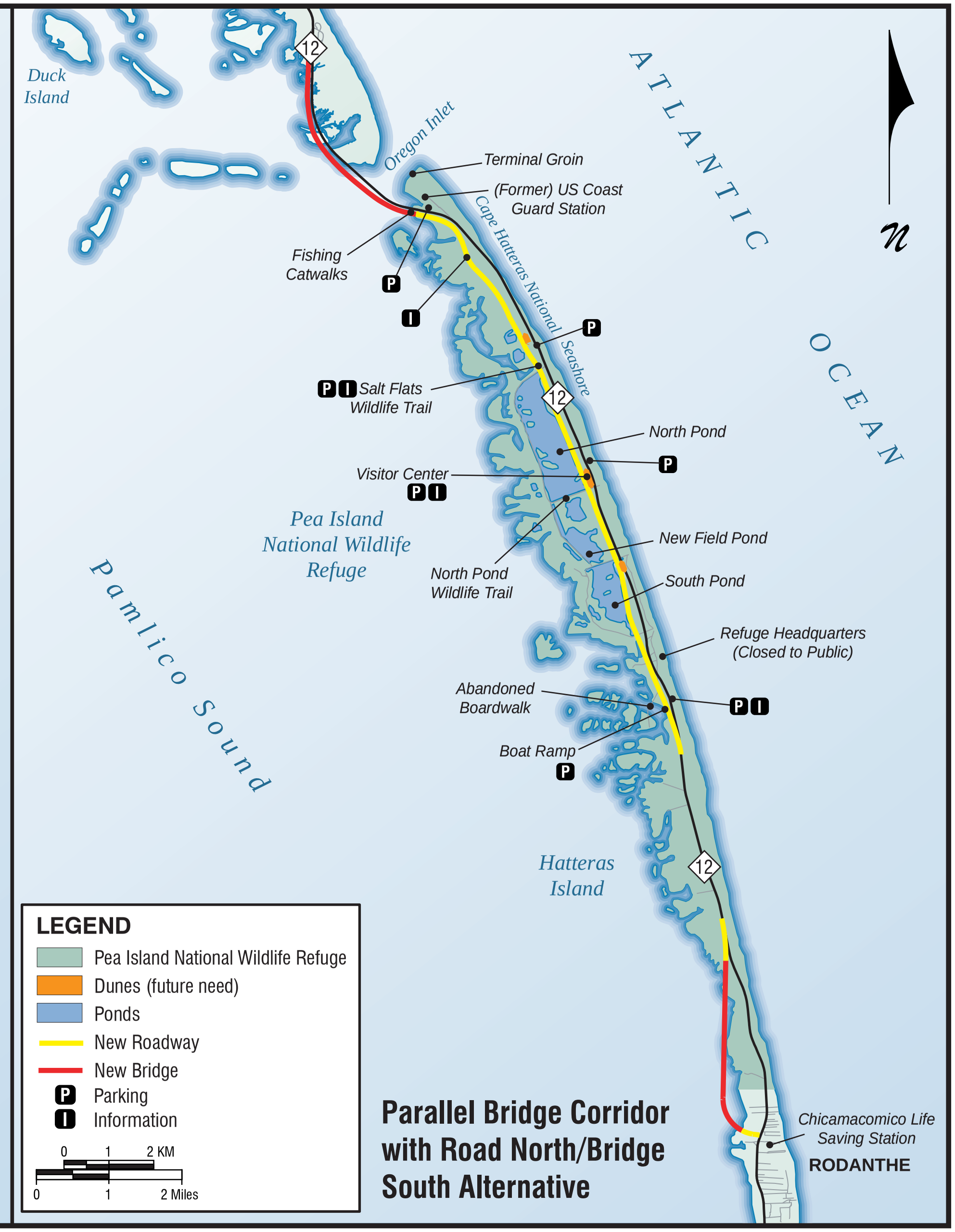
With the Nourishment Alternative, 19.7 acres (8.0 hectares) of Section 4(f) property associated with newly constructed dunes, plus nourishment of 6.3 miles (10.1 kilometers) of the Seashore within the Refuge would be required (see Figure 5-4a). A new access road to the Oregon Inlet area parking lot would require an additional 0.2 acre (0.07 hectare) of new right-of-way. NC 12 would remain in its existing easement. The Nourishment Alternative would have No Adverse Effect on the refuge as a historic resource, because the new dunes would be on the east side of NC 12 and the existing dikes and ponds would remain (see Section 4.4.1.2). Given that dunes are already present within the Refuge, the addition of new dunes would not represent a visual intrusion.

The Road North/Bridge South Alternative would require the use of 90.3 acres (36.6 hectares) of Section 4(f) property to establish a new 100-foot (30.5-meter) wide right-of-way to relocate NC 12 as a roadway and as a bridge (see Figure 5-4a). Approximately 2,961 feet (903 meters) of new bridge would be built over the Refuge. This alternative would also require a new access road to the Oregon Inlet parking area and 0.2 acre (0.07 hectare) of right-of-way would be needed, similar to the Nourishment Alternative. An additional 2.9 acres (1.2 hectares) also would be required for the construction of three new dunes. The Road North/Bridge South Alternative would have an Adverse Effect on the Refuge as a historic resource because the relocation of NC 12 would intrude up to 700 feet (213 meters) into the existing dikes and ponds (see Section 4.4.1.2). No long distance views would be blocked or altered. Vegetation that was disturbed with the construction of the new road would be restored upon completion. The long-term visual impact of this alternative would be minimal as it is similar to the natural changes in the current landscape resulting from beach erosion and ocean overwash.

The All Bridge Alternative would require the use of 89.6 acres (36.2 hectares) of Section 4(f) property to establish a new 100-foot (30.5-meter) wide right-of-way that would be used for the relocated NC 12 and new bridge (see Figure 5-4b). Approximately 7.6 miles (12.2 kilometers) of bridge would be built within the Refuge. A new access road to the Oregon Inlet area parking lot would necessitate 2.6 acres (1.1 hectares) of new right-of-way. The All Bridge Alternative would also have an Adverse Effect on the Refuge as a historic resource because the elevation of NC 12 on a bridge would place NC 12 over the existing dikes and ponds. The bridge would present a contrast with the natural character of the Refuge. The bridge would dominate views from the dunes lining the beach and, as the dunes disappear over time, it would also dominate views from the beach. It would also dominate views from the wildlife trails along the Refuge's ponds, interrupting the undeveloped and protected character of the Refuge that makes it rare along the eastern US seaboard in terms of views and a setting for recreation activities.

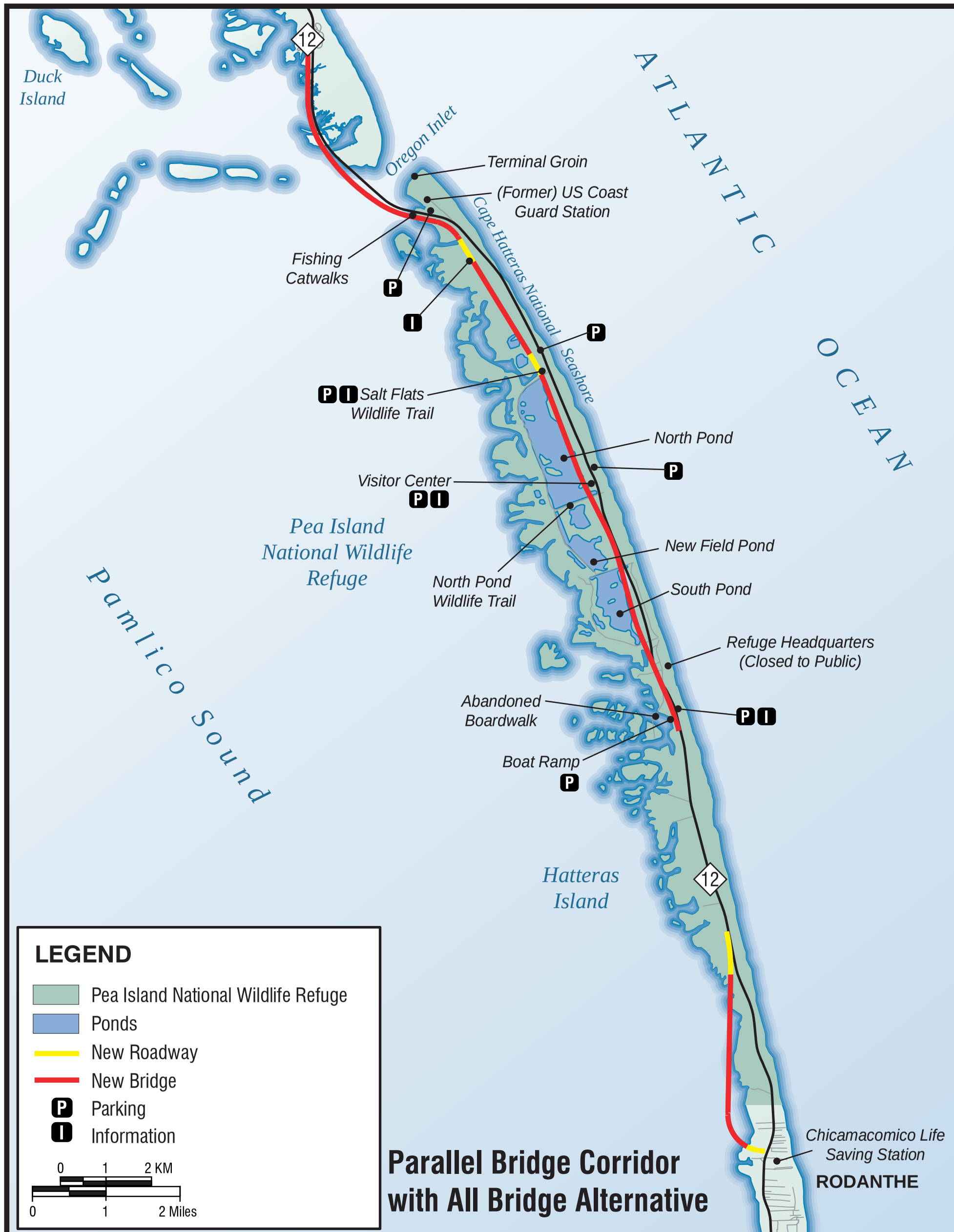
The visual impacts of both of the Phased Approach alternatives (including the Preferred Alternative) are described in Section 4.3.2. The Phased Approach alternatives (including the Preferred Alternative) would introduce a sizable new linear man-made feature for approximately 10 miles (16.1 kilometers) through the Refuge. NC 12 through most of the Refuge would be elevated on a bridge within the existing easement.

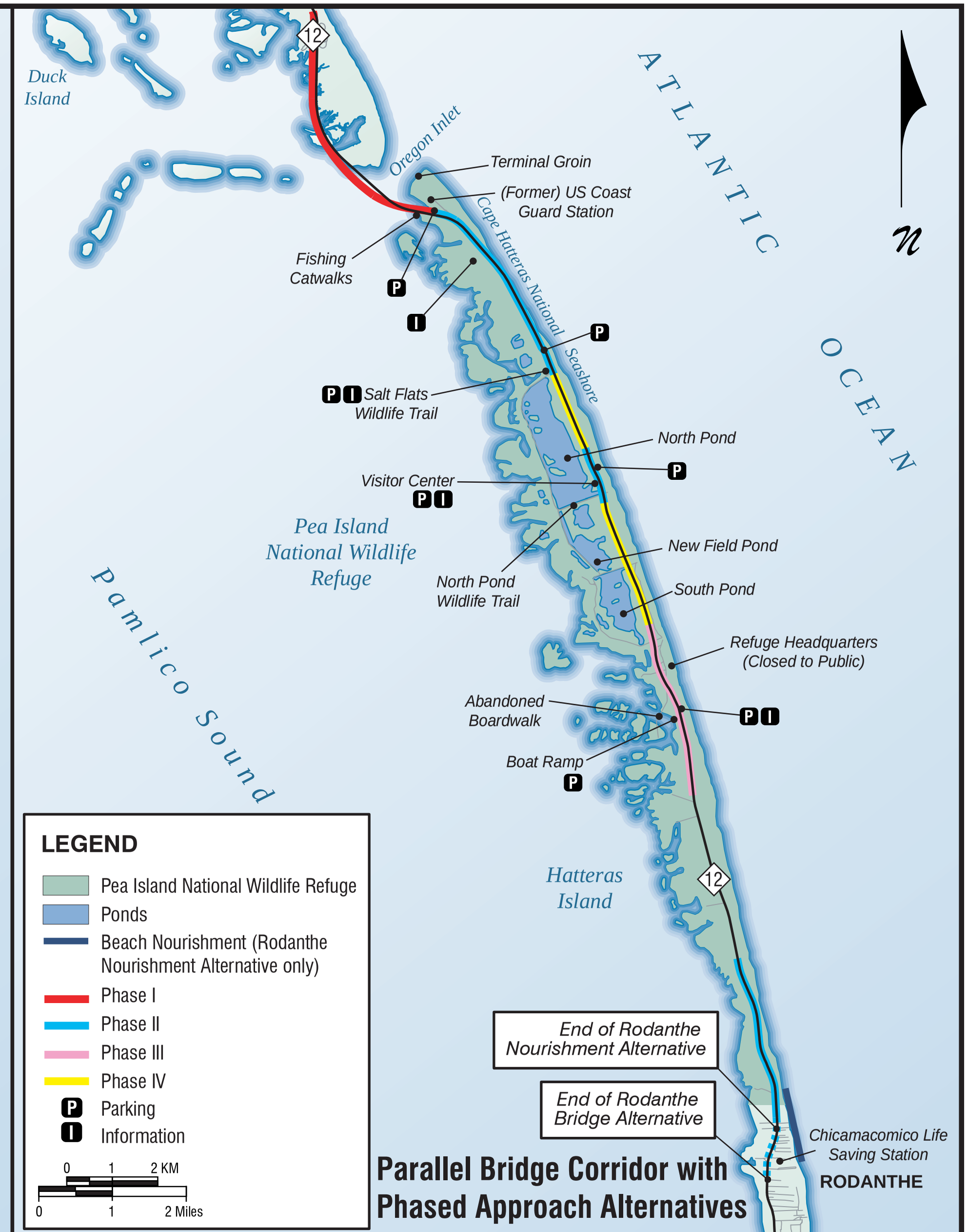




USE OF AND RELATIONSHIP TO SECTION 4(f) PROPERTIES

Figure 5-4a





USE OF AND RELATIONSHIP TO 4(f) PROPERTIES

Figure 5-4b

The bridge would be at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (approximately 30 feet [9.1 meters] above ground), allowing for the bottom of the superstructure to be a minimum of 25 feet (7.6 meters) above mean high water (see Figure 2-24). This is 15 feet (4.6 meters) higher than the height assumed for the All Bridge Alternative. Like the All Bridge Alternative, the bridge would present a contrast with the natural character of the Refuge. The bridge would dominate views from the dunes lining the beach and, as the dunes disappear over time, it also would dominate views of the beach and ultimately the ocean. It would not be characteristic of the undeveloped and protected character of the Refuge that makes it rare along the eastern US seaboard in terms of views and a setting for recreation activities.

The Phased Approach/Rodanthe Nourishment Alternative would use 1,500 feet (457.2 meters) of beach within the Refuge for beach nourishment activities (see Figure 5-4b). This alternative would also have an Adverse Effect on the Refuge as a historic resource because of the elevation of NC 12 on bridges as it passes through the historic Refuge landscape.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would not require the use of any property from the Refuge because it would be constructed and maintained entirely within the NCDOT's existing NC 12 easement (see Figure 5-4b). While the Phased Approach/Rodanthe Bridge Alternative (Preferred) would have an Adverse Effect on the Refuge as a historic resource because of the introduction of bridges as it passes through the historic Refuge landscape, the protected activities, features, and attributes of the Refuge would not be substantially impaired, and thus there would not be a constructive use of the Refuge (also see Section 5.5). All of the Parallel Bridge Corridor alternatives, except for the Phased Approach/Rodanthe Bridge Alternative (Preferred), would result in a permanent use of Refuge lands outside of the existing easement.

As described in Section 4.1.4.2, all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would maintain road access to the Refuge and its beaches. Section 4.5.3.1 provides specific discussion related to accessibility of Refuge facilities by the Parallel Bridge Corridor alternatives. The Nourishment Alternative would change the location of access to the fishing parking lot near Oregon Inlet; all other recreational facilities would remain accessible. Refuge access would be maintained in an altered format with the Parallel Bridge Corridor with Road North/Bridge South Alternative. Trail and beach access would be altered as NC 12 would be moved westward in the northern part of the Refuge, and the Rodanthe area bridge would bypass the southern 1.6 miles (2.6 kilometers) of the Refuge land near Rodanthe. The All Bridge Alternative would reduce Refuge access so that there would be only three locations to access Refuge facilities from NC 12. Access would be provided at the northern end of the Refuge near the catwalks parking lot, at the entrance to the Salt Flats Wildlife Trail to the north of the ponds, and south of the ponds. The All Bridge Alternative also would bypass the Refuge Visitor Center, the North Pond Trail, the Refuge headquarters, and the boat ramp. When completed, the bridges associated with both of the Phased Approach alternatives (including the Preferred Alternative) would limit access to the Refuge and to the beach to two locations off of NC 12; one access point would be at the catwalks parking lot at the northern end of the Refuge via access ramps constructed during Phases I and II. The second access point would be within the stable area south of the ponds. The two Phased Approach alternatives (including the Preferred Alternative) would bypass the Refuge Visitor Center, two trails, the Refuge headquarters, and the boat ramp. Access to the ocean and to the beach would be limited to the two access points. Figure 5-4a and Figure 5-4b show the Refuge access points for each of the alternatives.

CO levels exceeding the NAAQS would not be generated by the any of the Parallel Bridge Corridor alternatives (see Section 4.9 for further discussion of air quality impacts).

The noise level and abatement analysis for the Parallel Bridge Corridor alternatives is discussed in Section 4.10 and indicates that FHWA NAC would not be exceeded in the Refuge (see also Figure 4-2 and Table 4-31). Therefore, no traffic noise abatement would be needed at Refuge facilities.

No new facilities or activities are planned by the USFWS on the Hatteras Island side of the Parallel Bridge Corridor alternatives.

5.2.2.2 Pamlico Sound Bridge Corridor Alternatives

The Pamlico Sound Bridge Corridor alternatives would require no use of the Refuge, as they are not within the Refuge boundaries. In addition, the Pamlico Sound Bridge Corridor alternatives would have No Adverse Effect on the Refuge as a historic resource. The Pamlico Sound Bridge Corridor is not within the Refuge and is far enough from the Refuge to have no adverse visual effect.

The Pamlico Sound Bridge Corridor alternatives would eliminate access via a paved road to and from the Refuge, as NC 12 through the Refuge would not be maintained upon the completion of the Pamlico Sound Bridge. However, the USFWS and NPS would likely continue to provide some type of access to the Seashore and the Refuge for recreational users. Section 4.5.3.1 provides specific discussion relating to accessibility of Refuge facilities by the Pamlico Sound Bridge Corridor alternatives. While the loss of NC 12 would inconvenience Refuge visitors, the USFWS' view is that the primary purpose of the Refuge is not for recreation but to serve as a breeding ground and refuge for migratory birds and other wildlife, and that adequate access can be provided without a paved road.

CO levels exceeding the NAAQS would not be generated by the any of the Pamlico Sound Bridge Corridor alternatives (see Section 4.9 for further discussion of air quality impacts).

The noise level and abatement analysis for the Pamlico Sound Bridge Corridor alternatives is discussed in Section 4.10 and indicates that FHWA NAC would not be exceeded (see also Figure 4-2 and Table 4-31). The Pamlico Sound Bridge Corridor alternatives would reduce noise levels in the Refuge.

5.2.3 (Former) Oregon Inlet US Coast Guard Station

5.2.3.1 Parallel Bridge Corridor Alternatives – Including the Phased Approach/Rodanthe Bridge Alternative (Preferred)

None of the Parallel Bridge Corridor alternatives (including the Preferred Alternative), or the Pamlico Sound Bridge Corridor alternatives, would require any use of property from the (former) Oregon Inlet US Coast Guard Station, located on Hatteras Island within the Refuge (see Figure 5-3). However, all of the Parallel Bridge Corridor alternatives would have an Adverse Effect on the (former) Oregon Inlet US Coast Guard Station because of the greater height of the new Oregon Inlet Bridge (33.5 to 70 feet [10.2 to 21.3 meters] compared to the Bonner Bridge up to 15 feet [11.1 meters]). The visual impacts from the Parallel Bridge Corridor alternatives would alter the historic view, function, and setting of the station.

A replacement bridge in the Parallel Bridge Corridor would retain NC 12 through the Refuge and terminate at the southern tip of Bodie Island. The Parallel Bridge corridor could allow for the relocation of the (former) Oregon Inlet US Coast Guard Station across Oregon Inlet by bridge or by barge as discussed in Section 4.4.1.2 under "(Former) Oregon Inlet US Coast Guard Station." The retention of the terminal groin, required by all of the Parallel Bridge Corridor alternatives, would allow the station to remain on its current site, if desired by its owners. If it remains at its current site, road access to the (former) Oregon Inlet US Coast Guard Station would remain with all of the Parallel Bridge Corridor alternatives.

CO levels exceeding the NAAQS would not be generated by the any of the Parallel Bridge Corridor alternatives (see Section 4.9 for further discussion of air quality impacts).

More specific detail as to the impacts of each of the Parallel Bridge Corridor alternatives on the (former) Oregon Inlet US Coast Guard Station is included in Section 4.4.1.2.

5.2.3.2 Pamlico Sound Bridge Corridor Alternatives

The Pamlico Sound Bridge Corridor alternatives would not require any use of the (former) Oregon Inlet US Coast Guard Station on Hatteras Island. However, these alternatives would have an Adverse Effect on the property because of the potential for loss of access to the facility and the potential for the removal of the terminal groin at the northern end of Hatteras Island upon completion of the proposed project. If the groin is removed, the northern end of Hatteras Island would continue its southward migration (see Section 3.6.2.5) and, unless relocated, the (former) Oregon Inlet US Coast Guard Station would be washed away. For more discussion of the terminal groin, see Section 4.6.3.

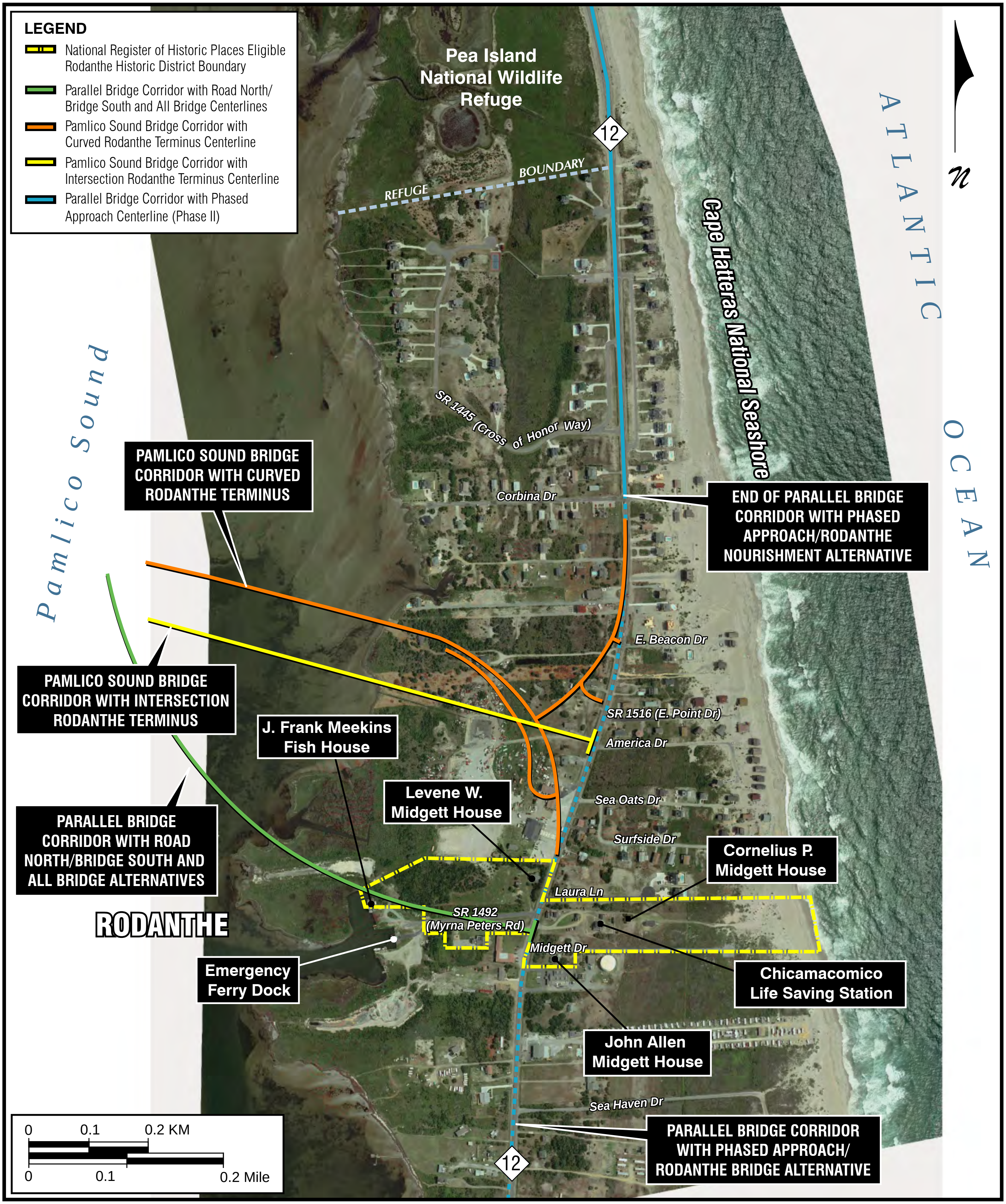
If the Pamlico Sound Bridge Corridor alternatives were selected for implementation, the Refuge and the Seashore plan to conduct an access study. The NCDOT would seek and accept an invitation to participate in the development of alternate access plans if one of the Pamlico Sound Bridge Corridor alternatives were selected for construction and it would suggest that the SHPO be invited to participate. If the alternate access provided is found by the SHPO to contribute potentially to the further neglect of the (former) Oregon Inlet US Coast Guard Station, the NCDOT would help ensure this potential impact is adequately mitigated. Such mitigation would not include retaining NC 12 in the Refuge. If mitigation would include relocating the (former) Oregon Inlet US Coast Guard Station to a site north of Oregon Inlet, the NCDOT currently expects not to demolish Bonner Bridge until that relocation occurred or until a process for taking the building across Oregon Inlet on a barge is developed. However, given the current condition of Bonner Bridge, consideration would have to be given to whether or not the weight of the (former) Oregon Inlet US Coast Guard Station could be safely borne by Bonner Bridge before relocation across the bridge could take place.

CO levels exceeding the NAAQS would not be generated by the any of the Pamlico Sound Bridge Corridor alternatives (see Section 4.9 for further discussion of air quality impacts).

5.2.4 Rodanthe Historic District – Including Chicamacomico Life Saving Station

5.2.4.1 Parallel Bridge Corridor Alternatives – Including the Phased Approach/Rodanthe Bridge Alternative (Preferred)

As shown in Figure 5-5, there would be no use of the Rodanthe Historic District (the historic district) or the Chicamacomico Life Saving Station with the Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) and the Parallel Bridge Corridor with



USE OF AND RELATIONSHIP TO SECTION 4(f) PROPERTIES IN RODANTHE

Figure 5-5

Nourishment Alternative, as these alternatives would remain within the existing NC 12 right-of-way within the historic district.

There would be no use of the historic district or the Chicamacomico Life Saving Station as a result of the Nourishment Alternative because no component of the alternative would be in proximity to these resources. The Nourishment Alternative would involve nourishment to protect NC 12 north of Chicamacomico and the historic district. No dunes would be built in proximity to Chicamacomico or the historic district. The alternative would have No Effect on these historic resources.

The Road North/Bridge South and All Bridge alternatives would be identical in the vicinity of the Chicamacomico Life Saving Station and other historic district features (see Figure 5-5). The alternatives would have an Adverse Effect on the Chicamacomico Life Saving Station and the historic district, as they would both pass through the district. These alternatives would approach Rodanthe on a bridge approximately 28 feet (8.5 meters) high through Pamlico Sound, and would enter the historic district at an elevation of approximately 18 feet (5.5 meters). Bridge foundations probably would be built every 100 feet (30.5 meters). The bridge component would end and the final fill leading down to an intersection at NC 12 would begin within the historic district. The alternatives would terminate at NC 12 across from the existing NC 12/Midgett Drive intersection, just to the south of the Chicamacomico Life Saving Station. The Road North/Bridge South and All Bridge alternatives would both use land from non-contributing properties within the historic district, and would pass 14 feet (4.3 meters) and 320 feet (97.5 meters), respectively, from two contributing structures – the J. Frank Meekins Fish House and Levene W. Midgett House. These alternatives would be visible from the watchtower that is a part of the Chicamacomico Life Saving Station building.

At one house within the historic district peak-hour noise levels in 2025 would approach or exceed FHWA's NAC with the Nourishment Alternative and with the two Phased Approach alternatives. Myrna Peters Road would be separated from NC 12 with the Road North/Bridge South and All Bridge alternatives, so an alternative access road to NC 12 immediately south of the (former) Rodanthe School would be provided to the J. Frank Meekins Fish House and the (former) Rodanthe School because their current access to NC 12 is via Myrna Peters Road. The Chicamacomico Life Saving Station would not leave control of its owners.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would involve building a bridge in the existing right-of-way with a one-lane/one-way frontage road on either side of the bridge substructure at grade to maintain access to adjoining properties (see Figure 5-5). These features would fit into the existing right-of-way in the historic district, but would use the entire right-of-way width. NC 12 would remain on bridge until a point on NC 12 is reached that is 230 feet (70.1 meters) from the 2060 high erosion shoreline. Because this point occurs south of the historic district, the bridge would pass through the historic district. The bridge would be at its full height of 33.5 feet (10.2 meters) above mean high sea level (approximately 30 feet [9.1 meters] above ground) as it enters the historic district from the north (see Figure 2-24). It would begin to drop down to grade within the historic district and would be approximately 12.5 feet (4.0 meters) above ground at the southernmost point of the district. It would still be 30 feet (9.1 meters) above ground in front of the Chicamacomico Life Saving Station. Direct vehicle access across the right-of-way would be eliminated in the historic district. Connections between the frontage roads would be approximately 963 feet (294.0 meters) south of the southern district boundary and 734 feet (224.0 meters) north of the northern district boundary. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would have an Adverse Effect on the Chicamacomico Life Saving Station and the historic district because of the change in the visual setting. The bridge would be a feature not in keeping with the historic setting of the structures contained within the district in terms of its height and structural components, and it would impede views across NC 12; however, the elevated structure would allow travelers to see more of the landscape.

CO levels exceeding the NAAQS would not be generated by the any of the Parallel Bridge Corridor alternatives (see Section 4.9 for further discussion of air quality impacts).

Like the Parallel Bridge Corridor with Nourishment Alternative, the Phased Approach/Rodanthe Nourishment Alternative would maintain NC 12 in Rodanthe using beach nourishment, so it would have No Effect on the Life Saving Station or the historic district.

5.2.4.2 Pamlico Sound Bridge Corridor Alternatives

The two Pamlico Sound Bridge Corridor Alternatives would not require any use of lands in the historic district or the Chicamacomico Life Saving Station (see Figure 5-5). The proposed bridge within the Pamlico Sound Bridge Corridor would be visible from the watchtower that is a part of the Life Saving Station building. However, the viewshed currently is occupied by modern commercial and residential development and an automobile junkyard (partially removed between 2003 and 2004). Thus, the integrity of the view has already been compromised.

At one house within the historic district peak-hour noise levels in 2025 would approach or exceed FHWA's NAC with the Pamlico Sound Bridge Corridor. However, this noise level is associated more with the forecast growth in traffic than the implementation of a bridge within the Pamlico Sound Bridge Corridor. There would be no difference at the affected site between 2025 noise levels assuming Bonner Bridge remains in place and 2025 noise levels with the Pamlico Sound Bridge Corridor. In addition, 2025 noise levels with the Pamlico Sound Bridge Corridor would only be 2 dBA above existing conditions, an imperceptible difference. Since the Pamlico Sound Bridge Corridor ends north of the eligible district, the proposed bridge would not affect traffic volumes that pass through the historic district on NC 12. Because of the lack of direct or substantial indirect affects on the historic district, there is no reason to believe that a bridge in the Pamlico Sound Bridge Corridor would lead to neglect of the properties within the district.

CO levels exceeding the NAAQS would not be generated by the any of the Pamlico Sound Bridge Corridor alternatives (see Section 4.9 for further discussion of air quality impacts).

Given these findings, the Pamlico Sound Bridge Corridor has No Adverse Effect on the Chicamacomico Life Saving Station and the associated historic district as historic resources.

5.3 Avoidance Alternatives

FHWA cannot approve the use of a Section 4(f) property if there is a feasible and prudent avoidance alternative available. A feasible and prudent avoidance alternative is one that avoids using Section 4(f) property and does not cause other severe problems of a magnitude that substantially outweighs the importance of protecting the Section 4(f) property. Few avoidance alternatives exist for this project because of its location along the narrow barrier islands that largely consist of lands protected by Section 4(f). The rehabilitation of the Bonner Bridge is the only alternative presented in Chapter 2 that would completely avoid the use of lands from the Seashore. This section considers whether the rehabilitation of Bonner Bridge, as well as two other potential avoidance options, are feasible and prudent. The second avoidance option would involve building a bridge across the Pamlico Sound from Rodanthe, the northernmost location of privately held land on Hatteras Island south of Oregon Inlet, to Wanchese on Roanoke Island. The third avoidance option would involve building a new Oregon Inlet bridge completely within the existing NC 12 right-of-way within the Seashore at the southern end of Bodie Island and over Oregon Inlet (see Figure 5-3).

The No-Action Alternative, which calls for the construction of a small-scale ferry service, is not an avoidance alternative because ferry facilities would have to be constructed within the Seashore and within either the Refuge or Rodanthe to provide service between Bodie and Hatteras islands. Access to the mainland also would remain via existing ferry routes from the mainland (i.e., Cedar Island and Swan Quarter) to Ocracoke Island and then the existing ferry route from Ocracoke Island to Hatteras Island. This route offers space for approximately 400 to 450 vehicle crossings per day during the summer. Emergency ferry service across Oregon Inlet was provided from November 1990 to February 1991 after Bonner Bridge had been damaged by a dredge and was closed. This emergency ferry service had a maximum transport of 900 vehicles per day and took 80 minutes, including loading and unloading. A similar service would not meet the existing demand or the 2025 average daily traffic of 9,600 vehicles per day and peak traffic of 25,200 vehicles per day (see Table 1-2 in Section 1.5.6). This alternative also would not avoid the use of land from Section 4(f) property.

5.3.1 Rehabilitate Bonner Bridge Avoidance Alternative

As discussed in Section 1.3.3, Bonner Bridge has recurring maintenance problems, insufficient ship impact strength, and a narrow navigation zone. Bonner Bridge has required continual maintenance since its construction.

Three major continuing maintenance problems exist:

- Deterioration of the bridge through extensive corrosion of the reinforcing steel and major spalling of concrete on the supporting structures;
- Scour to a depth equal to or greater than the critical depth for the piles supporting the substructure; and
- Natural channel migration that results in the periodic need for boat traffic to pass beneath a span adjacent to, and lower than, the bridge's primary navigation span.

Although these problems have been addressed in previous rehabilitation programs (and in a rehabilitation project currently underway), they continue to occur. Extensive maintenance and repair expenditures are expected to continue on a regular basis, and the required repairs are expected to grow in expense and complexity. The replacement of complete bridge piers and complete girders could eventually be needed, requiring closure of Bonner Bridge for months at a time. Thus, a rehabilitation alternative that dealt with bridge deterioration and scour would be an ongoing effort disruptive to traffic operations on the bridge, and not a one-time project to extend the life of Bonner Bridge for many years.

With continued rehabilitation, the narrow navigation span zone of Bonner Bridge would remain, and the potential benefits of reduced dredging associated with the proposed project would not occur. Navigation heights and widths cannot be changed without replacing those spans.

Finally, Bonner Bridge was not designed to withstand the impact of a dredge, a vessel type that regularly operates near the bridge. A hopper dredge demolished several spans of Bonner Bridge in late 1990, requiring the bridge to be closed from October 1990 to February 1991. Nothing short of replacing the substructure with the type proposed for either of the replacement bridge corridors (see Section 2.10.1.2) would provide the strength needed. The existing substructure is too short and too light to withstand the required ship impact loads.

The rehabilitation of the Bonner Bridge presents unacceptable safety, maintenance, and operational problems for the traveling public. This alternative would also fail to meet the purpose and need for the project as it would not include long-term maintenance and protection to NC 12 south of Oregon Inlet which is frequently threatened by shoreline erosion and overwash.

The severe problems described above outweigh the importance of protecting the 30,319 acre (12,270 hectare) Seashore from the use of the 6.3 to 7.3 acres (2.6 to 3.0 hectares) that would be required to complete the project with one of the other alternatives under consideration. Therefore, the Rehabilitate Bonner Bridge Avoidance Alternative is determined to not be a feasible and prudent avoidance alternative because the problems identified above cumulatively cause unique problems and impacts of extraordinary magnitude.

5.3.2 Bridge from Rodanthe to Roanoke Island Avoidance Alternative

A bridge from Rodanthe to either Roanoke Island (near Wanchese) or the mainland (at Stumpy Point) would avoid the use of Seashore lands. However, only the Roanoke Island terminus of this alternative would avoid using Section 4(f) property. The mainland terminus is not an avoidance alternative because it would require using land from the Alligator River National Wildlife Refuge, a Section 4(f) property. The Alligator River National Wildlife Refuge could not be avoided because US 264, the road leading to Stumpy Point, passes through the Alligator River National Wildlife Refuge (see Figure 5-1) and would need to be improved to adequately serve NC 12 traffic.

With the western bridge termini at Roanoke Island, existing roads would need to be improved in order to accommodate NC 12 traffic. Shifting traffic from one road to another often necessitates road improvements, such as wider lanes and shallower curves, to safely accommodate the increased traffic volumes. In order to add NC 12 traffic to Wanchese, such improvements would be needed on NC 345. Widening NC 345 would reduce the distance to adjacent development through Wanchese from 15 feet (4.6 meters) to approximately 6 feet (1.8 meters). The introduction of traffic, the loss of front yards, and the displacement of several homes would substantially reduce the quality of life of this rural community. In addition, the cohesion of the community would be reduced since the introduction of NC 12 traffic would make it more difficult to cross NC 345 to visit neighbors. Constructing a bypass around Wanchese would require construction on new location through estuarine wetlands (forested and marsh) for almost 2 miles (3.2 kilometers).

Further, the alternative of building a new bridge from Rodanthe to Roanoke Island would not meet the project's purpose and need, which calls for a "new means of access from Bodie Island to Hatteras Island." With the alternative of building a new bridge from Rodanthe to Roanoke Island, the internal traffic circulation patterns of the Outer Banks would be altered. The travel distance from Whalebone to Rodanthe for users of the Seashore would increase by 29 percent (from 24 miles [38.6 kilometers] to 31 miles [49.9 kilometers]). Road user costs would increase with distance, and travelers would no longer be able to go directly from Bodie Island to Hatteras and Ocracoke islands. Response times for emergency service vehicles also would be increased by this alternative. Because the sole hospital serving the area is on Bodie Island, the loss of a direct connection to Bodie Island from Hatteras and Ocracoke islands would be a severe impact on residents and visitors.

The connection of electric and utility services to Hatteras Island also would need to be relocated from the southern end of Bodie Island (northern terminus of Bonner Bridge) to Roanoke Island at a northern terminus for a replacement bridge from Roanoke Island to Rodanthe. The major components of such a relocation would be moving the electrical substation now on Bodie Island to Roanoke Island, placing telephone lines on 22 miles (35.4 kilometers) of new bridge, and placing electric lines adjacent to 22 miles (35.4 kilometers) of new bridge. In contrast, a bridge in the Pamlico Sound Bridge Corridor would be 17.5 miles (28.2 kilometers) long and, as indicated in Table 2-11, relocating utilities in association with that bridge is estimated to cost $53.9 million. Based on the ratio of bridge lengths, the cost of line relocation with a bridge from Roanoke Island to Rodanthe would be approximately 26 percent higher ($67.8 million). A further additional cost would be the cost of the substation relocation and any costs that could be associated with the diversion of power from lines on Hatteras Island to lines on Roanoke Island.

The accumulation of severe problems described above outweighs the importance of protecting the 30,319 acre (12,270 hectare) Seashore from the use of the 6.3 to 7.3 acres (2.6 to 3.0 hectares) that would be required to complete the project with one of the other alternatives under consideration. Therefore, the Bridge from Rodanthe to Roanoke Island Avoidance Alternative is determined not to be a feasible and prudent avoidance alternative because the alternative would result in severe disruption to the established community of Wanchese, not meet the project's purpose and need, severely impact the operations of emergency services from Hatteras Island, and require substantial utility relocation.

5.3.3 Build the Replacement Bridge Completely within the Existing NC 12 Right-of-Way Avoidance Alternative

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) avoids a Section 4(f) impact to the Seashore and the Refuge on Hatteras Island by building the project within the existing NC 12 easement, including the southern terminus of the Oregon Inlet bridge. Construction of the southern terminus of the Oregon Inlet bridge in the existing easement requires the demolition of the Bonner Bridge's southern terminus to provide room to accommodate the new bridge's southern terminus. Traffic operations would be maintained by building an approximately 2,600-foot-long (793-meter-long) traffic maintenance bridge to carry NC 12 traffic until the new southern terminus is completed. This is a reasonable and feasible approach because of the relatively short distance of temporary bridge involved. For the balance of the project within the Refuge and Seashore on Hatteras Island, a temporary road could be built to maintain NC 12 traffic operations in the existing easement during construction. Road construction is far less expensive than bridge construction.

The approach of staying within the existing easement/right-of-way applied on Hatteras Island, however, would not be a reasonable and prudent approach to avoiding a Section 4(f) use in the rest of the Seashore. Off of Hatteras Island, the Seashore encompasses most of Oregon Inlet and the area behind Bodie Island (see Figure 5-3). Almost all of NC 12 in this area is on Bonner Bridge. Bonner Bridge is centered on an existing 100-foot (30.5-meter) wide right-of-way. Bonner Bridge is 33.3 feet (10.1 meters) wide, leaving 33.4 feet (10.2 meters) of right-of-way on either side of the bridge. It would not be physically possible to build the new Oregon Inlet bridge

(42.6 feet [13.0 meters]) wide in that space while maintaining traffic. It would not be prudent to build a narrow (26-foot [7.9-meter] wide) temporary bridge for an additional distance of approximately 10,300 feet (3,139 meters) beyond the 2,600-foot-long (793-meter-long) traffic maintenance bridge discussed in the previous paragraph (i.e., the rest of the way across Oregon Inlet), demolish the existing bridge, build the new bridge over Oregon Inlet, and then demolish the temporary bridge. The end result would be NCDOT essentially building and demolishing two bridges with associated costs and environmental impact. Thus, this does not represent a feasible and prudent alternative.

There is no feasible and prudent avoidance alternative to the use of Section 4(f) property to construct the proposed action.

5.4 Least Harm Analysis

The sheer size and location of the Seashore and Refuge within the project area make it impossible to design an alternative that would avoid using any Section 4(f) property (see Figure 5-1). Section 5.3 of this Section 4(f) Evaluation documented that no feasible and prudent avoidance alternatives exist (i.e., all alternatives use Section 4(f) properties). In circumstances like this, where FHWA determines that there is no feasible and prudent avoidance alternative, the Section 4(f) regulations require FHWA to identify, from among the alternatives using Section 4(f) property, the alternative that causes the least overall harm. The regulations determine which alternative would cause the least overall harm with a balancing test that compares seven different aspects of the alternatives. Therefore, an assessment of the alternatives carried forward for detailed study (i.e., the five Parallel Bridge Corridor alternatives [including the Preferred Alternative] and the two Pamlico Sound Bridge Corridor alternatives) was conducted to determine which alternative meets the requirements of 23 CFR 774.3(c) for causing the least overall harm.

The Section 4(f) regulations, 23 CFR 774.3(c), specify that the alternative that causes the least overall harm is determined by balancing seven specific factors. These factors are:

1. The ability of the alternatives to mitigate adverse impacts to each Section 4(f) property (including any measures that result in benefits to the property);

2. The relative severity of the remaining harm, after mitigation, to the protected activities, attributes, or features that qualify each Section 4(f) property for protection;

3. The relative significance of each Section 4(f) property;

4. The views of the official(s) with jurisdiction over each Section 4(f) property;

5. The degree to which each alternative meets the purpose and need for the project;

6. After reasonable mitigation, the magnitude of any adverse impacts to resources not protected by Section 4(f); and

7. Substantial differences in costs among the alternatives.

A discussion is contained in the sections below to address these factors and provide the basis for the determination of the alternative that causes least overall harm. For this analysis, the two main corridors, the Parallel Bridge Corridor (including the Preferred Alternative) and the Pamlico Sound Bridge Corridor, are compared. For many of the factors, the alternatives within the corridors are the same. Where there is a difference between the alternatives within the corridors under a factor, the differences are explained. The alternatives within the two main corridors are:

- Pamlico Sound Bridge Corridor:
  - With Curved Rodanthe Terminus; and
  - With Intersection Rodanthe Terminus.
- Parallel Bridge Corridor:
  - With Nourishment;
  - With Road North/Bridge South;
  - With All Bridge;
  - With Phased Approach/Rodanthe Bridge (Preferred); and
  - With Phased Approach/Rodanthe Nourishment.

5.4.1 Ability to Mitigate Adverse Impacts and Relative Severity of Remaining Harm

Below are combined discussions of the first two factors, the mitigation considered for impacts to the Section 4(f) properties used and the relative severity of the remaining harm to Section 4(f) properties for each alternative after mitigation. Section 4.7.10 contains a more complete discussion of all mitigation activities for the alternatives.

5.4.1.1 Cape Hatteras National Seashore on Bodie Island

All of the alternatives would avoid impacts to the activities, features, and attributes that qualify the Seashore on Bodie Island as a Section 4(f) property. More specifically, the alternatives were designed to avoid impacting the Seashore on Bodie Island (see Sections 2.4 and 2.6), and this resource would not be substantially affected by any of the alternatives (including the Preferred Alternative).

<u>*Impacts*</u>

The only impacts of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) and the Pamlico Sound Bridge Corridor alternatives within the Seashore on Bodie Island that are great enough to warrant mitigation would be those related to small potential construction-related impacts to piping plover nesting, and construction access impacts (dredging, work bridge, and/or haul road) to natural resources behind Bodie Island. Mitigation of wetland impacts that could result from construction or demolition access activities on Bodie Island (0.52 acres [0.21 hectares]) would consist of restoring these areas to their pre-construction condition following completion of this project. These areas would be replanted immediately following the restoration of the pre-construction elevation in order to provide rapid coverage and to prevent erosion. Species composition of the plantings would be based on pre-construction baseline data on species composition of the areas to be impacted. Detailed monitoring of hydrology and vegetation would be conducted in order to ensure a return to full wetland function. A more complete description of mitigation for waters of the US can be found in Section 4.7.10.

The Parallel Bridge Corridor alternatives (including the Preferred Alternative) would require the permanent use of 6.3 acres (2.6 hectares) of the Seashore on Bodie Island. The Pamlico Sound Bridge Corridor alternatives would require 7.3 acres (3.0 hectares). Bonner Bridge currently occupies a corridor consisting of approximately 6.3 acres (2.6 hectares) that bisects the Seashore on Bodie Island. This corridor would be restored and returned to the Seashore after Bonner Bridge is demolished and removed. Other than the current Bonner Bridge corridor, there is no non-Seashore property in the area of the use that could be acquired and added to the Seashore as additional mitigation. Therefore, there would be no net loss of Section 4(f) property with the Parallel Bridge Corridor alternatives (including the Preferred Alternative), but an unmitigatable 1.0 acre (0.4 hectare) net loss of Seashore property with the Pamlico Sound Bridge Corridor alternatives. All of the alternatives were designed to avoid impacts to Seashore activities, features, and attributes that qualify the Seashore on Bodie Island as a Section 4(f) property. All alternatives would equally restrict the access of fishing vessels from the Oregon Inlet Marina and Fishing Center from following the "crack," a short cut to the ocean from the Marina. This would result in an average increase of approximately 30 minutes of travel time to reach Oregon Inlet. As stated in Section 5.2.1.1, this increased travel time is not a use of Section 4(f) property, but it does represent an impact on people who travel by boat between the Marina and Oregon Inlet.

In summary, after mitigation, all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would cause slightly less harm to the Seashore on Bodie Island than the Pamlico Sound Bridge Corridor alternatives. After mitigation (return of the land currently occupied by Bonner Bridge) the Seashore would not lose any net area with the Parallel Bridge Corridor alternatives, but would lose approximately 1.0 acre (0.4 hectare) with the Pamlico Sound Bridge Corridor alternatives. This 1.0 acre (0.4 hectare) net difference is considered important but not critical because the Seashore contains 30,319 acres (12,270 hectares) of land, so the 1.0 acre (0.4 hectare) net use is a very minor impact.

Conclusion

Therefore, the FHWA and NCDOT consider the two replacement bridge corridors (including the seven alternatives within the two replacement bridge corridors) to be substantially equal in terms of the agencies' ability to mitigate the adverse impacts to the Seashore on Bodie Island.

5.4.1.2 Pea Island National Wildlife Refuge/Cape Hatteras National Seashore on Hatteras Island

The following is a summary of the mitigation that has been considered for impacts on Section 4(f) resources on the Refuge and the remaining harm for each alternative. It should be noted that of the Parallel Bridge Corridor alternatives, only the Phased Approach/Rodanthe Bridge Alternative (Preferred) stays completely within the existing easement within the Refuge and, therefore, does not constitute a use of the Refuge under Section 4(f). The Pamlico Sound Bridge Corridor alternatives also avoid the use of Refuge lands.

Use of Refuge Land

As can be seen in Table S-1, all of the Parallel Bridge Corridor alternatives would have a use of the Refuge with the exception of the Phased Approach/Rodanthe Bridge Alternative (Preferred). The Nourishment Alternative would use 19.9 acres (8.1 hectares) of the Refuge, mostly through affecting the dunes and beach areas with beach nourishment and dune maintenance activities.

The Road North/Bridge South Alternative would use 93.4 acres (37.8 hectares) of the Refuge. The horizontal shift of NC 12 to the west would change the appearance of the surrounding terrain, change wetland to road, and narrow the ponds as much as 700 feet (213.4 meters). This alternative also would cross the dikes around the ponds, as well as the wildlife trails on top of the dikes associated with the northernmost pond. The All Bridge Alternative would use 92.2 acres (37.3 hectares) of the Refuge. The bridge through the Refuge with this alternative would be built as much as 900 feet (274.4 meters) west of existing NC 12. The bridge structure would pass above the wildlife trails on top of the dikes associated with the northernmost pond and over the ponds. The bridge would dominate views from the wildlife trails. The Phased Approach/ Rodanthe Nourishment Alternative would use approximately 1,500 feet (457.2 meters) of shoreline for nourishment activities just north of Rodanthe. The Phased Approach/Rodanthe Bridge Alternative (Preferred) and Pamlico Sound Bridge Corridor alternatives would not use any property from the Refuge/Seashore.

Since the Pamlico Sound Bridge Corridor alternatives and the Phased Approach/Rodanthe Bridge Alternative (Preferred) are the only alternatives that avoid permanently incorporating land from the Refuge, the FHWA and NCDOT consider them to be substantially equal as the best options in terms of use of Refuge lands under the requirements of Section 4(f).

Loss of Recreation Access

Though recreation is not defined as the primary purpose of the Refuge, it is a popular area for fishing, surfing, and other activities. With the Pamlico Sound Bridge Corridor, NC 12 between Bodie Island and Hatteras Island no longer would pass through the Refuge. Paved road access would continue in the Refuge with the Parallel Bridge Corridor. Access would focus on three points in the Refuge with the All Bridge Alternative and two points with the Phased Approach alternatives (including the Preferred Alternative). Access would be lost to the Refuge Visitor Center, headquarters, and North Pond Trail with the All Bridge and Phased Approach alternatives (including the Preferred Alternative).

When the first phase of the two Phased Approach alternatives (the new Oregon Inlet bridge) is complete, the bridge built to provide a temporary connection between Bonner Bridge and Hatteras Island while the replacement bridge is built in the existing easement could be left in place to be used as a fishing pier, replacing the existing catwalks. This could also occur with the Nourishment Alternative, which also would involve replacing the bridge in the existing easement at the north end of Hatteras Island. At this time, one viable approach for maintaining fishing access with the Pamlico Sound Bridge Corridor, the Parallel Bridge Corridor with Road North/Bridge South, and the Parallel Bridge Corridor with All Bridge alternatives appears to be leaving a portion of the Bonner Bridge for fishing. However, in order to maintain a portion of Bonner Bridge as a fishing pier, some government body or non-governmental organization would have to take responsibility for pier operation, maintenance, and liability. Construction of a “boardwalk” on top of the riprap that currently blankets the northern shore of Hatteras Island is another option.

Unlike the other Parallel Bridge Corridor alternatives, the Phased Approach alternatives (including the Preferred Alternative) would directly affect activities on the beach front, including fishing, hiking, surfing, wind surfing, kite boarding, swimming, ocean kayaking, and birding. Bridge piles in the ocean could change the types of fish that congregate around the shore. To the extent that certain sections of the bridged roadway would be over the beach, beach activities would be affected, but not precluded, by the presence of the bridge and bridge piles. Once the Phased Approach alternatives’ bridge piles are in the ocean, the ability to surf in a particular area would be eliminated. The piles would change how and where the waves break, which would interfere with the swells in such a way that the waves would no longer be conducive to good surfing. In addition, the presence of bridge piles every 120 feet (36.6 meters), in areas where the bridges would be less than 150 feet (45.7 meters) from shore, would be a safety hazard to surfers and other recreational ocean users. A complete description of the changes in recreational access to the Refuge is included in Section 4.5.3.

With the Pamlico Sound Bridge Corridor alternatives, however, access to fishing at either Oregon Inlet or within the Refuge would be more difficult because there would be no paved road within the Refuge as there would be with the Parallel Bridge Corridor alternatives (including the Preferred Alternative), as discussed in Section 5.2.2.2.

The Parallel Bridge Corridor alternatives (including the Preferred Alternative) are considered the best option by FHWA and NCDOT for maintaining recreational opportunities at Oregon Inlet and within the Refuge. With the Pamlico Sound Bridge Corridor alternatives, access to these areas would be limited because of the likely loss of paved road access.

Protected Species

As discussed in Section 4.7.9, the Pamlico Sound Bridge Corridor would not likely result in adverse impacts to the 13 federally-listed threatened or endangered species in Dare County. With the Pamlico Sound Bridge Corridor, the biological conclusion for 10 of these species is "May Affect – Not Likely to Adversely Affect," and the biological conclusion for three species is "No Effect."

The remaining discussion refers to mitigation and remaining harm for the Parallel Bridge Corridor alternatives (including the Preferred Alternative).

With the Parallel Bridge Corridor alternatives (including the Preferred Alternative), the biological conclusion for six of these species (five species with the Nourishment and Phased Approach/ Rodanthe Nourishment alternatives) is "May Affect – Not Likely to Adversely Affect," the biological conclusion for three species is "No Effect," and the biological conclusion for four species (five species with the Nourishment and Phased Approach/Rodanthe Nourishment alternatives) is "May Affect – Likely to Adversely Affect." These species include the piping plover, leatherback sea turtle, green sea turtle, loggerhead sea turtle, and the seabeach amaranth. Formal consultation was completed with the USFWS for the Phased Approach/Rodanthe Bridge Alternative (Preferred), and concurrence was obtained on biological conclusions from both the USFWS and National Marine Fisheries Service (NMFS). The biological opinions resulting from the formal consultation with the USFWS is reflected in the biological conclusions and discussed in Section 4.7.9.

Conservation measures agreed to with the USFWS and the NMFS for species under their jurisdiction are described in Section 4.7.10.4 for the Phased Approach/Rodanthe Bridge Alternative (Preferred). They also are incorporated in the Project Commitments. Reasonable and prudent measures and associated terms and conditions to minimize take of the piping plover, loggerhead sea turtle, green sea turtle, and leatherback sea turtle were also agreed to with the USFWS and are also presented in Section 4.7.10.4 and included in the Project Commitments. Though consultation was only completed for the Phased Approach/Rodanthe Bridge Alternative (Preferred), many of the terms and conditions could be applied to the other Parallel Bridge Corridor alternatives. However, additional mitigation measures likely would be required for the two Parallel Bridge Corridor alternatives that utilize beach nourishment.

FHWA and NCDOT believe that the remaining harm, after mitigation, to these species would be minor. The USFWS concurred that the proposed action would not jeopardize the continued existence of any endangered or protected species, and would not result in the destruction or adverse modification of habitat of such species. The USFWS agreed that there may be a take of the piping plover, loggerhead turtle, leatherback turtle, and the green sea turtle, as well as the proposed critical habitat of the piping plover. An incidental take statement for these species and the piping plover critical habitat has been issued by the USFWS. The FHWA and NCDOT consider the two replacement bridge corridors (including the alternatives within the two replacement bridge corridors) to be substantially equal in terms of the remaining harm to protected species in the Refuge after mitigation.

Historic

A more thorough discussion of impacts to the Refuge as a historic resource can be found in Section 4.4.1. The Phased Approach/Rodanthe Bridge Alternative (Preferred) does not permanently incorporate land from the Refuge. It does not constitute a use of Refuge property under Section 4(f), though it does have an Adverse Effect on the Refuge as a historic resource.

The Parallel Bridge Corridor with Nourishment Alternative would avoid impacts to the Refuge as a historic resource by maintaining the existing shoreline and the status quo regarding the historic CCC facilities. The Nourishment Alternative, as stated above, also would most protect Refuge facilities, including the landscape that contributes to its NRHP-eligibility. Also, as discussed in Section 5.2.2.1, current access to the Refuge facilities would be maintained. The Road North/Bridge South and All Bridge alternatives would have the most impacts to the historic CCC facilities, because both of the alternatives would place NC 12 over the existing dikes and ponds.

As discussed in Section 5.2.2.1, a replacement bridge within the Parallel Bridge Corridor would provide a paved road the full length of the Refuge. The Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives, however, would bypass the Refuge Visitor Center, the North Pond Trail, the Refuge headquarters, and the boat ramp (see Figure 5-4a and Figure 5-4b). The Phased Approach alternatives (including the Preferred Alternative) would reduce Refuge access the most of the various Parallel Bridge Corridor alternatives. Once the full project is complete, only two access points off of NC 12 would be provided in the Refuge. The first access point would be the interchange adjacent to the fishing catwalks parking lot that would be started during Phase I and completed during Phase II. In Phase I, the Oregon Inlet bridge would be built and would end as a stub on Hatteras Island in the existing easement and adjacent to the catwalks parking lot. Ramps would be built on either side of the bridge to bring traffic down to the existing road. During Phase II, the bridge would be extended south and a second set of ramps would be built. The ramps would function as a highway interchange to bring NC 12 traffic down to the existing parking lot (see Section 2.10.1.2 and Figure 2-22). The second access point would be south of the ponds in the 2.1-mile (3.4-kilometer) section of NC 12 in the southern half of the Refuge that is not expected to be threatened by erosion prior to 2060 (see Figure 5-4b).

Potential mitigation strategies for impacts from the Phased Approach/Rodanthe Bridge Alternative (Preferred) on the Refuge as an historic resource were discussed with the Section 106 consulting parties at a July 10, 2008 meeting in Manteo, North Carolina. Although specific mitigation commitments will be fully documented in the final Section 106 MOA, some examples of potential mitigation include:

- Design bridge rail so that drivers can view Refuge;
- Research context for CCC involvement along the North Carolina coastline;
- Identify and map shipwrecks;
- Provide signs to direct people to the Refuge Visitor Center and view CCC installations;
- Provide USFWS information for the NRHP nomination, including previous historic architecture, terrestrial archaeology, and underwater archaeology surveys;
- Install interpretative text/displays and kiosks to provide visitors with information about historic significance of site; and
- Maintain access to site, including restoring road as part of staging for construction, possibly installing power, and creating visitor parking.

As discussed in Section 5.2.2.2 for the Pamlico Sound Bridge Corridor alternatives, although the USFWS and the NPS have indicated that they intend to maintain some type of access within the Refuge, the method of access would not likely be a paved road between Rodanthe and Oregon Inlet. There would be a reduction in visitors to the Refuge because of the loss of paved road access with associated economic impacts to Dare County (see Section 4.1.5.3). Regarding visual impacts, the Pamlico Sound Bridge Corridor alternatives would minimize impacts to views from the Refuge that are an attribute of its historic character. The Pamlico Sound Bridge Corridor alternatives would still be visible in parts of the Refuge, but not as visible as the Parallel Bridge Corridor alternatives (including the Preferred Alternative). No specific mitigation has been identified for the Pamlico Sound Bridge Corridor alternatives.

With regard to all alternatives, the FHWA and the NCDOT consider the Parallel Bridge Corridor with Nourishment Alternative to have the least impact to the Refuge as a historic resource by maintaining the existing shoreline and the status quo regarding the historic CCC features. The most substantial of the remaining harm to the Refuge as a historic resource is the visual impact of an elevated structure as proposed for the Phased Approach alternatives (including the Preferred Alternative) and the All Bridge Alternative. However, the Refuge would remain eligible for the NRHP and the historic features and attributes of the Refuge would not be substantially impaired, as discussed in Section 5.5. Overall, the Pamlico Sound Bridge Corridor alternatives, the All Bridge Alternative, the Road North/Bridge South Alternative, and the Phased Approach alternatives (including the Preferred Alternative) are considered to result in substantially equal harm after mitigation from a historic resource perspective. Although the Pamlico Sound Bridge Corridor alternatives were determined to have No Effect on the Refuge as defined in the regulations of the Advisory Council of Historic Preservation, the loss of visitors because of loss of paved road access was considered in determining the degree of harm to the Refuge as a historic resource.

Natural Systems – Wetlands and Biotic Communities

The biotic community impacts from fill by the Parallel Bridge Corridor alternatives would vary by alternative. The greatest impacts to biotic communities within the Refuge would come with the Road North/Bridge South Alternative at 60.98 acres (24.69 hectares). The Refuge biotic community impacts for the other Parallel Bridge Corridor alternatives (from greatest to least) would be: 19.92 acres (8.06 hectares) for the Nourishment Alternative; 7.95 acres (3.22 hectares) for the All Bridge Alternative; and 3.67 acres (1.49 hectares) for the two Phased Approach alternatives (including the Preferred Alternative). The land devoted to the existing road would be returned to the Refuge for the All Bridge and Road North/Bridge South alternatives. Construction within the ponds in the interior of the Refuge associated with the Road North/Bridge South and All Bridge alternatives would generate localized impacts to water quality. These impacts would be temporary and most likely affect turbidity and siltation of sediments. The Pamlico Sound Bridge Corridor alternatives would have no impacts on biotic communities and wetlands within the Refuge.

Regarding wetland mitigation (as described in Section 4.7.10.3), the 1990 MOA related to wetland mitigation between the USACE and the USEPA states that "appropriate and practicable compensatory mitigation is required for unavoidable adverse impacts which remain after all appropriate and practicable minimization has been required." Compensatory mitigation refers to the restoration, creation, enhancement, or preservation of wetlands as compensation for unavoidable wetland impacts. Temporary impacts to wetlands would be mitigated on a 1:1 basis by restoring these areas to their pre-construction condition. Species composition of the plantings would be based on pre-construction baseline data on species composition of the affected areas. Detailed monitoring of hydrology and vegetation would be conducted in order to ensure a return to full wetland function. Permanent wetland losses would be mitigated by restoring, creating, or enhancing wetlands at agency-approved ratios. Potential compensatory wetland mitigation includes on-site restoration and enhancement of in-kind wetlands as compensation for as much of the permanently affected area as possible; however, the limited availability of potential mitigation sites in the immediate vicinity of the project area would necessitate an exploration of additional options, which include off-site restoration, creation, and enhancement of wetlands. Mitigation credit available from the Ballance Farm Mitigation Site in Currituck County could provide for all or a portion of the mitigation required for the Phased Approach/Rodanthe Bridge Alternative (Preferred). The amount of mitigation credit available from this site cannot be currently determined because other projects could debit credit from the site. Any mitigation not accounted for by the Ballance Farm would be reconciled through onsite mitigation and monetary contributions to North Carolina's *Ecosystem Enhancement Program* (EEP).

Some wildlife habitat would be regained by removing the existing NC 12 pavement where it is no longer needed and replanting with native vegetation. This habitat would not be equivalent to native, undisturbed habitat. However, potential habitat created by the removal of replaced portions of NC 12 could be colonized very quickly by ephemeral species that inhabit maritime islands. Natural shoreline movement, allowed to occur with most of the alternatives (including the Preferred Alternative), also would contribute to naturalizing this area of the Outer Banks, and benefiting wildlife in the Refuge.

The FHWA and NCDOT consider the Road North/Bridge South Alternative to have the greatest harm to wetlands and biotic communities. Since the other alternatives (including the Preferred Alternative) impact wetlands and biotic communities to a substantially lesser degree than the Road North/Bridge South Alternative, the FHWA and NCDOT consider the other alternatives within the two replacement bridge corridors to be substantially equal in this respect after mitigation as described above.

Natural Systems - Natural Shoreline Movement

As discussed in Section 4.7.7, a return to allowing natural changes in the barrier island environment to take place, including new inlet formation and shoreline migration, is a priority for the NPS and the Refuge. Taking into account natural changes in the barrier island environment is also a component of the project's purpose and need (see Section 1.2). The Nourishment Alternative would not allow for the natural barrier island processes. The other Parallel Bridge Corridor alternatives (including the Preferred Alternative), as well as the Pamlico Sound Bridge

Corridor alternatives, would allow for natural barrier island change to occur, with the exception of the 0.4 mile (0.6 kilometer) of dunes defined as a part of the Road North/Bridge South Alternative and the nourishment associated with the Phased Approach/Rodanthe Nourishment Alternative. In addition, all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would require the retention of the terminal groin.

FHWA and NCDOT consider the Pamlico Sound Bridge Corridor alternatives, as well as the Parallel Bridge Corridor with All Bridge Alternative and the Phased Approach/Rodanthe Bridge Alternative (Preferred), to be the best in terms of allowing natural process to take place, and also consider them to be substantially equal in terms of remaining harm. The Phased Approach/ Rodanthe Nourishment and the Road North/Bridge South alternatives have slightly more unmitigatable impacts, with the Nourishment Alternative having the most unmitigatable impacts on natural shoreline movement.

Conclusion

The FHWA and NCDOT consider the Pamlico Sound Bridge Corridor alternatives to have the least harm to the Refuge/Seashore on Hatteras Island because these alternatives would not be within the Refuge. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would be confined to the existing easement, reducing its potential impact by not using Refuge lands, providing for fishing access, minimizing protected species impacts, minimizing direct impacts to habitat, and allowing for shoreline erosion. The other Parallel Bridge Corridor alternatives would cause greater harm after mitigation to the Refuge/Seashore on Hatteras Island because they would use from 1,500 feet (457.2 meters) of shoreline to 93.4 acres (37.8 hectares) of the property.

5.4.1.3 (Former) Oregon Inlet US Coast Guard Station

A replacement bridge in the Parallel Bridge Corridor would retain NC 12 through the Refuge and terminate at the southern tip of Bodie Island. All of the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would introduce a taller or longer bridge into the viewshed of the (former) Oregon Inlet US Coast Guard Station resulting in an Adverse Effect from a historic resource perspective. However, no property would be used with any of the Parallel Bridge Corridor alternatives.

The Parallel Bridge Corridor could allow for the relocation of the (former) Oregon Inlet US Coast Guard Station across Oregon Inlet (most likely by barge) as discussed in Section 4.4.1.2 under "(Former) Oregon Inlet US Coast Guard Station." The retention of the terminal groin, required by all of the Parallel Bridge Corridor alternatives, would allow the station to remain on its current site, if desired by its owners. If it remains at its current site, road access to the station would remain with all of the Parallel Bridge Corridor alternatives (including the Preferred Alternative).

The Pamlico Sound Bridge Corridor alternatives would not require any use of the (former) Oregon Inlet US Coast Guard Station. Although the Pamlico Sound Bridge Corridor alternatives would minimize visual impacts to the property as compared to the Parallel Bridge Corridor alternatives, these alternatives would have an Adverse Effect on the property because of the potential for loss of access to the facility and the potential for the removal of the terminal groin at the northern end of Hatteras Island upon completion of the proposed project. If the groin is removed, the northern end of Hatteras Island would continue its southward migration (see Section 3.6.2.5) and, unless relocated, the (former) Oregon Inlet US Coast Guard Station would be washed away. Because of the current condition of Bonner Bridge, further consideration would have to be given to determine if the Bonner Bridge can safely bear the weight of the station in the attempt to relocate the structure to the north. However, a barge could be used to relocate the structure to a new site to the north on Bodie Island should that be the desire of the North Carolina Aquarium Society.

Potential mitigation strategies for impacts from the Phased Approach/Rodanthe Bridge Alternative (Preferred) on the (former) Oregon Inlet US Coast Guard Station were discussed with the Section 106 consulting parties at a July 10, 2008 meeting in Manteo, North Carolina. Although specific mitigation commitments will be fully documented in the final Section 106 MOA, some examples of potential mitigation, not only limited to the Phased Approach/Rodanthe Bridge Alternative (Preferred), include:

- Restoration and interpretive displays/kiosks providing visitors with information about the historic significance of the site;
- If the terminal groin is removed, help in moving building to a new site;
- Provide signs to direct people to the site;
- Provide information for cultural interpretive exhibits;
- Update the NRHP nomination and develop measured drawings/structural report for the station; and
- Joint marketing for tourism with other US Coast Guard and Life Saving stations along the Outer Banks.

Conclusion

The FHWA and NCDOT consider the Parallel Bridge Corridor alternatives, including the Phased Approach/Rodanthe Bridge Alternative (Preferred), to have less harm after mitigation to the (former) Oregon Inlet US Coast Guard Station because these alternatives would allow access to the site, allow the structure to remain at its existing location, if desired, and allow for more mitigation opportunities as described above. The Pamlico Sound Bridge Corridor would reduce access to the site, potentially eliminate the original location of the site, has lesser mitigation opportunities from the lack of access and potential loss of original location, and may have a complex engineering challenge with relocating the structure to the north, if so proposed.

5.4.1.4 Rodanthe Historic District/Chicamacomico Life Saving Station

The Pamlico Sound Bridge Corridor alternatives and all of the Parallel Bridge Corridor alternatives, except for the Road North/Bridge South and All Bridge alternatives, were designed to mitigate impacts to the historic district by avoiding the use of land from within the district. No contributing structures would be displaced. With the Road North/Bridge South and All Bridge alternatives, Myrna Peters Road would be separated from NC 12, so an alternative access road would be provided for one contributing structure (the J. Frank Meekins Fish House).

Most of the proposed alternatives would avoid using any property in the historic district. This would include the Pamlico Sound Bridge Corridor alternatives, the Parallel Bridge Corridor with Nourishment Alternative, and the Phased Approach alternatives (including the Preferred Alternative). The All Bridge and Road North/Bridge South alternatives would both use land from non-contributing properties within the historic district, and would pass 14 feet (4.3 meters) and 320 feet (97.5 meters), respectively, from two contributing structures - the J. Frank Meekins Fish House and the Levene W. Midgett House (see Section 5.2.4).

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would have an Adverse Effect on the Chicamacomico Life Saving Station and the historic district because of the change in the visual setting. The bridge would be a feature not in keeping with the historic setting of the structures contained within the district in terms of its height and structural components, and it would impede views across NC 12.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would not permanently incorporate land from the historic district and, thus, would not constitute a use of the district under Section 4(f). Potential mitigation for the adverse effects of the Phased Approach/Rodanthe Bridge Alternative (Preferred) was discussed with the Section 106 consulting parties at a July 10, 2008 meeting in Manteo, North Carolina. Although specific mitigation commitments will be fully documented in the final Section 106 MOA, some examples of potential mitigation include:

- Supplement the access roads for property owners on and off NC 12 (current design includes one-way, one-lane access roads on either side of the bridge) with directional signs to guide visitors to the site;

- Provide potential pedestrian access under the bridge;

- Include guardrail around each of the piers, estimated to be spaced about 120 feet (36.6 meters) apart, such that the guardrail would not be continuous; and

- Provide assistance in relocating the Chicamacomico Life Saving Station because it would be less visible to motorists on NC 12.

Conclusion

Of the Parallel Bridge Corridor alternatives, the Road North/Bridge South and All Bridge alternatives would cause the most impacts to the historic district and the Chicamacomico Life Saving Station as assessed in this FEIS. However, the reason the Road North/Bridge South and All Bridge alternatives are within the district is because the district boundaries changed between the 2005 Supplemental Draft Environmental Impact Statement (SDEIS) when these alternatives were developed and the 2007 Supplement to the SDEIS (SSDEIS). These alternatives could be modified to avoid the use of historic district lands by designing them to end in the same general area as the Pamlico Sound Bridge Corridor; however, once the Phased Approach/Rodanthe Bridge Alternative was selected as the Preferred Alternative, the decision was made to not expend the effort to modify the Road North/Bridge South and All Bridge alternatives since their impact on the historic district was not a reason for them not being selected as the Preferred Alternative. If these alternatives had been modified, their impact in the district and Rodanthe would have been similar to the Pamlico Sound Bridge Corridor alternatives.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would have adverse impacts on the historic district, although these impacts do not constitute a use and, with the exception of the visual impacts, the impacts are mitigatable. The Nourishment, Phased Approach/Rodanthe Nourishment, and Pamlico Sound Bridge Corridor alternatives (as well as the Road North/Bridge South and All Bridge alternatives if modified as discussed in the previous paragraph) would cause the least harm to the historic district and the Chicamacomico Life Saving Station. The Nourishment and Phased Approach/Rodanthe Nourishment alternatives would essentially maintain the status quo, while the Pamlico Sound Bridge Corridor alternatives (as well as the Road North/Bridge South and All Bridge alternatives if modified as discussed in the previous paragraph) would avoid the historic district. If the Phased Approach/Rodanthe Bridge Alternative (Preferred) is selected for implementation, the FHWA and NCDOT expect to be able to reach an agreement through the Section 106 process that will adequately mitigate for adverse effects.

5.4.2 Relative Significance of Each Section 4(f) Property

Although it is difficult to compare the relative significance of the Section 4(f) properties affected by this project (described in Section 5.1), FHWA and NCDOT have placed a priority, and therefore have assigned a higher degree of significance, to minimizing the potential effects of the project on the Refuge/Seashore on Hatteras Island. As described above in Section 5.1, the Refuge qualifies as a Section 4(f) property because it is a significant publicly owned park, recreation area, and wildlife refuge, and also is a historic site of national, state, or local significance. The Refuge dominates the project area and has been a central consideration in project development and environmental decision making with regard to the Bonner Bridge replacement project, with several alternatives being modified, or in some cases created, to avoid and/or minimize effects on the Refuge. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is one of these alternatives. As discussed in Section 5.2.2, the Phased Approach/Rodanthe Bridge Alternative (Preferred) and the Pamlico Sound Bridge Corridor alternatives are the only alternatives that completely avoid a use of the Refuge.

5.4.3 Views of Officials with Jurisdiction over Each Section 4(f) Property

The Bonner Bridge replacement project has a long history, and there has been substantial coordination with the agencies with jurisdiction throughout the history of the project, and this coordination has often been contentious. For a more complete discussion, see Chapter 8.

In all cases, the agencies with jurisdiction over the Section 4(f) properties would prefer the Pamlico Sound Bridge Corridor alternatives over all others. The discussion below focuses on the most recent views of the agencies with jurisdiction, and the viewpoints of the FHWA and NCDOT in response to agency concerns. The discussion focuses mainly on the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred), since the most recent discussions occurred within the context of selecting the Preferred Alternative and the Least Environmentally Damaging Practicable Alternative (LEDPA).

5.4.3.1 US Department of Interior

<u>Views</u>

The Secretary of the Interior is the official with jurisdiction over the Seashore and Refuge. Although that jurisdiction is delegated to the USFWS with respect to the Refuge and to the NPS with respect to the Seashore, this project has been so controversial that the Secretary has also been involved.

On July 5, 2006, the Secretary of the DOI sent a letter to US Senator Richard Burr in response to the Senator's concern for the need to replace Bonner Bridge. The letter is presented in Appendix A. In the letter, the Secretary noted that it is important for coordination to occur between DOI and the State of North Carolina in finding a way to replace the bridge as soon as possible to protect the health and safety of the public.

The Secretary indicated that he believed that the best way to proceed would be to separate the replacement of Bonner Bridge, a project whose delay could constitute a clear and present safety issue for all concerned, from the more difficult and less urgent issues of the realignment of

NC 12. The letter indicated that DOI believes the replacement of the bridge itself could be accomplished in a way which is compatible with the National Wildlife Refuge System Improvement Act of 1997, and other laws, if it is constructed within the same easement or with minor changes to the current easement. With this understanding, the letter said that NCDOT could quickly conclude their planning and begin construction of a bridge to replace the existing bridge that Senator Burr stated is an imminent threat to public safety. The Secretary pledged the support of DOI to allow replacement of the bridge, providing safe transportation while protecting important wildlife resources on the Refuge. A similar letter from the DOI also was sent to North Carolina Governor Michael F. Easley on September 11, 2007 (see Appendix A) and is summarized in Section 8.8.3. The DOI also submitted comments on the 2005 SDEIS and the 2007 SSDEIS in 2006 and 2007, respectively. A presentation of the comments included in these letters and responses to those comments is included in Section 8.12.2.

The USFWS and NPS participate on the National Environmental Policy Act (NEPA)/Section 404 of the Clean Water Act (NEPA/Section 404) Merger Team, and indicated that they could not concur on the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) as the LEDPA at the first Concurrence Point 3 Merger Team meeting on May 23, 2007. An issue brief was submitted to FHWA and NCDOT from USFWS and NPS requesting additional information on alternative costs, effects on habitat loss, biological and ecological integrity of the barrier island system, and information regarding the NC 12 easement agreement between NCDOT and DOI, among other concerns (for a more complete list of agency concerns, see Chapter 8). The USFWS made it clear that a compatibility determination would have to be made for an amendment to that easement agreement, and that the DOI indicated that the Phased Approach alternatives would not likely receive a favorable compatibility determination if one were required.

NCDOT and FHWA held a meeting on June 11, 2007 with representatives of the USFWS (Refuge and Raleigh Field Office) and the NPS to further discuss selection of the LEDPA. The USFWS reiterated that any construction outside of the existing NCDOT easement through the Refuge, including emergency actions, would trigger a compatibility determination. The USFWS said that they would have to perform a NEPA analysis on any action that triggers a compatibility determination. The USFWS also emphasized that special use permits for emergency repairs or other activities outside the existing NC 12 easement are causing negative impacts on the Refuge, and if the Phased Approach/Rodanthe Bridge Alternative (Preferred) is selected, the USFWS would not continue to approve these permits.

Conclusion

FHWA and NCDOT agree with DOI that that the bridge replacement is urgent and can be constructed within the existing easement (thus not requiring a compatibility determination). However, DOI has not provided a consistent message at the national, regional, and Refuge levels regarding whether or not a compatibility determination would be required for the Phased Approach/Rodanthe Bridge Alternative (Preferred). FHWA and NCDOT maintain, since the Phased Approach/Rodanthe Bridge Alternative (Preferred) stays within the existing easement for the length of the project on the Refuge, that a compatibility determination is not required because the Phased Approach/Rodanthe Bridge Alternative (Preferred) falls within the terms of the easement permit. However, the administration of the National Wildlife Refuge System Improvement Act of 1997 is the responsibility of the DOI. All of the other Parallel Bridge Corridor alternatives would require new easement agreements with USFWS since they cannot be built within the existing easement, and would likely require a compatibility determination.

5.4.3.2 State Historic Preservation Officer (SHPO)

As the entity charged with protecting historic resources in North Carolina under the National Historic Preservation Act, the SHPO has jurisdiction over the historic properties in the project area. The SHPO participates on the Merger Team and, like the USFWS and NPS, indicated that they could not concur on the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) as the LEDPA at the first and third Concurrence Point 3 Merger Team meetings held on May 23, 2007 and August 15, 2007, respectively. The SHPO's Issue Brief, submitted after the second meeting, asked for further clarification regarding the Phased Approach/Rodanthe Bridge Alternative (Preferred) and its sizable visual intrusion into the landscape of the Refuge and whether this constituted a constructive use under Section 4(f). FHWA and NCDOT address this issue in Section 5.5.

The SHPO subsequently concurred on the finding of effect for the three historic resources in the area of potential effects (APE) for each of the replacement bridge corridor alternatives (see Sections 5.2 and 4.4.1 for a more complete discussion). Although the Section 106 MOA has not been finalized for the Phased Approach/Rodanthe Bridge Alternative (Preferred), the Section 106 consulting parties identified potential mitigation options at a July 10, 2008 meeting in Manteo, North Carolina. NCDOT and FHWA believe that the commitments in the final MOA will adequately mitigate for adverse effects to historic resources.

5.4.4 Degree to Which Each Alternative Meets the Purpose and Need for the Project

<u>*Analysis*</u>

All of the alternatives selected for detailed study would meet the purpose and need for the project (see Sections 1.1 and 1.2). Section 4(f) regulations specify that the degree to which each alternative meets the purpose and need can be weighed in the analysis of least overall harm. The alternatives being considered all meet the second and third purpose and need equally, in that they all take into account channel migration to 2050, and adequately take into consideration shoreline migration to 2050.

The first purpose and need, regarding the continued demand of "convenient daily and emergency access" for "residents, businesses, services, and tourists," is not equally met by all of the alternatives, though differences are minor. Current and forecasted future demand would be met to similar degree by all of the alternatives being considered. As stated in Section 4.1.6.1, however, emergency access times from Rodanthe to Bodie Island were estimated to be two minutes longer for emergency response using the Pamlico Sound Bridge Corridor when compared to the Parallel Bridge Corridor. Also, as noted in Section 5.2 and Section 4.5.3.1, road access to certain refuge activities and facilities would be reduced by several of the alternatives. With the Pamlico Sound Bridge Corridor alternatives, paved road access to the Refuge would not be retained and the potential alternate access proposed by the Refuge would be less convenient for Refuge visitors. The Parallel Bridge Corridor alternatives (including the Preferred Alternative) would provide various levels of paved road access with the Nourishment Alternative maintaining existing levels of road access. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would provide two locations for road access to the Refuge, but more than that associated with the Pamlico Sound Bridge Corridor alternatives. It should be noted, however, that the first purpose and need statement refers to continued access to all of Hatteras Island, not just the Refuge.

Conclusion

The differences are minimal in the degree to which the Parallel Bridge Corridor alternatives and the Pamlico Sound Bridge Corridor alternatives meet the purpose and need of this project. The alternatives are substantially equal in the degree to which they meet the purpose and need. Therefore, the degree to which the alternatives meet the purpose and need of the project is not a significant factor in determining least overall harm.

5.4.5 After Reasonable Mitigation, the Magnitude of Any Adverse Impacts to Properties Not Protected by Section 4(f)

Since most of the properties in the project area are Section 4(f) properties, most of the discussions regarding impacts are contained in Section 5.2. In addition, this section will focus on areas where there are impacts to the degree that it would affect the least overall harm analysis.

5.4.5.1 Relocations

A summary of the relocations for each alternative is provided in Table S-1 and discussed in Section 4.1.1. The Pamlico Sound Bridge Corridor would require the most relocations, with the Curved Rodanthe Terminus requiring 12 relocations and the Intersection Rodanthe Terminus requiring six. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would require three relocations. The Road North/Bridge South and the All Bridge alternatives would require two relocations, and the Nourishment and the Phased Approach/Rodanthe Nourishment alternatives would require no relocations.

5.4.5.2 Economic

Economic effects, discussed in detail in Section 4.1.5, mainly stem from loss of tax revenue because of relocations, changes in access to the Refuge, and the potential breach of NC 12 after a storm event. The tax base loss associated with taking private land for public use for any of the replacement bridge corridor alternatives would be a fraction of one percent of the county's total tax base. The loss of paved road access to the Refuge, which could occur under the Pamlico Sound Bridge Corridor alternatives, would result in an estimated loss of $4.5 to $5.8 million in annual earnings, and a loss of $1.5 to $2.1 million annually in tax revenue.

The potential effect of a storm related breach is more substantial. For example, a peak season breach of NC 12 lasting one month is estimated to cause a loss of $36.68 million, and one lasting three months a loss of $110.04 million. It should be noted that there is substantial uncertainty regarding the potential frequency of weather events that would cause such breaches to form. These breach-related economic impacts would be relevant for all of the Parallel Bridge Corridor alternatives except for the All Bridge Alternative and the Phased Approach/Rodanthe Bridge Alternative (Preferred) (unless the breach occurred before Phases II and III were implemented). Neither of the Pamlico Sound Bridge Corridor alternatives would have any breach-related economic impacts since breach areas would be bypassed.

5.4.5.3 Visual Impacts

At Rodanthe, panoramic views of the Pamlico Sound from homes along the sound's shoreline would be changed with all of the alternatives except for the Parallel Bridge Corridor with Nourishment Alternative and the two Phased Approach alternatives (including the Preferred Alternative). The location of the Pamlico Sound Bridge Corridor would minimize impacts to views by maintaining a predominantly straight and perpendicular final approach to land. The proposed bridge would not generally obscure the full panorama of the views of Pamlico Sound from homes along the shoreline, but only views to the immediate south or north depending on the location of the homes. The Rodanthe area bridge, included in the Road North/Bridge South and All Bridge alternatives, would be closer to the shore over its full length than the Pamlico Sound Bridge Corridor bridge. The intactness and unity of the view would be split by the line of the Rodanthe area bridge across the full 180 degrees of the view.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) would not have an effect on the homes along the Pamlico Sound shore, but would have a sizable visual effect on Rodanthe, introducing into views an elevated roadway in Rodanthe for a distance of 1.1 miles (1.8 kilometers) (see Figure 5-5). The Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment Alternative would introduce an elevated roadway in Rodanthe for a distance of 0.3 mile (0.5 kilometer). The elevated roadway also would be introduced into views of the Refuge from Rodanthe. The bridge would be at its full height of approximately 33.5 feet (10.2 meters) as it enters Rodanthe from the north. The bridge would remain at its full height for 0.8 mile (1.3 kilometers) and then begin to descend to ground level. The final 400 feet (122.0 meters) of the elevated roadway would be on fill contained by retaining walls. Views of the Atlantic Ocean from homes on the west side of NC 12 would be substantially obscured, in some cases up to the third or fourth floor.

5.4.5.4 Conclusion

When considering the magnitude of any adverse impacts to properties not protected by Section 4(f) for the replacement bridge corridor alternatives, FHWA and NCDOT consider that the Parallel Bridge Corridor with Nourishment and Phased Approach/Rodanthe Nourishment alternatives cause the least harm. This is mainly because of the lack of visual impacts in Rodanthe. When balancing the magnitude of impacts, FHWA and NCDOT consider the remaining alternatives (including the Preferred Alternative) substantially equal.

5.4.6 Substantial Differences in Costs among the Alternatives

The cost of the Pamlico Sound Bridge Corridor and Parallel Bridge Corridor alternatives are presented in Table 5-1. These costs illustrate a substantial range between alternatives, from just over $600 million for the Parallel Bridge Corridor with Road North/Bridge South Alternative (low estimate range), to almost $1.8 billion for the Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus (high estimate range).

Of all the replacement bridge corridor alternatives being considered, the Phased Approach/ Rodanthe Bridge Alternative (Preferred) is the least expensive option (estimated between $1,171,459,000 and $1,497,113,000) that avoids a Section 4(f) use of the Refuge, which is the most significant Section 4(f) property in the project area.

As discussed in Section 2.12.4, funding availability and alternative costs are of paramount concern. Because of the funding allocation process in North Carolina (the “Equity formula”), and the lack of funding to cover the entire cost of any of the detailed study alternatives in one seven-year Transportation Improvement Program (TIP) period, any of the replacement bridge corridor alternatives only could be built if it is possible to build them in operational phases. The four phases of the Phased Approach alternatives (including the Preferred Alternative) were developed primarily to address future forecast coastal conditions, but the issue of funding availability also

Table 5-1. Cost Comparison

Alternative	Total Costs through 2060	
	Low	High
Pamlico Sound Bridge Corridor		
• Curved Rodanthe Terminus	$1,305,564,000	$1,797,564,000
• Intersection Rodanthe Terminus	$1,299,066,000	$1,788,066,000
Parallel Bridge Corridor		
• Nourishment	$671,835,000	$970,350,000
• Road North/Bridge South	$602,208,000	$740,208,000
• All Bridge	$1,107,683,000	$1,435,283,000
• Phased Approach/Rodanthe Bridge Alternative (Preferred)	$1,171,459,000	$1,497,113,000
• Phased Approach/Rodanthe Nourishment	$1,149,098,000	$1,524,350,000

was a consideration in the decision to phase these alternatives. The Pamlico Sound Bridge Corridor alternatives cannot be built in operational phases. Any of the Parallel Bridge Corridor alternatives could be built in operational phases.

The Dare County Board of Commissioners sent a letter to North Carolina Senators Richard Burr and Elizabeth Dole, as well as North Carolina Representative Walter Jones, on June 5, 2006 (see Appendix A). In the letter, the Commissioners expressed their support for a "Short Bridge Alternative" across Oregon Inlet between the southern end of Bodie Island and the northern end of Hatteras Island as is assumed with the Parallel Bridge Corridor alternatives. They requested assistance in allowing construction on a short bridge to begin as "quickly and economically as possible." The primary reason that the Commissioners expressed support for a short bridge over the Pamlico Sound Bridge Corridor was that funding exists for the short bridge, whereas funding does not exist and is not available from the State of North Carolina for a Pamlico Sound Bridge. They went on to state that because funding does not exist for a Pamlico Sound Bridge, a short bridge must be constructed immediately because of the potential safety and economic impacts to the residents and visitors of Dare County if the Bonner Bridge fails or has to be closed.

On June 20, 2007 an informational Merger Team meeting was held to discuss funding issues with regard to the Pamlico Sound Bridge Corridor and the Phased Approach alternatives (see Section 8.10.1.2). FHWA and NCDOT presented details on the cost estimates for the detailed study alternatives that were presented in the 2007 SSDEIS. The Merger Team also was informed that the cost estimates were independently reviewed by both the FHWA Office of Bridge Technology and an independent bridge contractor.

On August 27, 2007 representatives of NCDOT, FHWA, USACE, and NCDENR, as part of the NEPA/Section 404 merger process, concurred that the Phased Approach/Rodanthe Bridge Alternative was the LEDPA. The design and phasing of the Phased Approach/Rodanthe Bridge Alternative (Preferred) in the context of the changing coastal and shoreline conditions, ability of the alternative to meet the project's purpose and need, environmental consequences, opportunities available to mitigate impacts, limitation of available funding and project cost, avoidance and minimization of the use of Section 4(f) properties, the compatibility requirements of the 1997 National Wildlife Refuge System Improvement Act, and public and agency comments were all considerations in this decision (see Section 2.15 and Appendix D).

In conclusion, the Pamlico Sound Bridge Corridor alternatives cannot reasonably be built because of the lack of available funding and the inability to phase the project in operational segments. The other alternatives (including the Preferred Alternative) can be built because of the ability to phase these alternatives in operational segments.

5.4.7 Conclusion

Based on a consideration and balancing of the seven factors above, FHWA and NCDOT have determined that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is the alternative that causes the least overall harm. Although the Phased Approach/Rodanthe Bridge Alternative (Preferred) does not always cause the least environmental impacts (e.g., visual, biotic communities, wildlife, relocations, access), the intent of the least harm analysis is to balance all of the seven factors. The most weight is placed on the ability to mitigate adverse impacts of the alternatives to each Section 4(f) property (including any measures that result in benefits to the property); the relative severity of the remaining harm after mitigation to the protected activities, attributes, or features that qualify each Section 4(f) property for protection; the relative significance of each Section 4(f) property; and substantial differences in cost.

As stated above, the Refuge is the most significant resource in the project area. Refuge officials have been clear that any alternatives that use the Refuge would require a compatibility determination and that any alternative that requires land not in the existing easement would not be approved. Of the Parallel Bridge Corridor alternatives, all of the alternatives, except for the Phased Approach alternatives (including the Preferred Alternative), would use land from the Refuge and would require new or modified easements. The All Bridge and Road North/Bridge South alternatives have large impacts on the Refuge in terms of the total area taken (land permanently incorporated from the Refuge) and impacts to biotic communities, although the current NC 12 easement would be re-vegetated and returned to the Refuge. The Phased Approach/Rodanthe Nourishment Alternative would require the use of a small amount of the Refuge (and would require a compatibility determination) and would not allow for natural shoreline processes to occur. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is the only Parallel Bridge Corridor alternative that would stay within the existing easement, would not use the Refuge, would not require a compatibility determination, and would allow natural shoreline process to take place.

Like the Phased Approach/Rodanthe Bridge Alternative (Preferred), the Pamlico Sound Bridge Corridor alternatives also would not use Refuge lands, and would not require a compatibility determination. The Pamlico Sound Bridge Corridor alternatives would minimize other impacts to natural systems, and would allow natural shoreline process to take place. For these reasons, the remainder of this assessment will focus on comparing the Phased Approach/Rodanthe Bridge Alternative (Preferred) and the Pamlico Sound Bridge Corridor alternatives.

Between the Phased Approach/Rodanthe Bridge Alternative (Preferred) and the Pamlico Sound Bridge Corridor alternatives, the Pamlico Sound Bridge Corridor alternatives would cause fewer impacts to most environmental resources, including the Refuge which it avoids completely.

However, the Phased Approach/Rodanthe Bridge Alternative (Preferred) is the only option that can be feasibly built that does not use property in the Refuge or the historic district. The Preferred Alternative would ultimately end regular storm-related NC 12 maintenance in the Refuge, including substantially decreasing such maintenance after the completion of Phase II.

As discussed in Section 5.4.6, the construction of the Phased Approach/Rodanthe Bridge Alternative (Preferred) can reasonably be funded. The Pamlico Sound Bridge Corridor alternatives cannot be built in operational phases and are, therefore, not practicable because of the lack of funding for construction. Both FHWA and the State of North Carolina have made it clear that adequate funding would not be available for either of the Pamlico Sound Bridge Corridor alternatives. Since the current Bonner Bridge has a sufficiency rating of 2 (on a scale of 2 to 100), and long-term rehabilitation of the bridge is not possible, the timely replacement of the bridge is of immediate concern. The major rehabilitation project currently underway (see Section 1.1) is expected to extend the life of Bonner Bridge no more than 10 years. Therefore, it would not be in the public's best overall interest to select an alternative for which funding will not be available.

The conclusion that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is the overall least harm alternative has been reached by considering the ability of the alternative to meet the project's purpose and need, environmental consequences, opportunities available to mitigate impacts, limitation of available funding and project cost, the design and phasing of the alternative in the context of the changing coastal and shoreline conditions, and public and agency comments. In addition, as discussed in Section 2.15, this conclusion is further supported by the August 27, 2007 concurrence by representatives of NCDOT, FHWA, USACE, and NCDENR under the project's NEPA/Section 404 merger process. In that meeting these agencies concurred that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is the LEDPA for replacing the Bonner Bridge (see Appendix D for the signed agreement).

5.5 Constructive Use

The purpose of this constructive use analysis is to evaluate the potential for constructive uses of significant publicly owned parks, recreation areas, or wildlife and waterfowl refuges, or any significant historic sites that could result from the Phased Approach/Rodanthe Bridge Alternative (Preferred). A constructive use occurs when the transportation project does not incorporate land from a Section 4(f) property, but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired. This analysis evaluates proximity impacts because of noise, visual intrusion, restriction of access, vibration, and ecological intrusion.

Substantial impairment occurs only when the protected activities, features, or attributes of the property are substantially diminished per 23 CFR 774.15(a). Additional guidance as to what factors do and do not result in substantial impairment can be found at 23 CFR 774.15(e) and 23 CFR 774.15(f).

As described in 23 CFR 774.15(d), this constructive use analysis is intended to identify any proximity impacts to Section 4(f) properties that would result in the substantial impairment of the activities, features, or attributes that qualify the property for protection under Section 4(f) and may be sensitive to proximity impacts. If any of the proximity impacts can be mitigated, only the net impact after mitigation needs to be included in this analysis. This analysis also considers the impacts that could be reasonably expected if the proposed project were not implemented as these impacts should not be attributed to the proposed project.

It was documented in Section 5.2 that all of the detailed study alternatives would use a portion of a Section 4(f) property, the Cape Hatteras National Seashore. Thus, there can not also be a constructive use of the Seashore. This analysis will review the remaining Section 4(f) properties within this project area (the [former] Oregon Inlet US Coast Guard Station, Pea Island National Wildlife Refuge, and the Rodanthe Historic District and Chicamacomico Life Saving Station) to determine whether there would be a constructive use of any of these Section 4(f) properties with the selection of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred).

5.5.1 Methodology

The following methodology provides a framework for evaluating potential proximity impacts. This methodology is consistent with the guidelines provided in 23 CFR 774.15(e) and (f), and establishes a threshold or standard for determining when proximity impacts would be so severe as to substantially impair the activities, features, or attributes that make the Refuge and historic sites eligible for protection under Section 4(f). The following guidance includes the methodology for determining if proximity impacts because of noise, visual intrusion, restriction of access, vibration, and ecological intrusion would constitute a significant impairment to the activities, features, or attributes that qualify the property for protection under Section 4(f).

In addition to individually considering the proximity impacts of noise, visual intrusion, restriction of access, vibration, and ecological intrusion, a substantial impairment also could result from a combination of the proximity impacts. Therefore, in assessing the constructive use of a Section 4(f) property, the overall (combined) proximity impacts also were considered.

Federal regulations (23 CFR 774.15(f)) state that a constructive use does not occur when “Compliance with the requirements of 36 CFR 800.5 for proximity impacts of the proposed action, on a site listed on or eligible for the National Register, results in an agreement of ‘no historic properties affected’ or ‘no adverse effect.’” In addition, if “There are proximity impacts to a Section 4(f) property, but a governmental agency’s right-of-way acquisition or adaptation of project location, … established the location for the proposed transportation project before the designation, establishment, or change in significance of the property,” then there is no constructive use. The regulations also state that a constructive use does not occur when “Proximity impacts will be mitigated to a condition equivalent to, or better than, that which would occur if the project were not built, as determined after consultation with the official(s) with jurisdiction.”

5.5.1.1 Noise and Vibration as Substantial Impairment

Project-related noise constitutes a substantial impairment to a Section 4(f) property only if the noise level increase substantially interferes with the use and enjoyment of a noise sensitive facility of the Section 4(f) property (see also Section 3.10 for additional information about noise and FHWA’s NAC). For a wildlife refuge, the primary refuge purpose/activities of the refuge must be of a nature that increased noise levels would substantially interfere with the viewing of wildlife in an area of the refuge intended for such wildlife viewing. For a public park or recreation area, the primary recreational activities of the park or recreation area must be of a nature such that increased noise levels would substantially interfere with those activities. For a historic site to derive some of its value from a relatively quiet setting, the resource must have some type of noise sensitive activity, or have a quiet setting as a generally recognized feature or attribute of the site's significance.

The information contained within 23 CFR 774.15(f) states that "The Administration has reviewed the following situations and determined that a constructive use does not occur when: (2) The impact of projected traffic noise levels of the proposed highway project on the noise-sensitive activity do not exceed the FHWA NAC as contained in Table 1 in part 772 of this chapter [23 CFR], or (3) The projected noise levels exceed the relevant threshold in paragraph (f)(2) of this section because of high existing noise, but the increase in the projected noise levels if the proposed project is constructed, when compared with the projected noise levels if the project is not built, is barely perceptible (3 dBA or less). Also, no constructive use based on noise would occur where the projected noise is mitigated to a level at or below the noise level that would occur under a no-build scenario."

The FHWA NAC are contained in 23 CFR 772. The criteria are based on specific land uses and are employed in determining the need for studying noise attenuation measures. The majority of locations within the project area are of Land Use Category B or C, which have design noise levels of 67 dBA and 72 dBA, respectively. Three sites within the historic district (two homes and the Chicamacomico Life Saving Station) were analyzed. The homes in the historic district are Land Use Category B and the Chicamacomico Life Saving Station is Land Use Category C. The Refuge also is Land Use Category B. A discussion of the noise analysis is included in Section 4.10. It concludes that there would not be a substantial increase in noise levels because of the Phased Approach/Rodanthe Bridge Alternative (Preferred) at any of these receptors. Therefore, no traffic noise abatement would be needed at these sensitive receptors.

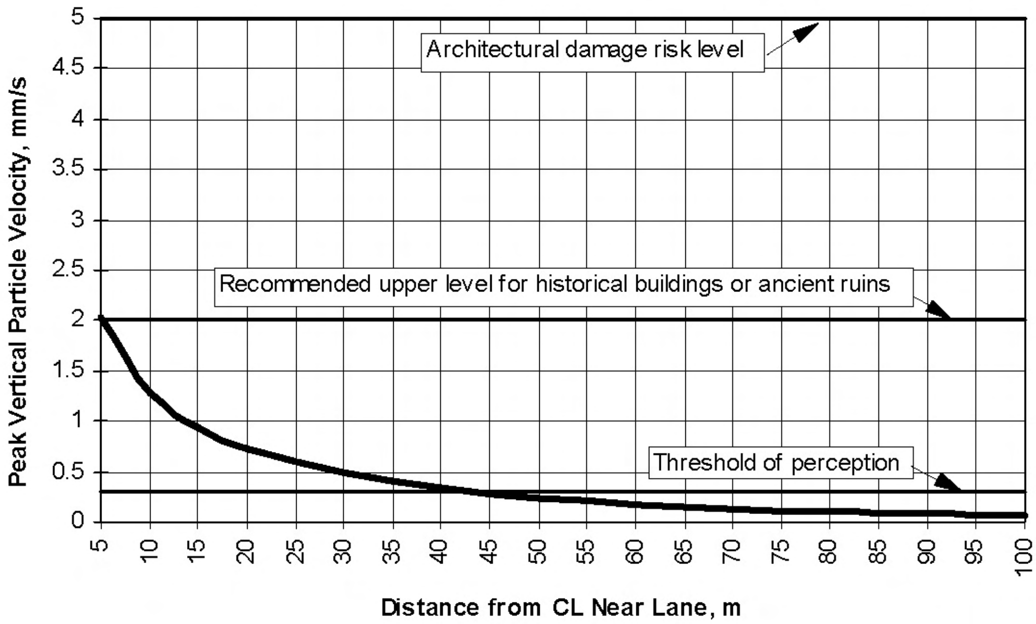
A constructive use because of vibration occurs when the vibration impact from the operation of a project substantially impairs the use of a Section 4(f) property, such as projected vibration levels from a highway project that are great enough to affect the structural integrity of a historic building or substantially diminish the utility of the building. Likewise, substantial impairment of a park would occur if the vibrations substantially detracted from the primary activities of the park. The preamble to 23 CFR 771.135(p) states that "numerous studies of operational highway traffic vibration impacts have all shown that vibration levels from highway traffic have been well below criteria for architectural or structural damage to nearby buildings."

For transportation projects, such as the proposed Bonner Bridge replacement, there are two types of transportation related earth-born vibration sources: normal highway traffic and construction equipment. Generally, advance planning and monitoring during construction can effectively limit vibration to levels that would not cause any structural or architectural damage to resources protected by Section 4(f). Therefore, vibration from highway traffic was assessed in locations where an alignment is adjacent to a protected resource.

Data contained in Figure 5-6 was developed by the California Department of Transportation (CALTRANS) based on 40 years of measurements of vibrations adjacent to highways. It shows typical vibrations (Peak Particle Velocity [PPV]) with distance for trucks. Figure 5-6 was used to determine vibrations at protected resources within the project area because of highway traffic.

As shown in Figure 5-6, the recommended upper level for peak vertical particle velocity for historical buildings is 2.0 millimeters/second (mm/s). This upper level is only exceeded when the distance from the historic structure to the centerline (CL) of the nearest lane is less than 5 meters (17 feet).

Figure 5-6. Maximum Highway Truck Traffic Vibration Levels vs. Distance



5.5.1.2 Visual Intrusion as Substantial Impairment

A constructive use based on visual intrusion would occur only when there is substantial impairment of aesthetic features or attributes of a Section 4(f) property, where such features or attributes are important contributing elements to the value of the Section 4(f) property. Also, a constructive use would occur when the location of a proposed transportation facility is "in such proximity that it obstructs or eliminates the primary views of an architecturally significant historical building, or substantially detracts from the setting of a Section 4(f) property which derives its value in substantial part to its setting (23 CFR 774.15(e)(2))." In the case of a historic property, the setting is defined in National Register (NR) Bulletin 15 as the physical environment of a historic property, and refers to its character and "often reflects the basic physical conditions under which a property was built and the functions it was intended to serve." Physical features that may constitute the setting of a historic property include such elements as: topographic features; vegetation; simple man-made features; and relationships between buildings and other features or open space.

Historic properties, eligible for the NRHP as described in 36 CFR 60.4 under Criterion A, are significant for their historic association with an important event, historical pattern, or person(s). Properties eligible under Criterion A must retain the essential physical features that made up their character or appearance during the period of their association (NR Bulletin 15). It follows that substantial diminishment of integrity for most resources eligible under Criterion A would involve the loss of the physical features that made up their character or appearance during the period of their association with the important event, historical pattern, or person(s).

Historic properties eligible for the NRHP under Criterion C are important for illustrating a particular architectural style or construction technique. Properties eligible under Criterion C must retain design, workmanship, and materials. This is more important than location, setting, feeling, and association. However, location and setting will be important for those properties whose design is a reflection of their immediate environment (such as designed landscapes and bridges)

(NR Bulletin 15). From this definition, it would be apparent that substantial diminishment of integrity for most resources eligible under Criterion C would involve loss of the design, workmanship, and materials; the physical features, which define the integrity of the resource. Substantial loss of location, setting, feeling, and association would generally not be as important to the determination of substantial impairment for most resources eligible under Criterion C.

5.5.1.3 Restriction of Access as Substantial Impairment

In order for restriction of access to be considered a constructive use, the access restriction would have to substantially diminish the utility of a publicly owned park or recreation area, or significant historic site (23 CFR 774.15(e) (3)).

5.5.1.4 Ecological Intrusion as Substantial Impairment

In order for ecological intrusion to be considered constructive use, the project must be shown to substantially diminish the value of wildlife habitat in a wildlife and waterfowl refuge adjacent to the project. In addition, the project must be shown to substantially interfere with the wildlife access to a wildlife and waterfowl refuge when such access is necessary for established wildlife migration or critical life cycle processes, or substantially reduce the ability of wildlife to use the wildlife and waterfowl refuge (23 CFR 774.15(e)(5)).

5.5.2 Analysis of Proximity Impacts

This analysis assesses proximity impacts to Section 4(f) properties that would be in proximity to the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred), but from which land would not be acquired. If land is acquired from a Section 4(f) property, there cannot also be a constructive use. These resources are the Pea Island National Wildlife Refuge, the (former) Oregon Inlet US Coast Guard Station on Hatteras Island, the Rodanthe Historic District, and the Chicamacomico Life Saving Station. The assessment of proximity impacts resulting from the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) focuses on potential noise and vibration impacts, potential visual impacts, potential impacts because of proposed changes in access, and potential ecological intrusions. Each of these types of impacts are identified and described.

5.5.2.1 Pea Island National Wildlife Refuge

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would not use property from the Refuge as it would be constructed and maintained entirely within the existing NC 12 easement through the Refuge; thus there is no permanent or temporary use of Refuge lands associated with construction of the project. This analysis will demonstrate that there is no constructive use of Refuge lands as the proximity impacts are not severe enough as to substantially impair the protected activities, features, or attributes that qualify the Refuge for protection under Section 4(f).

<u>*Noise and Vibration*</u>

Noise and vibration impacts on the Refuge caused by the construction of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would be minimal and do not rise to the level of constituting a constructive use as defined by 23 CFR 774.15(e)(1) or (4).

As described in Section 4.10.3, noise impacts of traffic on the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be associated with forecast traffic growth and not the project because NC 12 would remain in the existing easement. The 66 dBA contour for NC 12 traffic would be 117 feet (35.7 meters) from the centerline of the Phased Approach/Rodanthe Bridge Alternative (Preferred) exclusive of dunes along the shoreline. The existing 66 dBA contour is 96 feet (29.3 meters). The difference reflects traffic growth from 2002 to 2025. As the shoreline erodes under the Phased Approach bridges, the Refuge would move away from the bridge, including areas used by the public and wildlife.

From the perspective of vibration, no facilities maintained by the Refuge are within 5 meters (17 feet) from the proposed project. As shown in Figure 5-6**,** any distance greater than 5 meters (17 feet) from the roadway, the maximum PPV for highway traffic, is less than the recommended maximum PPV of 2.0 millimeters/second. Therefore, vibrations from NC 12 traffic would not adversely affect Refuge facilities.

As discussed in Section 4.7.6.6 under “Noise Disturbance,” the greatest new noise disturbance in the Refuge would come from bridge construction, particularly pile placement. As the project would be phased, the most intense construction disturbance would be confined to the location of the construction of any given phase. However, the four phases would be built over an estimated 12.5 years of construction within a period of approximately 20 years, and movement of construction equipment and materials could be expected throughout the Refuge during the construction of each phase. Noise and vibration impacts of construction of this alternative would be minimized via the implementation of minimization measures and managing construction activities (see Section 4.13.3).

In its April 27, 2007 comment letter, DOI stated a concern that noise impacts would directly affect wildlife outside of the existing easement. Construction impacts, including noise and vibration, to threatened and endangered species within the Refuge would be mitigated through conservation measures (see Section 4.7.10.4) and reasonable and prudent measures (see Section 4.7.10.5) agreed to with the USFWS during Section 7 (of the Endangered Species Act) consultation.

Visual

As described in Sections 4.3.2 and 5.2.2, there would be visual impacts to the Refuge caused by the presence of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred). This alternative would introduce a sizable new linear man-made feature for approximately 10 miles (16.1 kilometers) through the Refuge. NC 12 through most of the Refuge would be elevated on a bridge within the existing easement. The bridge would be at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (approximately 30 feet [9.1 meters] above ground), allowing for the bottom of the superstructure to be a minimum of 25 feet (7.6 meters) above mean high water (see Figure 2-24). The bridge would dominate views from the dunes lining the beach and, as the dunes disappear over time because of natural processes, it also would dominate views of the beach and ultimately the ocean. It would not be characteristic of the undeveloped and protected character of the Refuge that makes it rare along the eastern US seaboard in terms of views and a setting for recreation activities. This alternative would also have an Adverse Effect on the Refuge as a historic resource because of the elevation of NC 12 on bridges as it passes through the historic Refuge landscape.

When assessing whether there would be a constructive use because of visual impacts, a review of the Historic Survey Report completed in July 2003 was conducted. The survey report determined that the Refuge is eligible for the NRHP under Criterion A (history), stating that the Refuge is eligible in the areas of conservation and social history. The Refuge was noted as being an outstanding example of national wildlife refuges that arose in early 20th century. The study also noted that with its man-made dikes and dunes, the Refuge also illustrates the efforts of the CCC on the Outer Banks to protect and revitalize natural resources. Typical of such cultural landscapes, the Refuge has changed over time. This section of seashore is continually threatened by shoreline erosion and overwash; however, the Refuge retains its key original elements, and the changes do not significantly detract from its integrity.

The DOI has commented, specifically in its April 27, 2007 comment letter on the 2007 SSDEIS, that the visual presence of the bridges within this landscape would adversely affect the character of the Refuge. However, it is the position of FHWA and NCDOT that the visual impacts of the bridges would not eliminate the Refuge's ability to function as a wildlife refuge. Wildlife would still have access to habitat beneath the bridges.

Access

As described in Sections 4.1.4.2, 4.5.3.1, and 5.2.2, some access to Refuge activities, features, and attributes would be maintained. When complete, the bridges associated with the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would limit access to the Refuge to two locations off of NC 12. The first access point would be the interchange adjacent to the fishing catwalks parking lot that would be started during Phase I and completed during Phase II. In Phase I, the Oregon Inlet bridge would be built and would end as a stub on Hatteras Island in the existing easement and adjacent to the catwalks parking lot. Ramps would be built on either side of the bridge to bring traffic down to the existing road. During Phase II, the bridge would be extended south and a second set of ramps would be built. The ramps would function as a highway interchange to bring NC 12 traffic down to the existing parking lot (see Section 2.10.1.2 and Figure 2-22). The second access point would be south of the ponds in the 2.1-mile (3.4-kilometer) section of NC 12 in the southern half of the Refuge that is not expected to be threatened by erosion prior to 2060 (see Figure 5-4b). This alternative would eventually bypass the Refuge Visitor Center, two trails, the Refuge headquarters, and the boat ramp. Access to the ocean and to the beach also would be limited to the two access points discussed above. Shoreline analysis studies have indicated that the Refuge Visitor Center and headquarters would be threatened by beach erosion by 2020 with all of the Parallel Bridge Corridor alternatives except for the Nourishment Alternative, and would need to be relocated. While visitor access to Refuge activities, features, and attributes would be reduced, this reduced access would not substantially diminish the ability of the Refuge to continue to function as a wildlife refuge or the eligibility of the Refuge for the NRHP.

The USFWS has not indicated that the reduction of access to Refuge visitor facilities would eliminate the Refuge's ability to function as a wildlife refuge.

Ecological Intrusion

Ecological impacts of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) are discussed in detail in Section 4.7. When reviewing the ecological impacts to the Refuge, several key areas were identified. Impacts to threatened and endangered species, water quality, migratory birds, and habitat quality were considered.

There are 13 federally-listed threatened or endangered species in Dare County. With the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred), the biological conclusion for six of these species is "May Affect – Not Likely to Adversely Affect," the biological conclusion for three species is "No Effect," and the biological conclusion for four species is "May Affect – Likely to Adversely Affect."

Based on the biological conclusions, the Refuge could still provide habitat and protection for endangered and threatened species as outlined in its objectives. During the 2005 SDEIS comment period, the USFWS did request additional studies be done for nighttime lighting effects on green sea turtles and the effects on the piping plover as a result of having an eventual offshore bridge.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) impacts to migratory birds do not inhibit the Refuge's objective of providing nesting, resting, and wintering habitat to migratory birds. It should be noted that once shoreline erosion reaches the structure, feeding and nesting areas may be disturbed.

There has been a concern about the mortality rate of migratory birds because of vehicular traffic on the bridge. This is a common issue for roads and bridges in coastal areas.

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would allow more natural coastal processes to occur by eliminating artificial dune construction and beach nourishment. Breaches may form underneath the completed bridges; there would be erosion along the coastline. These natural processes could benefit the ecology in the area, as discussed in Section 4.7.7.

There would be habitat loss from fill at bridge termini and bridge piles from the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred), both initially as each phase is completed and in the long-term as the shoreline erodes and the bridge is in the ocean. The total area of disturbance within the easement in the Refuge is 3.7 acres (1.5 hectares) of permanent impact and 48.5 acres (19.6 hectares) of temporary construction impact. A substantial portion of this land disturbed within the NC 12 easement would be man-dominated upland, including 3.2 acres (1.3 hectares) of permanent impact and 20.7 acres (8.4 hectares) of temporary construction impact.

Table 4-23 in the same section presents bridge length over beach and ocean for several years with the Phased Approach/Rodanthe Bridge Alternative (Preferred). Once segments of the bridge are in the ocean, although they would affect ocean habitat as discussed in Section 4.7.6.2, they would no longer be within the Refuge.

Thus, the use of habitat would be small in relation to the rest of the Refuge; much of it is already man-dominated. The Refuge would have adequate habitat to manage. During the 2007 SSDEIS comment period, DOI/USFWS did suggest additional analysis for impact to habitat as a result of scour, maintenance, placement of revetment or stabilizing structures, and repair of bridge piles. These comments are addressed in this FEIS and additional analyses were conducted as needed.

The Phased Approach/Rodanthe Bridge Alternative (Preferred) impacts to water quality do not inhibit the use of the Refuge to comply with its mission. Bridge Stormwater Controls presented in NCDOT's *Stormwater Best Management Practices Toolbox* (NCDOT, 2008), or proprietary devices applicable to controlling bridge deck runoff, would be considered for all bridge replacement segments traversing the Refuge and adjoining receiving water bodies. Refuge lands currently receive runoff from NC 12 traffic and the Phased Approach/Rodanthe Bridge Alternative (Preferred) would serve that same traffic. The amount of bridge runoff in the Refuge would decline over time as the shoreline erodes.

Conclusion

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would have impacts to the Refuge in terms of noise and vibration, visual, access, and ecological systems; however, they are not of a severity that the protected activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired preventing the Refuge from continuing to function as a refuge. The impacts would not substantially impair the activities, features, or attributes that make the Refuge eligible under Criterion A for the NRHP, or cause a substantial impairment to its ability to function as a refuge. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would not substantially diminish the historic nature of the Refuge, and would not affect the historical significance of the CCC facilities on the Refuge.

5.5.2.2 (Former) Oregon Inlet US Coast Guard Station

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) does not use property from the (former) Oregon Inlet US Coast Guard Station, thus there is no permanent or temporary use of the station property. This analysis will demonstrate that there is no constructive use of the (former) Oregon Inlet US Coast Guard Station property as the proximity impacts are not severe enough, or directly related to the proposed action, as to substantially impair the protected activities, features, or attributes that qualify the station for protection under Section 4(f).

Noise and Vibration

Noise and vibration impacts caused by the Parallel Bridge Corridor with Phased/Approach Rodanthe Bridge Alternative (Preferred) do not rise to the level of constituting a constructive use as defined by 23 CFR 774.15 (e)(1) or (4). The (former) Oregon Inlet US Coast Guard Station has not been identified as a noise-sensitive facility. It is unoccupied and as such no noise-sensitive activities are associated with the resource. The station would be located 577 feet (175.6 meters) from the nearest edge of the main travelway of the Phased Approach/Rodanthe Bridge Alternative (Preferred). The 66 dBA noise contour for NC 12 traffic would be 117 feet (35.7 meters) from the centerline of the Phased Approach/Rodanthe Bridge Alternative (Preferred). The recommended upper vibration level (PPV) to which historic structures should be subjected is 2.0 mm/s. As shown in Figure 5-6, at any distance greater than 5 meters (17 feet) from the roadway, the maximum PPV for highway traffic is less than the recommended maximum PPV of 2.0 mm/s. Therefore, noise and vibration from NC 12 traffic would not adversely affect this historic site. In addition, noise and vibration impacts because of the construction of this alternative would be minimized via the implementation of minimization measures and managing construction activities.

The North Carolina Aquarium Society has not provided any comments through review and comment periods or coordination meetings to indicate that the noise or vibration impacts of the proposed project would substantially impair the activities, features, or attributes that qualify the (former) Oregon Inlet US Coast Guard Station for protection under Section 4(f).

Visual

As discussed in Section 5.2.3, the Adverse Effect determination is based on the visual impacts the replacement bridge would have on the historic viewshed and setting of the (former) Oregon Inlet US Coast Guard Station. The Phased Approach/Rodanthe Bridge Alternative's (Preferred) bridge would be higher than Bonner Bridge as it enters the Refuge and longer in the vicinity of the station. It would not come down to grade like the existing bridge but continue south. Bonner Bridge currently enters Hatteras Island at an elevation of approximately 15 feet (4.6 meters). The new bridge would enter Hatteras Island at an elevation of approximately 33.5 feet (10.2 meters) above mean sea level (see Figure 2-24).

The (former) Oregon Inlet US Coast Guard Station is currently surrounded by sand on three sides and is in a deteriorating condition (see Figure 5-2). Its historic landscape has been compromised by neglect. The North Carolina Aquarium Society let a project for bidding in July 2008 to stabilize the structure, remove its modern dormitory, and restore the exterior. The objective of this contract would be to stabilize the structure until final decisions are made regarding the Bonner Bridge replacement project.

The North Carolina Aquarium Society has not provided any comments through review and comment periods or coordination meetings to indicate that the visual impacts of the proposed project would substantially impair the activities, features, or attributes that qualify the (former) Oregon Inlet US Coast Guard Station for protection under Section 4(f) and for listing on the NRHP.

<u>*Access*</u>

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would not prohibit access to the (former) Oregon Inlet US Coast Guard Station. As described in Section 5.2.3, the selection of this alternative would phase the project in this area. In Phase I, the Oregon Inlet bridge would be built and would end as a stub on Hatteras Island in the existing easement and adjacent to the station. Ramps would be built on either side of the bridge to bring traffic down to the existing road. During Phase II, the bridge would be extended south and a second set of ramps would be built. The ramps would function as a highway interchange to bring NC 12 traffic down to the existing parking lot adjacent to the station, thus allowing for access to the property for visitors should the building be opened and used on its current site. NCDOT has expressed a willingness to coordinate with the North Carolina Aquarium Society should there be any need to briefly disrupt or alter access to the station during the construction of the proposed project. However, at this time the Aquarium Society has no plans to occupy the building prior to the completion of Phase I.

If it was considered desirable in the future to move the (former) Oregon Inlet US Coast Guard Station from its current site to a site north of Oregon Inlet, it would be more difficult to move the building across the new Oregon Inlet bridge. With the Phased Approach/Rodanthe Bridge Alternative (Preferred) a narrower (18 feet [5.5 meters] including lane and shoulder) and steeper (approximately 5.3 percent grade) access ramp (in contrast to the existing bridge) would need to be used if one wanted to move the building across the new bridge. However, the condition of the existing bridge may not allow it to be used to move the building north anyway. As with all alternatives, however, the building also could be moved across Oregon Inlet on a barge.

The North Carolina Aquarium Society was invited to, and accepted, an invitation to participate in the Section 106 consultation process. In the meeting held July 10, 2008 the Aquarium Society indicated that their goal is to restore, interpret, and educate the public about the US Coast Guard, the building, and the surrounding natural environment. In July 2008 the Aquarium Society let a project for bidding for the stabilization of the structure. The NCDOT and the Aquarium Society agreed that should the terminal groin remain in place, possible mitigation to ensure continuous access to this site could include NCDOT restoring the road to the station as part of the construction staging plan, assistance with the restoration of the facility including signage and interpretive displays, the installation of electricity and power to the station, and the establishment of a visitor parking lot. NCDOT could also provide assistance in updating the NRHP nomination for the station. If the terminal groin was removed upon the completion of the project, NCDOT may be able to provide assistance in moving the station. The potential mitigation options for the

Phased Approach/Rodanthe Bridge Alternative (Preferred) will be finalized at the completion of the Section 106 consultation process and will be included in the MOA with the SHPO. The MOA will be incorporated into the Record of Decision (ROD) for this project.

The terminal groin was originally constructed in the late 1980s at the northern end of Hatteras Island to limit the migration of the Oregon Inlet at the southern terminus of the Bonner Bridge. The terminal groin halted inlet migration and consequently enhanced shoreline stabilization for the (former) Oregon Inlet US Coast Guard Station. Prior to the installation of the groin, it was the intent of Dare County (the then current owners) to move the station because it was at risk from erosion. This risk was one reason why the US Coast Guard built a new station at the southern end of Bodie Island and abandoned this station. If the terminal groin were removed, the (former) Oregon Inlet US Coast Guard Station would immediately be threatened by natural processes, including shoreline erosion. NCDOT supports the continued presence of the terminal groin and will request a new permit from the USFWS for its continued operation; the terminal groin is within the Refuge. The only mitigation available to the station should the terminal groin be removed would be relocating the station. The Aquarium Society owns property in Nags Head and would consider moving the station to this location or another if funding was available and the NRHP status of the station could be maintained. NCDOT could participate in the relocation of the station to another site; final mitigation options will be agreed upon and documented at the conclusion of the Section 106 consultation process. The Section 106 process will be completed prior to the issuing of the ROD.

The proposed project would not impair access to the (former) Oregon Inlet US Coast Guard Station located on the northern end of Hatteras Island. Thus, there is no constructive use of the facility associated with access and the proximity impacts related to access of the proposed project are not so severe as to substantially impair the protected activities, features, or attributes which make the property eligible for Section 4(f) protection.

Ecological Intrusion

Ecological intrusion is not a factor in evaluating the potential for constructive use on the (former) Oregon Inlet US Coast Guard Station as the station is a Section 4(f) property based on its status as a historic property listed on the NRHP.

Conclusion

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would have visual impacts on the historic setting of the (former) Oregon Inlet US Coast Guard Station located on Hatteras Island. Though the Bonner Bridge is within the current viewshed of the property, the proposed new bridge with the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be a more dominant feature in the viewshed. Potential mitigation options resulting from the Section 106 consultation process would allow for the retention of access and aid in the renovation and interpretation of the station for education purposes. Therefore, the Phased Approach/Rodanthe Bridge Alternative (Preferred) would not constitute a constructive use of the station.

5.5.2.3 Rodanthe Historic District – Including the Chicamacomico Life Saving Station

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) does not use property from the Rodanthe Historic District or the NRHP-listed Chicamacomico Life Saving Station as it would be constructed entirely within the existing NC 12 right-of-way through the district. NC 12 is a non-contributing element to the historic district. Although there are noise and vibration, visual, and access impacts to the historic district, including the Chicamacomico Life

Saving Station, as a result of the proposed project, the impacts with mitigation would not be so severe as to substantially impair or diminish the activities, features, or attributes that qualify the historic district or the Life Saving Station for protection under Section 4(f).

Noise and Vibration

As described in Sections 4.10 and 5.2.4, FHWA's NAC would be approached or exceeded at one property within the Rodanthe Historic District with the selection of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred). It is predicted that the noise levels also would approach or exceed FHWA NAC assuming Bonner Bridge remains in place. The increased future noise levels are associated more with the forecast growth in traffic than the implementation of the Phased Approach/Rodanthe Bridge Alternative (Preferred) in that the associated noise level would be identical to the level that would occur if Bonner Bridge remained in place. No reasonable or foreseeable opportunities exist to reduce noise levels at this residence. An effective noise barrier would block or limit the access of residents of the one home and adjoining land uses to NC 12 by blocking driveways and side streets. FHWA's NAC would not be approached or exceeded at the Chicamacomico Life Saving Station. Additional discussion on reasonable and foreseeable opportunities to reduce noise is included in Section 4.10.4.

The Levene Midgett House is the closest historic structure to NC 12 within the historic district. The nearest pile of the structure carrying NC 12 traffic would be approximately 40 feet (13.2 meters) from the Levene Midgett House based on the preliminary design used to assess impacts. As shown in Figure 5-6**,** at any distance greater than 5 meters (17 feet) from the roadway, the maximum PPV for highway traffic is less than the recommended maximum PPV of 2.0 millimeters per second. Therefore, vibration from NC 12 traffic would not adversely impact any of the historic sites within the district.

NCDOT has agreed to monitor and implement minimization measures for noise and vibration impacts from construction of the Phased Approach/Rodanthe Bridge Alternative (Preferred). One possible mitigation measure could be designing bridge deck joints to decrease noise. Mitigation measures for noise and vibration would be agreed upon and documented at the conclusion of the Section 106 consultation process. The agreed upon mitigation measures will be included in the MOA with the SHPO, and the MOA will be incorporated into the ROD for this project.

Neither Dare County nor Chicamacomico Life Saving Station representatives have provided comments in the review and comment periods or in coordination meetings to indicate that noise or vibration impacts associated with the Preferred Alternative would substantially impair the activities, features, or attributes of the historic district or of the Life Saving Station that qualify the historic properties as Section 4(f) properties. Based on the findings described above, the minor noise and vibration impacts would not result in the constructive use of the historic district or of the Life Saving Station.

Visual

As described in Section 5.2.4, the construction of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would involve the construction of a bridge within the existing right-of-way through the district with frontage roads on either side of the bridge structure at grade. NC 12 would be elevated at 33.5 feet (10.2 meters) at the northern end of the historic district, 30 feet (9.1 meters) in front of the Chicamacomico Life Saving Station, and 12.5 feet (3.8 meters) at the southern end of the district. The construction of a bridge through the historic district would be an Adverse Effect on the historic district, as well as the Life Saving Station, because of the change in the visual setting. While this is true, NC 12 is not considered to be a contributing factor to the historic district, and the Phased Approach/Rodanthe Bridge

Alternative (Preferred) would be constructed entirely within the existing right-of-way. No property from architecturally significant properties would be taken.

Possible mitigation measures identified as part of the Section 106 consultation process include designing the bridge rails so that travelers can view the historic district, including the Life Saving Station, and placing bridge piers to facilitate those views. Mitigation measures will be agreed upon and documented upon the completion of the Section 106 consultation process, planned for completion prior to the approval of the ROD.

The historic district and the Chicamacomico Life Saving Station are significant for their association with the social history of the development of the Outer Banks, as well as the architectural features of the properties being representative of the original setting. However, there are modern features adjoining the district, including gas stations, a water treatment plant, and multi-story beach homes. Within that context, the visual impacts associated with the addition of the Phased Approach/Rodanthe Bridge Alternative (Preferred) would not be so severe so as to substantially diminish the protected activities, features, or attributes of the district's contributing structures.

Access

Access would be maintained within the approximately 402 feet (122.5 meters) NC 12 travels within the historic district and adjacent to the Chicamacomico Life Saving Station via one-lane/one-way frontage roads at grade on either side of the bridge substructure. Direct vehicle access across the NC 12 right-of-way in northern Rodanthe would be eliminated with the exception of three cross-overs. The closest connections between the frontage roads to the historic district would be 963 feet (294.0 meters) south of the southern boundary of the historic district (at the intersection where the frontage roads tie back into NC 12) and 734 feet (224.0 meters) north of the northern boundary of the historic district. A representative of the Life Saving Station indicated at the July 2008 MOA meeting that they relied heavily on drive-by tourists for their customer base. They said that the change in the way the Life Saving Station would be reached and the elevation of NC 12 would reduce the number of visitors and the associated loss of income could make the site economically unviable. They also indicated that for promoted events, their visitors often use the NC 12 right-of-way to park. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would use the entire NC 12 right-of-way, eliminating the opportunity to use it for informal parking.

Possible mitigation measures identified in the Section 106 consultation process that would aid the visibility and accessibility in the historic district include: signage directing travelers to the Life Saving Station; safe access road between the two frontage roads near the Life Saving Station; the provision of overflow parking as visitors currently park on the NC 12 right-of-way for popular events; and assistance with joint marketing opportunities for the Life Saving Station and other historic life saving stations along the Outer Banks. Relocation of the Life Saving Station and associated buildings to a new location also was discussed. Mitigation measures would be agreed upon and documented at the conclusion of the Section 106 consultation process. The agreed upon mitigation measures will be included in the MOA with the SHPO, and the MOA will be incorporated into the ROD for this project.

The Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) would not require right-of-way acquisition from the historic district or the Chicamacomico Life Saving Station. While access would be altered, it would still be provided to and from the properties associated with the historic district. The alteration of access would not detract from the historic district's eligibility for inclusion on the NRHP as a result of its importance in the social history of the Outer Banks, or from the district's importance as architecturally significant properties. Measures would be taken to mitigate the potential loss of Life Saving Station visitors. Thus, there would be no substantial impairment to the activities, features, or attributes of these properties as a result of access.

Ecological Intrusion

Ecological intrusion is not a factor in evaluating the potential for constructive use on the historic district and the Chicamacomico Life Saving Station in that these are Section 4(f) properties based on their status as historic properties listed on the NRHP.

Conclusion

The analysis of the potential proximity impacts of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) on the historic integrity of the historic district, including the Chicamacomico Life Saving Station, indicates that, with mitigation for access changes at the Life Saving Station, these resources would not be impaired to the extent that a substantial diminishment of their protected activities, features, or attributes would occur from noise or vibration, visual intrusion, restriction of access, or ecological intrusion. In addition, there would be no substantial impairment of these resources because of the combined proximity impacts associated with the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred).

5.5.3 Constructive Use Conclusion

The evaluation of the proximity impacts to the Pea Island National Wildlife Refuge, the (former) Oregon Inlet US Coast Guard Station, and the Rodanthe Historic District, including the Chicamacomico Life Saving Station, that would result from the construction of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) found that there would be no substantial impairment of the activities, features, or attributes that qualify the resources for protection under Section 4(f); therefore, there is no constructive use as defined by 23 CFR 774.15.

5.6 All Possible Planning to Minimize Harm

Under 23 CFR 774.3(c)(2), the alternative selected as causing the least overall harm must also include "all possible planning…to minimize harm to Section 4(f) property." According to 23 CFR 774.17, all possible planning could include design modifications, replacement, or monetary compensation for parks, recreation areas, or wildlife refuges. With regard to historic sites, all possible planning would include measures to preserve the historic activities features and attributes. Also specified in 23 CFR 774.17 are considerations for FHWA in evaluating the reasonableness of the measures. These considerations include the views of the agencies with jurisdiction, whether the measures are a reasonable expense of public resources, and the impacts and benefits of the measures to communities or environmental resources outside of the Section 4(f) property.

In the case of the least overall harm alternative, the Phased Approach/Rodanthe Bridge Alternative (Preferred), all possible planning to minimize harm has occurred. With regard to its use of Seashore property on Bodie Island (6.3 acres [2.6 hectares]), FHWA and DOT would restore and return the 6.3 acres (2.6 hectares) of Seashore currently used by Bonner Bridge. After mitigation, the Seashore would not lose any net area with the Phased Approach/Rodanthe Bridge Alternative (Preferred).

As discussed in Section 2.10.2.4, the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be designed to avoid impacts to Refuge lands by staying within the existing NC 12 easement. Through the design/build contract, construction techniques and staging would be employed to ensure that all activities would be contained within the existing easement. The Phased Approach alternatives (including the Preferred Alternative) were specifically created to avoid a use of Refuge lands. As stated previously, potential methods for mitigating adverse effects to the historic district, the (former) Oregon Inlet US Coast Guard Station, and the Refuge under the Section 106 process have not been completed, but would be agreed upon and documented at the conclusion of the Section 106 consultation process. The agreed upon mitigation measures will be included in the MOA with the SHPO, and the MOA will be incorporated into the ROD for this project.

As described in Section 5.4.3, the agencies with jurisdiction over these resources have concerns with regard to the Phased Approach/Rodanthe Bridge Alternative (Preferred). However, FHWA and NCDOT have considered the views and input from the agencies during project development in order to minimize harm on Section 4(f) properties. FHWA and NCDOT would continue to work with the agencies with jurisdiction to implement environmental commitments as specified in the Project Commitments and the planned MOA. Coordination would continue through the remainder of the NEPA/Section 404 merger process and during the permitting phase of the proposed project.

5.7 Coordination

Contact with the NPS and USFWS was initiated at the beginning of the 1991 feasibility study process. During the 1991 feasibility study and preparation of the 1993 DEIS, the two agencies:

- Provided information on the significance and use of the lands within their jurisdiction at meetings with the study team. This information is presented in the project purpose and need, land use, land use planning, parks, and natural systems discussions contained in the 1993 DEIS.

- Were given the opportunity to participate in the feasibility study and Environmental Impact Statement Scoping processes.

- Sent representatives to government officials' meetings preceding the Citizens Informational Workshops on July 19, 1990 and on February 19 and 20, 1991.

- Sent representatives to an interagency scoping meeting on May 29, 1991.

- Sent representatives to a joint permitting agency meeting on July 1, 1993.

- Provided comments on a review copy of the preliminary DEIS in their role as cooperating agencies.

- Provided comments through the Department of Interior on the DEIS's findings.

Following the comment period on the 1993 DEIS and during the preparation of the 2005 SDEIS and its associated alternatives studies, both agencies participated in the following ways:

- Served as members of the Outer Banks Task Force, which is examining short- and long-term options for maintaining a transportation system on the Outer Banks.

- Provided comments on a review draft of a FEIS that helped lead to the decision to prepare the 2005 SDEIS.

- Served as members of the NEPA/Section 404 Merger Team, concurring with the rest of the Merger Team on project purpose and need and the alternatives to be evaluated in the 2005 SDEIS.

- Attended the July 22, 2003 Citizens Informational Workshop in Manteo, North Carolina.

- Provided comments through the Department of Interior on the 2005 SDEIS's findings.

The USFWS service also:

- Participated in a July 26, 2004 meeting with the NCDOT, USACE, FHWA, and NCDENR's Division of Water Resources to discuss the addition of the Parallel Bridge Corridor to the list of alternatives to be evaluated in detail in the 2005 SDEIS.

- Participated in January 7, 2005 and April 4, 2005 meetings with the NCDOT, USACE, FHWA, and NCDENR's Division of Water Resources to discuss the development and refinement of the NC 12 maintenance component of the Parallel Bridge Corridor.

- Answered questions from the NCDOT and other study team representatives, as needed, on Refuge policies and characteristics.

Three meetings of the project's NEPA/Section 404 Merger Team were conducted since the November 2005 public hearings. Representatives of the Refuge attended the meeting on June 15, 2006. Representatives of both the Refuge and the NPS attended meetings on September 21, 2006 and December 14, 2006. A Constructability Workshop was conducted for the Phased Approach alternatives in August 2006 at which Mike Bryant, manager of the Refuge, made opening remarks. The meetings and the workshop are described in Sections 8.8.1 and 8.8.2, respectively.

The NPS and USFWS provided comments through the Department of Interior on the 2007 SSDEIS findings. Three additional meetings of the project's NEPA/Section 404 Merger Team were conducted after the March 2007 public hearings for the 2007 SSDEIS for the purpose of identifying the LEDPA. Representatives of the NPS and USFWS attended all three meetings, which were held on: May 23, 2007; June 20, 2007; and August 15, 2007. In addition, an individual agency coordination meeting with representatives of the NPS was held on December 11, 2007. These meetings are described in Section 8.10.1.

The FHWA also undertook formal consultation with the USFWS under Section 7 of the Endangered Species Act. Meetings with the USFWS associated with this consultation were held on December 11, 2007 and June 11, 2008.

The SHPO also sent a representative to the NEPA/Section 404 Merger Team meetings listed above. Coordination with the SHPO specifically related to NRHP-eligibility and/or determination of effects under Section 106 of the Historic Preservation Act of 1966 occurred on January 26, 2007, November 28, 2006, June 28, 2005, and November 25, 2003. A meeting with the SHPO and other consulting parties (including representatives from the NPS, USFWS, North Carolina Aquarium Society, and the Chicamacomico Life Saving Station) regarding potential historic resource impact mitigation occurred on July 10, 2008. Owners of other contributing properties in the historic district were invited to attend this meeting individually in writing, but chose not to attend. Correspondence with the SHPO associated with eligibility determinations is presented in Appendix A. The concurrence forms with the SHPO associated with the assessment of historic effects are presented in Appendix E.

5.8 Conclusion

Based upon the above analysis, FHWA and NCDOT have concluded that there are no feasible and prudent avoidance alternatives to the use of land from the Cape Hatteras National Seashore (on Bodie Island), and that the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) is the alternative that causes the least overall harm and it includes all possible measures to minimize harm.

Chapter 6

List of Preparers

6.0 List of Preparers

The persons listed below were responsible for preparing this Final Environmental Impact Statement (FEIS), the associated Supplemental Draft Environmental Impact Statement (SDEIS) and Supplement to the SDEIS (SSDEIS), material from the original DEIS included in this FEIS, and/or background studies.

6.1 Federal Highway Administration

Name and Degree	Responsibility	Experience	Professional Discipline
John Sullivan, BSCE	Division Administrator responsible for administration of federal-aid projects in North Carolina; Federal Highway Administration (FHWA) oversight	23 years in transportation engineering	Civil Engineer, PE
Clarence Coleman, BSCE	Operations Engineer responsible for administration of federal-aid projects in North Carolina; FHWA oversight	16 years in transportation engineering	Civil Engineer, PE
Emily Lawton, BSCE	Operations Engineer responsible for administration of federal-aid projects in North Carolina; FHWA oversight	14 years in transportation engineering	Civil Engineer, PE
Ron Lucas, BSCE	Area Engineer; FHWA oversight, Final Section 4(f) Evaluation	16 years in transportation engineering	Civil Engineer, PE
Rob Ayers, BCP, MCP	Environmental Programs Coordinator, responsible for administration of federal-aid projects in North Carolina; FHWA oversight	18 years transportation planning/environmental coordination	Transportation Planning/ Environmental Coordination, AICP (American Institute of Certified Planners)

Name and Degree	Responsibility	Experience	Professional Discipline
Michael Culp, BSCE, MA	Senior Environmental Protection Specialist, responsible for FHWA Headquarters coordination and the National Environmental Policy Act (NEPA) oversight for federal-aid projects in North Carolina; prior concurrence issues, Final Section 4(f) Evaluation	16 years in transportation planning/ environmental coordination	Transportation Planner/Environmental Professional
Bethaney Bacher-Gresock, BS	Environmental Protection Specialist, responsible for FHWA Headquarters coordination and NEPA oversight for federal-aid projects; prior concurrence issues, Final Section 4(f) Evaluations	7 years in transportation and environmental issues and concerns	Environmental Professional

6.2 North Carolina Department of Transportation

Name and Degree	Responsibility	Experience	Professional Discipline
Beth Smyre, BSCE, MS	Project Manager for Project Development and Environmental Analysis Branch; project management and document review	7 years in transportation engineering	Civil Engineer, PE
Brian Yamamoto, BSCE	Consultant Group Leader (Eastern) for Project Development and Environmental Analysis Branch; project management and document review	18 years in transportation planning	Civil Engineer, PE
Robert Hanson, BSCE, MCE	Eastern Project Development Engineer for Project Development and Environmental Analysis Branch; management oversight and document review	21 years in transportation engineering	Civil Engineer, PE, CPM

Name and Degree	Responsibility	Experience	Professional Discipline
Gail Grimes, BSCE	Assistant Manager for Project Development and Environmental Analysis Branch; document review	30 years in transportation	Civil Engineer, PE
John Conforti, BECE	Project Manager for Project Development and Environmental Analysis Branch; project management and document review	18 years in transportation planning	Civil Engineer, REM
Jennifer Harris, BSCE	Project Manager for Project Development and Environmental Analysis; document review	5 years in transportation	Civil Engineer, PE

6.3 PB Americas, Inc.

Name and Degree	Responsibility	Experience	Professional Discipline
John M. Page, BS, MUP	Project Manager (2001 to present), Draft Section 4(f), environmental justice, indirect and cumulative impacts, document review, and DEIS Environmental Lead	33 years in land use planning and environmental document preparation	Planner, AICP; Environmental Professional, CEP
Robert Norburn, BSCE, BA	Deputy Project Manager (2003 to present), Parallel Bridge Corridor environmental analysis, parks and recreation, document development and review	14 years in transportation planning and environmental document preparation	Transportation Engineer/Planner, EIT
Jennifer Graf, BS	FEIS development and quality control	20 years in transportation planning and environmental document preparation	Planner and Environmental Professional
Liz Kovasckitz, BA, MS	Public involvement, community, visual, parks and recreation, energy, construction, and document review	13 years in environmental planning	Planner, AICP

Name and Degree	Responsibility	Experience	Professional Discipline
Don Brown, BS, MURP	Land-use plans and assessment support	11 years in transportation planning and environmental analysis	Planner, AICP
Doug Smith, BS, MS	Inlet use and dredging, quality control	30 years in ecological and environmental planning	Planner, AICP
Reggie Scales, BS	Community, indirect and cumulative impacts, Draft Section 4(f), and quality control	17 years in planning	Planner, AICP
Brian Byfield, BS, MUP	Community impacts	9 years in planning	Planner
Joseph Curtis, Jr., BA, MCP	Community impacts	4 years in transportation planning	Planner
Marlena Everett BS, MA	Document editing	6 years in environmental and transportation planning	Planner
Chris Coleman, BS	Air and noise analyses	17 years in environmental planning	Planner
Jacob B. Pirkle, BA	Noise analysis for the two Phased Approach alternatives	15 years in air quality and noise analyses	Air Quality and Noise Abatement Specialist
Nancy Skinner, BA, MA, MCRP	Quality control	21 years in environmental planning and document preparation	Planner, AICP
Mushtaqur Rahman, PhD	Traffic analysis	14 years in traffic engineering and transportation planning	Civil Engineer, PE
Andrew Topp, BSCE	Traffic analysis	5 years in traffic engineering	Civil Engineer, EI
Jeff Meador, BS, MCE	SDEIS Pamlico Sound Bridge Corridor functional roadway design	5 years in civil engineering	Civil Engineer

Name and Degree	Responsibility	Experience	Professional Discipline
Casey Woodall, BSCE	SDEIS Pamlico Sound Bridge Corridor functional roadway design	2 years in civil engineering	Civil Engineer, EI
Jennifer Lewis, BSCE	SDEIS Pamlico Sound Bridge Corridor functional roadway design, community data gathering	1 year in civil engineering and planning	Civil Engineer and Planner
Roland Robinson, Jr., ACET	Parallel Bridge Corridor functional roadway design	38 years in roadway design	Civil Engineer
Eric Misak, BSCE	Parallel Bridge Corridor functional roadway design	20 years in civil engineering	Civil Engineer
Kevin Crouch, BSCE	Parallel Bridge Corridor functional roadway design	5 years in structure and roadway design	Civil Engineer, EI
Daniel A. Dock, BSCE	Parallel bridge development and bridge type study	23 years in structural engineering	Structural Engineer, PE
James Phillips, BSCE	Bridge alternative development for DEIS	14 years in structural engineering	Structural Engineer, PE
Frank Pepe, Jr., BSCE, MSCE	Tunnel alternative development	16 years in geotechnical engineering	Geotechnical Engineer
Dean D. Hatfield, BSCE, MSCE	Geometry, quantities, and civil design for DEIS bridge alternatives	18 years in civil engineering	Civil Engineer, PE
Michael J. Fendrick, BSCE, MSCE	Civil design for DEIS bridge alternatives	13 years in civil engineering; highway projects	Civil Engineer, PE
James T. Jarvis, BS, MURP	Ferry alternative development	13 years in transportation engineering	Transportation Engineer
R. Jeffrey Brown, BA, ME	FEIS development and quality control	13 years in biological assessments and environmental document preparation	Planner
Chin Lien, BSHE, MSCE, MSCS	Water quality	20 years in civil and hydraulic engineering	Civil Engineer, PE

Name and Degree	Responsibility	Experience	Professional Discipline
David Charters, BSCE, MSCE	Design-build criteria	31 years in civil and structural engineering	Civil Engineer, PE
Jason Doughty, BSCE, MSCE	Design-build criteria	10 years in civil and structural engineering	Structural Engineer, PE

6.4 Panamerican Consultants, Inc.

Name and Degree	Responsibility	Experience	Professional Discipline
Stephen James, RPA, MA	Maritime archaeological field investigation	20 years in maritime archaeology	Marine Archaeologist
Michael C. Krivor, RPA, MA	Maritime archaeological field investigation	8 years in maritime archaeology	Marine Archaeologist

6.5 CZR, Incorporated

Name and Degree	Responsibility	Experience	Professional Discipline
James Hudgens, BS	Project review	38 years	Principal-Environmental Consultant
Samuel Cooper, BS, MS	Natural resource analysis and impact assessment	18 years in environmental assessment, permitting, and impact analysis	Coastal Ecologist and Technical Director
Julia K. Berger, BA, MS	Natural resource analysis and impact assessment	11 years in environmental assessment, permitting, and impact analysis	Environmental Scientist
Jeff Coward, BS	Biotic community and wetland delineation and evaluation	7 years in wetland delineation and assessment	Biologist
Dawn York, BS, MS	Biotic community and wetland analysis	4 years in natural resources assessment	Biologist

Name and Degree	Responsibility	Experience	Professional Discipline
Mark Grippo, BS, MS	Natural resource assessment and impact analysis	4 years in natural resources assessment and impact analysis	Biologist
Cory Novak, BA	Biotic community and wetland delineation and evaluation	5 years experience in wetland assessment	Biologist
Travis Brown, BS, MS	Ecological documentation	2 years	Biologist
Barbara Goad	Graphics, Impact calculations	25 years	Graphics Manager, CADD Operator
Terry Jones	Graphics, Impact calculations	22 years	CADD Operator/ Graphic

6.6 Moffatt & Nichol Engineers

Name and Degree	Responsibility	Experience	Professional Discipline
Jeffrey G. Shelden, BSCE, MSCE	Review of SDEIS coastal engineering analysis, DEIS coastal engineering analysis for Oregon Inlet movement	18 years in shoreline structures, dredging, beach nourishment	Coastal and Hydraulic Engineer, PE
Ramona Holdstock, BSCE, BS, MCE	SDEIS coastal engineering analysis for Oregon Inlet movement	6.5 years in coastal engineering and computer modeling	Coastal and Hydraulic Engineer, PE

6.7 Mattson, Alexander & Associates

Name and Degree	Responsibility	Experience	Professional Discipline
Frances P. Alexander, BA, MA	Identification of historic resources	16 years experience	Architectural Historian
Richard L. Mattson, BA, MA, PhD	Identification of historic resources	16 years experience	Historical Geographer

6.8 FDH Engineering, Inc.

Name and Degree	Responsibility	Experience	Professional Discipline
John S. Fisher BS, MS, PhD	Coastal engineering analysis for shoreline and breaches; nourishment alternative design	30 years experience	Coastal and Hydraulic Engineer, PE
Margery F. Overton BS, MS, PhD	Coastal engineering analysis for shoreline and breaches; nourishment alternative design	20 years experience	Coastal and Hydraulic Engineer

6.9 PB Consult

Name and Degree	Responsibility	Experience	Professional Discipline
Ira Hirschman, BS, MS, PhD	Economic impact assessment	25 years in economics and planning	Economist, Planner, AICP
Meredith Coley, BS, MS	Economic impact assessment	5 years in economics and transportation	Economist, Civil Engineer, EIT

6.10 URS Corporation—North Carolina

Name and Degree	Responsibility	Experience	Professional Discipline
Kate Wolfe, BA, MSES	Project Manager for URS Corporation, natural resources, erosion modeling, and design coordination and review for NC 12 maintenance alternatives	8 years in environmental planning and ecology	Environmental Planner/Ecologist, PWS, AICP
Michael Lindgren, BSCE	Functional design engineer; civil design for NC 12 maintenance road and bridge alternatives	12 years experience in roadway design	Civil Engineer, PE

Name and Degree	Responsibility	Experience	Professional Discipline
Marvin Brown, BA, MA, JD	Architectural Historian for URS, conducted historic architectural surveys in Rodanthe	Mr. Brown has 25 years of experience in historic and architectural studies in compliance with NEPA and the National Historic Preservation Act.	Senior Architectural Historian

6.11 Arcadis G&M, Inc.

Name and Degree	Responsibility	Experience	Professional Discipline
Linda Diebolt, BS	Biotic community assessment, wetland delineation, and endangered species surveys in Pea Island National Wildlife Refuge	17 years in natural resources assessment, and wetland delineation and analysis	Biologist
W. Scott Hunt, III, BSCE	Biotic community assessment in Pea Island National Wildlife Refuge	7 years in natural resources assessment	Civil Engineer, PE
Ben Furr, BS	Biotic community, wetland delineation and evaluation, and endangered species surveys in Pea Island National Wildlife Refuge	4 years in natural resources assessment and wetland delineation	Biologist
Keven Duerr, BS	Natural resource assessment, biotic community assessment, and wetland delineation in Pea Island National Wildlife Refuge	3 years in natural resources assessment and wetland delineation	Biologist
Chris Sheats, BS	Biotic community and wetland delineation and evaluation in Pea Island National Wildlife Refuge	2 years in natural resources assessment and wetland delineation	Biologist
Anna Keith, BS	Biotic community and wetland delineation and evaluation in Pea Island National Wildlife Refuge	1 year in natural resources assessment and wetland delineation	Biologist

Chapter 7

List of Agencies, Organizations, and Persons to Whom Copies of the Statement are Sent

7.0 List of Agencies, Organizations, and Persons to Whom Copies of the Statement are Sent

The agencies and interest groups listed below were sent a copy of this Final Environmental Impact Statement (FEIS). The agencies and interest groups marked with an asterisk (*) provided comments on the Supplemental Draft Environmental Impact Statement (SDEIS) dated September 12, 2005 and/or the Supplement to the DEIS (SSDEIS) dated February 14, 2007.

7.1 Federal Agencies

Advisory Council on Historic Preservation

Federal Emergency Management Agency

Federal Energy Regulatory Commission

US Army Corps of Engineers*

US Coast Guard, 5th District*

US Department of Agriculture – Natural Resources Conservation Service*

US Department of Commerce – National Oceanic and Atmospheric Administration – National Marine Fisheries Service*

US Department of Health and Human Services

US Department of Housing and Urban Development

US Department of the Interior

- Office of the Secretary* [1]
- Fish and Wildlife Service
  - Pea Island National Wildlife Refuge
  - Raleigh Field Office
- Keeper of the National Register

[1] Comments from the Office of the Secretary of the US Department of the Interior addressed all comments of its associated agencies.

- National Park Service
- US Geological Survey

US Environmental Protection Agency, Region IV (Environmental Review Branch)*

7.2 State Agencies

North Carolina Department of Administration, State Clearinghouse*

North Carolina Department of Cultural Resources, Division of Archives and History*

North Carolina Department of Environment and Natural Resources*

- Division of Air Quality
- Division of Coastal Management*
- Division of Land Resources
- Division of Marine Fisheries*
- Division of Parks and Recreation
- Division of Water Quality*
- Natural Heritage Program*
- North Carolina Wildlife Resources Commission*

7.3 Local Governments and Agencies

Albemarle Regional Planning and Development Commission (Albemarle Rural Planning Organization)

Area Development Coordination Agency (ADCA)

County of Dare

- Chair, Dare County Commissioners*
- Dare County Manager
- Emergency Management Agency

Mayor of Duck

Mayor of Kill Devil Hills

Mayor of Kitty Hawk

Mayor of Manteo

Mayor of Nags Head

Town Manager of Nags Head*

Mayor of Southern Shores

Oregon Inlet and Waterways Commission

7.4 Local Interest Groups

Audubon North Carolina*

Cape Hatteras Electric Cooperative*

Carolina Electric Cooperatives

Center for Biological Diversity

Coastal Wildlife Refuge Society*

Conservation Council of North Carolina

Dare County Tourist Bureau

Defenders of Wildlife

Eastern Surfing Association, Outer Banks District

Environmental Defense*

Friends of Hatteras Island

Hatteras Civic Association

Hatteras Island Business Association

National Parks Conservation Association

North Carolina Coastal Federation

North Carolina Fisheries Association

NC Sea Grant*

Outer Banks Chamber of Commerce

Pamlico – Tar River Foundation

Sierra Club, North Carolina Chapter*

Southern Albemarle Association

Southern Appalachian Biodiversity Project

Southern Environmental Law Center*

7.5 Public Review Locations

Dare County Library in:

- Hatteras Village;
- Kill Devil Hills; and
- Manteo, North Carolina

Dare County Planning and Inspections Satellite office in Buxton, North Carolina

Fessenden Recreation Center in Buxton, North Carolina

North Carolina Department of Transportation Resident Engineer's Office in Manteo, North Carolina

The SDEIS, the SSDEIS, and associated public hearing announcements also were posted on the Outer Banks Task Force web site (http://www.obtf.org/) for public review.

Chapter 8

Comments and Coordination

8.0 Comments and Coordination

An Environmental Impact Statement (EIS) that addresses the full range of alternatives and issues important to the selection of a Preferred Alternative can be accomplished only in consultation with those who have a stake in the decision. This chapter summarizes in chronological order the scoping and coordination conducted in preparation of the 1993 Draft Environmental Impact Statement (DEIS), the 2005 Supplemental Draft Environmental Impact Statement (SDEIS), and the 2007 Supplement to the SDEIS (SSDEIS). The chapter then summarizes the public and agency review of both the SDEIS and SSDEIS, and it presents responses to the substantive comments received from both the public and environmental resource and regulatory agencies following the release of these documents.

8.1 1993 Draft Environmental Impact Statement

8.1.1 Citizen and Agency Scoping

Two rounds of scoping were conducted for the 1993 DEIS. In May 1990, upon initiation of a Bonner Bridge replacement feasibility study, a scoping letter was sent to government agencies. The feasibility study was undertaken to examine promising Oregon Inlet crossing replacement alternatives. A Citizens Informational Workshop was held July 19, 1990. Agency input from the scoping letter and public input from the workshop helped to formulate the range of alternatives examined in the feasibility study. The findings of the feasibility study are documented in *Feasibility Study for the Replacement of the Herbert C. Bonner Bridge on NC 12 Over Oregon Inlet* (NCDOT, April 1991).

Citizens Informational Workshops were held on February 19 (in Manteo) and 20 (in Hatteras Village), 1991, during which the alternatives and preliminary feasibility study findings were presented for public review. In May 1991, a second scoping letter—along with a copy of the final feasibility study report—was distributed to state and federal environmental resource and regulatory agencies. On May 29, 1991, a formal scoping meeting was held for local, state, and federal agencies. Input from the 1991 scoping letter, the scoping meeting, and the workshops was used to finalize the alternatives and issues to be considered in the 1993 DEIS.

Issues raised during the initial scoping process related to:

- Alternatives to be addressed in the DEIS;
- Meeting travel demand;
- Providing for emergency evacuation;
- Accommodating bicycles on the bridge;
- Using environmentally sensitive construction methods;
- Ensuring land use compatibility;

- Recreational resources;
- Considering effects on historic properties and archaeological resources;
- Considering coastal conditions;
- Assessing impacts to wildlife and aquatic life;
- Assessing impacts to threatened and endangered species; and
- Minimizing impacts to coastal wetlands.

8.1.2 Agency Coordination

Numerous government agencies and organizations were contacted during the feasibility study and preparation of the 1993 DEIS to gather data and discuss potential impacts. The information they provided was incorporated into:

- Traffic, community, and air quality studies;
- Coastal conditions studies;
- Natural systems studies;
- Archaeological studies; and
- Historic architecture studies.

In addition to the agency coordination conducted as part of the scoping process and data gathering, additional coordination meetings were held with agencies during preparation of the DEIS to discuss permitting and mitigation issues. Meetings were held with:

- US Army Corps of Engineers (USACE), Washington, North Carolina, Regulatory Field Office, July 8, 1991;
- North Carolina Department of Environment and Natural Resources (NCDENR), Division of Coastal Management, Elizabeth City, North Carolina, July 9, 1991;
- USACE, Wilmington, North Carolina, District Office, July 10, 1991;
- Interagency meeting in Manteo, North Carolina, July 11, 1991, with the National Park Service (NPS), the NCDENR Division of Coastal Management, the NCDENR Division of Environmental Management, the US Coast Guard, and the US Fish and Wildlife Service (USFWS);
- USFWS, Raleigh, North Carolina, Field Office, April 14, 1992; and
- North Carolina Department of Transportation (NCDOT) Permit Agency Review Meeting, Raleigh, North Carolina, July 1, 1993, with the NPS, the USACE, the US Coast Guard, the USFWS, and the NCDENR Division of Coastal Management.

In April 1993, the four cooperating agencies (US Coast Guard, USACE, NPS, and USFWS) were asked to examine a review copy of the DEIS. Revisions were made to the DEIS based on their comments.

8.1.3 Public Hearing and Agency Review

After the release of the DEIS in November 1993, combined (corridor and design) Public Hearings were held February 23, 1994 in Nags Head, North Carolina and February 24, 1994 in Buxton, North Carolina. Approximately 35 people attended the first hearing and 21 spoke. Approximately 40 people attended the second hearing and 10 spoke.

Comments on the DEIS were received from both the public and the following federal, state, and local agencies:

- Federal Emergency Management Agency;
- Federal Energy Regulatory Commission;
- USACE, Wilmington District;
- US Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS);
- US Department of the Interior;
- US Environmental Protection Agency (USEPA);
- NC Department of Cultural Resources, State Historic Preservation Office (SHPO);
- NCDENR:
  - Division of Coastal Management
  - Division of Environmental Management
  - Division of Land Resources
  - Division of Marine Fisheries
  - Division of Parks and Recreation
  - Office of Policy Development
  - Washington Regional Office
  - NC Wildlife Resources Commission; and
- County of Dare.

The following non-governmental organizations also submitted comments:

- Carolina Electric Cooperatives;
- Conservation Council of North Carolina;
- Outer Banks Chamber of Commerce; and
- Sierra Club (Legal Defense Fund and North Carolina Chapter).

8.2 Review of Preliminary Final Environmental Impact Statement

A preliminary Final Environmental Impact Statement (FEIS) was prepared in 1996, but never signed and released because formal consultation with the USFWS under Section 7 of the Endangered Species Act was not completed.

Because it had been more than seven years since completion of the DEIS, a re-evaluation was conducted in 2001 to determine if the preliminary FEIS remained a valid assessment of project impacts. Copies of the preliminary FEIS were distributed to the following state and federal environmental resource and regulatory agencies in May 2001:

- USACE, Wilmington District;
- US Coast Guard;
- US Department of Commerce, NOAA, NMFS;
- US Department of the Interior:
  - Fish and Wildlife Service, Pea Island National Wildlife Refuge
  - Fish and Wildlife Service, Raleigh Field Office
  - National Park Service, Outer Banks Group, including the Cape Hatteras National Seashore
- USEPA;
- NC Department of Cultural Resources, SHPO;
- NCDENR:
  - Division of Coastal Management
  - Division of Marine Fisheries
  - Division of Water Quality
  - Wildlife Resource Commission, Habitat Conservation Program, and

- County of Dare.

Issues raised during review of the preliminary FEIS included the need to:

- Update socioeconomic, biological, and environmental data and any resulting changes in impacts;

- Take into account Outer Banks Task Force (OBTF) activities and recent NC 12 vulnerability analysis findings;

- Discuss the current status of the proposed Oregon Inlet jetties;

- Take into account USFWS plans to designate the sand shoal island west of Bonner Bridge as a Wilderness area;

- Reflect increased piping plover nesting and critical habitat designations;

- Evaluate impacts to essential fish habitat;

- Prepare a new map of submerged aquatic vegetation;

- Consider a longer bridge to avoid three vulnerable areas ("hot spots") between Oregon Inlet and Rodanthe where the overwash of NC 12 during storms has become a regular problem, including reconsideration of the West Bridge Alternative;

- Take into account the National Wildlife Refuge System Improvement Act of 1997 in selecting a replacement bridge location;

- Take into account the NPS's policies on impairment of undisturbed natural processes; and

- Complete the Section 7 consultation process with the USFWS prior to the release of an FEIS.

On June 27, 2001, a meeting was held with the Federal Highway Administration (FHWA), the NCDOT, and other state and federal environmental resource and regulatory agencies to discuss the project. Discussions focused on:

- Cape Hatteras National Seashore (Seashore) and Pea Island National Wildlife Refuge (Refuge) boundaries and jurisdictions;

- The reappearance of a sand shoal island west of Bonner Bridge considered for designation as a Wilderness area in the early 1970s;

- The National Wildlife Refuge System Improvement Act of 1997 and its effect on the ability of the USFWS to authorize a new permanent easement for a bridge terminus within the Refuge;

- Hatteras Island's terminal groin and its potential disposition once Bonner Bridge is replaced; and

- Potential new Bonner Bridge replacement alignments and the scope of replacement alternatives given the above items, as well as the presence of three "hot spots" between Oregon Inlet and Rodanthe. Overwash of NC 12 at these spots during storms has become a regular problem and is under investigation as a part of the OBTF's study of the short-term and long-term protection and maintenance of a transportation system on the Outer Banks.

Based on the reasons listed above, the decision was made in 2001 to prepare a SDEIS.

8.3 SDEIS Scoping and Agency Coordination

Work on the SDEIS began in 2002 with a new study of potential Bonner Bridge replacement alternatives. Scoping for the SDEIS was conducted by reviewing the comments on the preliminary FEIS described in Section 8.2, as well as comments received during meetings of the project's National Environmental Policy Act (NEPA)/Section 404 of the Clean Water Act (NEPA/Section 404) Merger Team.

8.3.1 NEPA/Section 404 Merger Team Meetings

The NEPA/Section 404 merger process was developed under an agreement between the NCDOT, the FHWA, the USACE and other state and federal environmental resource and regulatory agencies. Bonner Bridge Replacement Study Merger Team members included representatives from the following environmental resource and regulatory agencies in addition to NCDOT and FHWA:

- USACE;
- USEPA;
- USFWS (Raleigh Office);
- USFWS—Pea Island National Wildlife Refuge;
- NMFS;
- NPS—Cape Hatteras National Seashore;
- NCDENR
  - Division of Coastal Management (DCM)
  - Division of Marine Fisheries (DMF)
  - Division of Water Quality (DWQ)
  - Wildlife Resources Commission (WRC); and
- North Carolina Department of Cultural Resources—SHPO.

The US Coast Guard is not a signing team member but is sent information before and following all NEPA/Section 404 Merger Team meetings.

NEPA/Section 404 Merger Team meetings allow for early formal involvement in the project development process for state and federal environmental resource and regulatory agencies. Participating agencies are those that have an interest in the issuance of USACE dredge and fill permits for wetland and stream impacts under the terms of Section 404 of the Clean Water Act.

The NEPA/Section 404 merger process is a streamlining effort that helps to avoid duplication of effort between the NEPA and Section 404 processes, since the USACE must meet the requirements of the NEPA in order to issue a dredge and fill permit under the Clean Water Act. The NEPA/Section 404 Merger Team meetings provide an opportunity for participants to formally concur with key decisions in the NCDOT's and the FHWA's National Environmental Policy Act impact assessment process so that those decisions do not need to be revisited during application for a USACE's permit.

The merger process includes the following concurrence points:

1. Concurrence on purpose and need;

2. Concurrence on the alternatives to be evaluated in detail in the environmental document;

2A. Concurrence on the approximate length of any proposed bridges to minimize impacts to wetlands and streams and preliminary alignment review for each detailed study alternative;

3. Concurrence on the Least Environmentally Damaging Practicable Alternative (LEDPA);

4A. Concurrence that all efforts were made to avoid and minimize harm to jurisdictional resources (streams and wetlands) to the maximum extent practicable;

4B. Concurrence on the 30 percent complete hydraulic design; and

4C. Concurrence on permit drawings after the hydraulic design is complete and prior to Section 404 permit application.

Concurrence Points 1, 2, and 2A occur prior to the release of a draft document (typically either an Environmental Assessment or Draft Environmental Impact Statement). Concurrence Points 3 and 4A occur after public and agency review processes for a draft document. Concurrence Points 4B and 4C occur during project final design.

The sections that follow describe four meetings that led to concurrence on points 1, 2, and 2A (which contributed to scoping the SDEIS) as well as a fifth briefing related to the development of the Parallel Bridge Corridor alternatives.

8.3.1.1 July 31, 2002 Meeting

The purpose of the first NEPA/Section 404 Merger Team meeting was to discuss the purpose and need of the Bonner Bridge replacement project, the relation of the project to the proposed NC 12 hot spot projects, and the project study area. Participants agreed that:

- The project area would be extended south to Rodanthe to encompass three locations (or hot spots) where overwash of NC 12 during storms is a particular problem;

- Data on locations of submerged aquatic vegetation (SAV) in Pamlico Sound for the project area would be gathered in order to determine if and where impacts to SAVs can be avoided and minimized;

- A study area should be established and impacts to wetlands should be avoided and minimized to the extent practicable;

- If a bridge replacement alternative is selected that does not end in Rodanthe, a future extension of the replacement bridge to Rodanthe must be considered; and

- The southern termini of the replacement bridge should be at least south of the northernmost hot spot (Canal Zone).

Concurrence was reached on the project's Statement of Purpose and Need (presented in Chapter 1). The signed concurrence form for Concurrence Point 1 is included in Appendix D.

8.3.1.2 February 12, 2003 Meeting

The purpose of the second NEPA/Section 404 Merger Team meeting (for Concurrence Point 2) was to identify the Bonner Bridge replacement corridor(s) to assess in detail in the SDEIS. Concurrence was reached on two corridors for detailed assessment in the SDEIS: Corridor Alternative 1 *wide* and Corridor Alternative 4. This decision was revisited at the July 23, 2003 meeting, which is described in the next section. The assessment of corridor alternatives that was the basis for this decision is presented in Section 2.3 of the FEIS and in Figure 2-3.

Scoping-related issues discussed at the meeting were:

- Migratory waterfowl is important within the Refuge.

- Hunt clubs that pre-date the Refuge might have historical importance.

- Islands on the Pamlico Sound side of Hatteras Island are candidate Wilderness lands and are currently managed as Wilderness lands. They could be affected by the project.

- Commercial and recreational fishing activities in the area could be affected by construction. Oyster shells have been planted in the vicinity of Corridor 1 *wide*. Corridor 4 could affect localized fishing pound nets and crab pot sets.

- Coordination related to SAV mitigation should begin early and be coordinated with groups that are already working on SAV issues.

- Construction techniques and work staging areas should be analyzed as they could influence bridge location decisions.

- The effects of the possible removal of the terminal groin at the northern end of Hatteras Island could be important when determining the location of navigation spans for a replacement bridge.

- The public will want to know if, and what type of, alternate access will be provided on Hatteras Island within the Refuge, the Seashore, and fishing opportunities at Oregon Inlet if the current easement for NC 12 is abandoned by the NCDOT north of the southern terminus of a replacement bridge.

- Provisions for bicycles on the replacement bridge should be considered.
- Stormwater management and pile installation techniques should be discussed in the SDEIS.
- Consider using Bonner Bridge components for an artificial fishing reef when it is demolished.
- The effect of a Corridor 1 *wide* alignment upon the implementation of long-term solutions to NC 12 overwash should be considered.

8.3.1.3 July 23, 2003 Meeting

The main objectives of this meeting were to discuss revising Concurrence Point 2 (selection of corridor alternatives to be studied in the SDEIS), to identify alignment locations to evaluate within the corridor, and to discuss bridge lengths (Concurrence Point 2A).

The USFWS indicated that in order to issue a permit for a replacement bridge landing in the Refuge, such a replacement bridge would have to be determined to be compatible with the purpose and mission of the Refuge, per the National Wildlife Refuge System Improvement Act of 1997. Based largely upon serious reflection and coordination within the USFWS since the February 12, 2003 meeting, the Refuge had concluded that it was unlikely that Corridor Alternative 1 could be determined compatible. The NEPA/Section 404 Merger Team therefore concurred to drop Corridor Alternative 1 *wide* from further consideration and focus the attention of the SDEIS on Corridor Alternative 4 (referred to in the SDEIS as the Pamlico Sound Bridge Corridor.) The NEPA/Section 404 Merger Team also concurred that the bridge should be placed approximately 1 mile (1.6 kilometers) farther west than agreed to at the February 12, 2003 meeting. This would place the bridge in deeper water and thereby reduce the need for dredging during construction.

The NEPA/Section 404 Merger Team also concurred that two termini options at Rodanthe should be evaluated in the SDEIS, Segment A (Curved Rodanthe Terminus) and Segment C (Intersection Rodanthe Terminus). The assessment of alignment alternatives that was the basis for these decisions is presented in Section 2.4 of the FEIS and in Figure 2-4.

The signed concurrence forms for Concurrence Points 2 and 2A are presented in Appendix D. This decision was revisited again at the July 26, 2004 meeting, which is described in the next section.

8.3.1.4 July 26, 2004 Meeting

The NEPA/Section 404 Merger Team Co-Chairs met to discuss the addition of the Parallel Bridge Corridor to the alternatives to be evaluated in detail in the SDEIS. The attendees included members of the following agencies: the NCDOT, the USFWS—Pea Island National Wildlife Refuge, the USACE, the FHWA, and the NCDENR Division of Water Resources.

The Parallel Bridge Corridor was defined as including both a bridge over Oregon Inlet immediately west of Bonner Bridge, as well as the maintenance of NC 12 to Rodanthe for the life of the project. Thus, both the Parallel Bridge Corridor and the Pamlico Sound Bridge Corridor would provide vehicular transportation between Bodie Island (and populated areas to the north) and the first populated area on Hatteras Island (Rodanthe). It was agreed that a variety of means for the long-term maintenance of NC 12 should be assessed, including combinations of one of more of the following:

- Road relocation;
- Dune reconstruction;
- Beach nourishment;
- Elevated roadway; and
- Bridging of hot spots or island breaches.

It was also discussed that borrow sources would need to be assessed with any NC 12 alternatives that include beach nourishment or dune maintenance. Also, if NC 12 leaves the existing easement, the Refuge's compatibility process would be triggered, and the project would require a compatibility determination from the USFWS.

The NCDOT representative indicated that, based on conversations with the remaining members of the NEPA/Section 404 Merger Team, there was a consensus that as defined above, the Parallel Bridge Corridor should be evaluated in detail in the SDEIS. The Co-Chairs agreed to circulate a concurrence form to the other NEPA/Section 404 Merger Team members without calling a formal meeting. The signing of the revised concurrence form for Concurrence Point 2 (included in Appendix D) was completed on October 13, 2004.

8.3.1.5 May 24, 2005 Briefing

NCDOT briefed the NEPA/Section 404 Merger Team on the Parallel Bridge Alternatives to be evaluated in detail in the SDEIS: Nourishment, Road North/Bridge South, and All Bridge. Several NEPA/Section 404 Merger Team members had previously participated in other meetings on January 7 and April 4, 2005 (see Sections 8.5.1.3 and 8.5.2.3) to develop NC 12 alternatives. No major comments or concerns were received.

8.3.2 Other Agency Meetings

In addition to the NEPA/Section 404 Merger Team meetings, the NCDOT met with representatives of various environmental resource and regulatory agencies to discuss specific issues related to natural and cultural resources within and near the project corridor.

On November 13, 2002, a meeting was held with representatives of the Refuge and the Seashore. The following items were discussed during the meeting:

- The area around the freshwater ponds within the Refuge has high concentrations of both shorebirds and other migratory birds as well as considerable recreational use. These factors are important considerations when deciding where to place a replacement bridge in the Refuge.
- Bridge construction techniques and their impacts are important considerations.
- The bridge should be kept on structure until it is very close to its connection with NC 12 in order to minimize wetland disturbance.

- Both agencies preferred the longer bridge alternative (Corridor Alternative 4/Pamlico Sound Bridge Corridor).

- The project must be compatible with USFWS and NPS objectives.

On June 5, 2003, the NCDOT met with representatives of the NCDENR Division of Coastal Management, the NCDENR Division of Marine Fisheries, and the National Marine Fisheries Service. The agencies discussed the possible selection of a bridge replacement corridor in Pamlico Sound utilizing existing SAV data compiled by the National Marine Fisheries Service (photo-interpreted from 1988 and 1990 aerial photography) and by the NCDENR Division of Marine Fisheries (from boat surveys conducted between 1995 and 2001).

The agency representatives at the meeting indicated they were agreeable to moving forward with corridor selection, particularly if the NCDOT chose a corridor that was in water depths of 6 feet (1.8 meters) or greater where SAVs are unlikely to exist.

On June 11, 2003, NCDOT met with representatives of the Refuge and the FHWA. They discussed the need to conduct a separate study on the future disposition of access within the Refuge. Refuge representatives indicated they would conduct such a study and the NCDOT agreed to participate, as needed.

On July 2, 2003, NCDOT consultant representatives met with the USACE. Comments from the USACE included:

- It is their opinion that removal of the terminal groin would increase their dredging costs and make maintenance of the Oregon Inlet channel much more difficult.

- Pipeline dredging currently is being used west of Bonner Bridge and materials are placed on the small existing islands. The material cannot be taken offshore.

On August 21, 2003, a meeting was held with representatives of the NCDOT, the North Carolina Aquarium Society (owners of the former US Coast Guard Station), and the SHPO. The following items were discussed during the meeting:

- The Aquarium Society owns a 5.12-acre (2.07-hectare) tract in Nags Head that is home to Jeanette's Pier.

- Consideration could be given to moving the (former) Oregon Island US Coast Guard Station at the north end of Hatteras Island to a site adjacent to the Nags Head location.

- The Aquarium Society needs assurance that the station would remain listed on the National Register of Historic Places if it were moved.

- Possible funding options for relocating the station need to be discussed.

In a follow-up telephone conversation on August 27, 2003, the Aquarium Society indicated that the idea of moving the (former) US Coast Guard Station is not an option for them at this time.

On June 28, 2005, NCDOT met with representatives of the SHPO to agree on the effects of the replacement bridge corridor alternatives on four project area resources:

- The (former) US Coast Guard Station at the northern end of Hatteras Island;
- Pea Island National Wildlife Refuge;
- The Chicamacomico Life Saving Station (National Register), which is within the Rodanthe Historic District.

The agreement of the project's effects on these resources is presented on a concurrence form in Appendix D. Potential changes to the historic district boundary, given that one of the contributing structures was moved to the Chicamacomico Life Saving Station site in 2005, also were discussed.

8.3.3 Local Officials Meeting

The NCDOT met with local officials on June 16, 2003 at the request of the Dare County Board of Commissioners. In addition to the Dare County Commissioners, a commissioner from the Town of Duck and a commissioner from the Town of Nags Head attended. The meeting replaced the public officials' meeting that was planned for June 26, 2003, in association with Citizens Informational Workshops. The focus of local government comments was on the importance of maintaining highway access to the recreational activities within the Refuge.

8.4 SDEIS Citizen Involvement

8.4.1 Citizens Informational Workshops

Three Citizens Informational Workshops were held in mid-2003 to:

- Present the corridor alternatives under consideration; and
- Obtain feedback on the merits of the corridor alternatives evaluated in 2002 and 2003 and issues important to consider when selecting the corridor alternatives to be assessed in detail in the SDEIS.

The agenda was informal. The public was invited to come at any time during a three-hour period. Copies of the workshop handouts are included in Appendix E.

The Citizens Informational Workshops were held in Rodanthe (June 26, 2003) at the Rodanthe Waves Salvo Community Center, in Buxton (June 26, 2003) at the Cape Hatteras Secondary School Auditorium, and in Manteo (July 22, 2003) at the Roanoke Island Festival Park Film Theatre. At these meetings, 173 persons registered their presence. Comments were requested and received at the workshops. Eight comment forms were received at the Rodanthe workshop, 15 at the Buxton workshop and eight at the Manteo workshop. Key issues raised by the citizens were:

- A bridge replacement is needed soon;
- The replacement bridge needs turn-offs for bird watching;
- Bike access needs to be considered when designing the replacement bridge;

- Access within the Refuge should be provided if NC 12 is moved from its present location since it is a prime surf fishing and birding area;

- Connect the replacement bridge to NC 12 near the southern terminus of Bonner Bridge and leave NC 12 where it is;

- A bridge from Wanchese to Rodanthe should be considered as an alternative;

- Adequate space should be provided in a few locations on a long bridge for helicopters to land and for emergency vehicles to turn around without going to the other end of the bridge;

- Consider whether a longer bridge might need to be closed earlier during evacuations than would a shorter bridge because of high winds;

- The Texaco (now Liberty) service station in Rodanthe should not be displaced as it is invaluable to the community;

- Corridor Alternative 4 (now Pamlico Sound Bridge Corridor) would affect views of Pamlico Sound from homes;

- Recreational commercial fishing boats use a channel adjacent to Bonner Bridge called "the crack;" and

- The terminal groin should not be removed.

Representatives from the Refuge (USFWS) were present at all three Citizens Informational Workshops. A representative from the Seashore (NPS) attended the July 22, 2003 Citizens Informational Workshop in Manteo.

8.4.2 Newsletter

The NCDOT issued the first project newsletter on SDEIS-related studies in June 2003. The newsletter was mailed to everyone on the project's mailing list (approximately 10,000 individuals), which includes all Hatteras Island property owners (based on tax records) and those individuals who attended any of the Citizens' Informational Workshops. Copies of the newsletter were also sent to those on the Refuge's mailing list.

The newsletter introduced the purpose of studying new replacement bridge corridor alternatives and presented the corridors under consideration. The newsletter also indicated how to contact the study team, including a toll-free phone number (see below). It invited community groups and other stakeholders to request small group meetings with the study team if they wanted additional information or to provide comments on the project. It also announced the two Citizens Informational Workshops held on June 26, 2003. A copy of the newsletter is included in Appendix E.

8.4.3 Toll-Free Telephone Number

A toll-free telephone was announced in the June 2003 newsletter. It is answered by a senior member of the NCDOT's consultant team. It provides a means for citizens to obtain answers to personal questions about the project and make individual comments at any time during the study.

The phone number is 1-866-803-0529. It has been available throughout the SDEIS, SSDEIS, and FEIS preparation portions of the study.

8.5 Meetings to Consider the Specific Components of NC 12 Maintenance with the Parallel Bridge Corridor

Two series of meetings were held in early 2005 for the purpose of refining the NC 12 maintenance component of the Parallel Bridge Corridor that had been agreed to by the NEPA/Section 404 Merger Team on October 13, 2004. The first series (round one) of meetings focused on identifying specific potential options for the NC 12 maintenance component; the second series (round two) focused on comparing the potential NC 12 maintenance options and selecting those to evaluate in detail in the SDEIS.

Each series consisted of three meetings:

- The first meeting was held with the study team members, as well as representatives from various planning, design, and construction divisions in the NCDOT. At this meeting, the results of study team research were discussed and a recommendation of how to proceed developed.
- The second meeting presented members of NCDOT management with the results of the first meeting for their input.
- The third meeting sought feedback from environmental resource and regulatory agency representatives.

A final decision on how to proceed was made by NCDOT after each series of meetings.

8.5.1 Round One Meetings

Three meetings held in January 2005 focused on identifying of specific potential options for the NC 12 Maintenance component. Participants discussed both the results of high erosion rate modeling of the shoreline in the Refuge from 2010 to 2060 (see Figure E-1 in Appendix E) and the potential for storm-related breaches to occur in the Refuge at five locations (see Section 2.6.2.3).

8.5.1.1 January 4, 2005 Meeting

Meeting participants defined the following NC 12 Maintenance alternatives for consideration at the subsequent two meetings:

- Beach nourishment with dune construction/maintenance to maintain NC 12 in its current location.
- North of and at the Refuge’s ponds, relocation of NC 12 as a roadway to a point 230 feet (70.1 meters) west of the predicted 2060 high erosion shoreline, with dunes. Previous NC 12 studies indicate that road maintenance caused by erosion and overwash increases when the distance between the road and the ocean is less than 230 feet (70.1 meters).

- North of the Refuge's ponds, extension of a replacement Oregon Inlet bridge on an alignment that is a minimum of 230 feet (70.1 meters) west of the predicted 2060 high erosion shoreline. Access to the Refuge from NC 12 would be provided near Oregon Inlet.

- At the Refuge's ponds, relocate NC 12 west of the ponds, utilizing the existing dikes as much as possible.

- In the northern Rodanthe area and the southern part of the Refuge, relocate NC 12 onto a bridge just off-shore in Pamlico Sound.

- In the northern Rodanthe area and the southern part of the Refuge, a short-term road relocation adequate to 2020 and then a bridge just off-shore in Pamlico Sound.

A bridge in the existing NC 12 easement was eliminated from consideration because such a bridge would be in the ocean by 2020 and subject to ocean wave action, which would increase the cost of the project. Also, once in the ocean, the bridge could interfere with ocean use by the public and would not provide access to the Refuge, defeating one of the primary objectives of the Parallel Bridge Corridor. This decision was affirmed at subsequent meetings.

8.5.1.2 January 6, 2005 Meeting

The alternatives identified at the January 4th meeting were discussed with NCDOT management representatives. The decisions from the first meeting were affirmed. In addition, the following points were discussed in relation to these alternatives:

- Placing NC 12 on a bridge would allow natural overwash to occur.

- A relocated NC 12 or nourishment alternative would protect the Refuge's ponds from being inundated by the ocean as the shoreline continues to advance towards the ponds.

- A relocated NC 12 west of the Refuge's ponds would cut the Refuge in half, but it could reduce the wetland impact of roadway relocation.

- A project in the Parallel Bridge Corridor could be phased as funding is available. A replacement bridge across Oregon Inlet could be built immediately and then followed by construction of the NC 12 maintenance component as needed.

- Protection or relocation of NC 12 would not resolve shoreline erosion expected in Rodanthe.

8.5.1.3 January 7, 2005 Meeting

The alternatives identified at the January 4th meeting were discussed with representatives from the USFWS (Pea Island National Wildlife Refuge), the USACE, the NCDENR Division of Water Quality, the NCDENR Division of Coastal Management, and the FHWA. It was suggested that the relocation of NC 12 on a bridge 230 feet (70.1 meters) west of the 2060 high erosion shoreline in the Refuge's ponds area be added to the list of alternatives; this addition was made. Other comments and discussions were:

- It may be unlikely that the NC 12 maintenance options outside of the existing easement would be permitted by the USFWS, but the study team should continue to examine them.

- The current location of NC 12 is interrupting natural processes (i.e., overwash) within the Refuge, so NC 12 itself is really not compatible with the Refuge. Bridging NC 12, even over land, could be more compatible because it would cause less interruption to natural processes within the Refuge.

- Bird mortality could increase with bridging NC 12 within the Refuge.

- The relocation of NC 12 along the dikes to the west of the ponds would include impacts to Refuge infrastructure (e.g., pump stations), impacts to bird flight paths, and impacts to trails used by bird watchers. Storm surges from the Pamlico Sound could affect NC 12 if it is relocated along the west side of the island.

- An NC 12 relocation as a roadway would have extensive wetland impacts.

- The practicality of building a connector bridge from a Pamlico Sound Bridge to the north end of Hatteras Island for Refuge access was discussed. This alternative was not added because of the high cost and, without the maintenance of NC 12 to the south, users would have no place to go in their automobiles once reaching Hatteras Island.

- If a breach were to open in the Rodanthe area, finding an adequate source of sand to close such a breach could be very difficult and potentially environmentally damaging.

- A compromise solution of building the Pamlico Sound Bridge, as well as the Rodanthe area bridge, was discussed. Such an approach would provide reliable access to Rodanthe and the rest of Hatteras Island, as well as the southern 5.5 miles (8.9 kilometers) of the Refuge. Such an alternative could be selected as the Preferred Alternative based on the assessment contained in the SDEIS.

8.5.2 Round Two Meetings

A second series of meetings was held in March and April 2005 for the selection of the specific Parallel Bridge Corridor with NC 12 Maintenance Alternatives to be assessed in detail in the SDEIS. Functional design, cost, and environmental impact potential findings developed by the study team for the potential alternatives identified at the first round of meetings were presented.

8.5.2.1 March 22, 2005 Meeting

Meeting participants discussed the design, cost, and environmental impacts of the potential alternatives. With the nourishment alternative, sand availability and impacts to the beaches' invertebrate population were discussed, including the potential for a reduction in abundance and diversity of species; the quality of available sand; and the risk of losing the USFWS permit for beach nourishment partially into a 50-year nourishment program because of ongoing impacts to invertebrate populations. Other points of discussion were:

- The continued accommodation of fishing that is currently available via the catwalks on Bonner Bridge.

- Dropping the alternative of relocating NC 12 west of the Refuge's ponds because if its impact to Refuge facilities.

- Presenting at the remaining meetings a representative combination of NC 12 Maintenance alternatives that include a bridge in the Rodanthe area and nourishment at both the Refuge's ponds and the area north of the ponds. Since nourishment is very costly in the Rodanthe area, it might be reasonable to drop it as an alternative at this time.

8.5.2.2 March 31, 2005 Meeting

Study findings and observations from the first round two meeting were discussed with NCDOT management representatives. Items discussed included:

- The strong preference of Dare County to include catwalks on the Oregon Inlet bridge at its south end and the challenges associated with accommodating this request.

- The rapid escalation of construction costs since 2003.

- The results of the NC 12 Task Force sand source study. The study identified several sources of sand, so the sand for nourishment is potentially available, but the quality of the sand is unknown. Participants discussed the potential for a cooperative effort between the NCDOT and the USACE to use sand dredged from Oregon Inlet for nourishment, potentially reducing costs for both agencies.

- The potential for storm-caused breaches on Hatteras Island and the risk breaches present to the various alternatives.

- Dropping the alternative of relocating NC 12 west of the Refuge's ponds because if its impact to Refuge facilities.

- The practicality of building a Pamlico Sound Bridge, as well connecting bridges to the Refuge on the north (a connector bridge from a Pamlico Sound Bridge to the north end of Hatteras Island) and south (relocating NC 12 onto a bridge in the Rodanthe area).

8.5.2.3 April 4, 2005 Meeting

The third meeting again involved environmental resource and regulatory agency representatives including: the USFWS, the USACE, the NCDENR Division of Water Quality, the NCDENR Division of Coastal Management, and the FHWA. Meeting participants agreed that the alternative relocating NC 12 to the west of the Refuge's ponds should be dropped because of its impact to the Refuge. The alternative of relocating NC 12 in the Rodanthe area to a point beyond the 2020 shoreline and then later building a bridge in Pamlico Sound just west of northern Rodanthe also was dropped because of the potential community and natural resource impact of the short-term relocation. Discussion topics included:

- Specifics related to beach nourishment, including: the minimum project length for beach nourishment, the proposed nourishment cycle, potential sand sources, proposed dune locations and sizes, sand availability, and sand characteristics needed to be compatible with Refuge beaches.

- Potential breaches, including an agreement that when relocating NC 12 on a bridge, the bridge would span potential Hatteras Island breach locations.

- The potential need for more study on the availability of sand and its characteristics for nourishment, dunes, and closing breaches before a decision were made to select nourishment as the Preferred Alternative for NC 12 maintenance and the preparation of a FEIS.

- The need to evaluate in detail in the SDEIS multiple ways to maintain NC 12 through the Refuge until 2060, because all of the different alternatives have both positive and negative aspects.

- The NEPA/Section 404 Merger Team should be briefed on the findings of these efforts to define the specifics of NC 12 maintenance. (This briefing occurred on May 25, 2005 and is discussed in Section 8.3.1.5.)

The study team's final decision on the NC 12 Maintenance alternatives for the Parallel Bridge Corridor is presented in Section 2.6.4.

8.6 North Carolina Legislation Related to Bonner Bridge Replacement

During its 2005 Session, the North Carolina General Assembly passed the following legislation (House Bill 747) related to the replacement of Bonner Bridge:

- Contract for Accelerated Construction of the Herbert C. Bonner Replacement Bridge Project. The [North Carolina] Department of Transportation shall implement all reasonable measures to expedite completion of environmental reviews required by the National Environmental Policy Act. Within 90 days of receiving an approved Record of Decision from the Federal Highway Administration, the Department shall contract with a single private entity to design and build a replacement bridge for the Herbert C. Bonner Bridge at Oregon Inlet, in accordance with G.S. [general statute] 136-28.11, in order to expedite and accelerate the efficient, cost-effective completion of the project.

- Replacement Bridge. The General Assembly recommends that the replacement bridge constructed pursuant to this section be located with north and south termini in general proximity to the termini at the existing Herbert C. Bonner Bridge. It is recognized, however, that the Preferred Alternative for the bridge location cannot be determined prior to compliance with all Federal and State laws and regulations.

- Department to Report on Project. The Department shall report to the Joint Legislative Transportation Oversight Committee on December 1, 2005, and each December 1 thereafter until completion, on the progress of the accelerated bridge project described in this section.

8.7 SDEIS Newsletter and Public Hearings

Two Public Hearings were held following publication of the SDEIS in September 2005. The first Public Hearing was held on November 9, 2005, at the Dare County Justice Center in Manteo. The second Public Hearing was held on November 10, 2005, at the Rodanthe-Waves-Salvo Community Center in Rodanthe. Citizens Informational Workshops were held prior to each Public Hearing. The purpose of the hearings was to give citizens the opportunity to express their opinions about the project and the various alternatives analyzed in the SDEIS. Approximately 207 people attended the two Public Hearings and 33 spoke. Written comments also were received from both the public and several state and federal agencies. Responses to these comments are provided in Section 8.11.

To announce the publication of the SDEIS, the NCDOT issued a second project newsletter in October 2005. The mailing list used to distribute the newsletter once again contained approximately 10,000 individuals, including all property owners on Hatteras Island (from tax records' addresses), individuals on the Refuge's and Seashore's mailing list, and other individuals who requested to be on the mailing list. The newsletter also was made available to individuals who attended the November 2005 Public Hearings and Pre-Hearing Open House Workshops.

The newsletter included a summary of the factors important to the selection of a Preferred Alternative, as well as two summary tables comparing the replacement bridge corridor alternatives based on the detailed evaluations in the SDEIS. The first table compared the alternatives based on: key community and cultural resource impacts; key natural resource impacts; and other considerations. The second table compared the alternatives based on estimated project costs. The newsletter also included: an announcement of the two upcoming Public Hearings and Pre-Hearing Open House Workshops along with the schedules and locations; a map showing the two replacement bridge corridor alternatives; information on how to comment on the project and how to contact the study team, including the toll-free phone number; locations at which the SDEIS and corridor maps were available for public review; and information on the next steps in the project development process. A copy of the newsletter is included in Appendix E.

The SDEIS and the public hearing announcement were posted on the Outer Banks Task Force web site (http://www.obtf.org/).

8.8 Agency Coordination between the SDEIS and the 2007 Supplement to the SDEIS

Three meetings of the project's NEPA/Section 404 Merger Team were conducted following the 2005 Public Hearings. NCDOT and FHWA hosted a Phased Approach Alternative Constructability Workshop at which Mike Bryant, manager of the Refuge, made opening remarks. A letter from the US Secretary of the Interior was sent to US Senator Richard Burr related to the project and its alternatives. The key meetings and the letter are described in the paragraphs below.

8.8.1 NEPA/Section 404 Merger Team Meetings

The sections that follow describe the three NEPA/Section 404 Merger Team meetings held following the release of the SDEIS.

8.8.1.1 June 15, 2006 Meeting

The purpose of this NEPA/Section 404 Merger Team meeting was to update the Merger Team on what was then an additional alternative being considered (the Phased Approach alternatives [including the Preferred Alternative] assessed in the SSDEIS and this FEIS), and to update the Merger Team on revised and augmented public cost estimates on both the alternatives assessed in the SDEIS, as well as the additional alternatives. Merger team members posed questions and made comments throughout the meeting. Issues discussed at the meeting included:

- Assumptions made for various costs, including both highway related and other public costs;
- The connection between the Parallel Bridge Corridor alternatives and ongoing long-range and interim NC 12 maintenance studies being conducted by the OBTF within the Refuge and Rodanthe areas, including cost considerations;
- The merits of introducing non-highway project related potential public costs into project cost comparisons;
- The differing costs between relocating utilities on a bridge and relocating utilities on land;
- Assumptions related to the potential for a storm-related breach in the Refuge;
- Refuge representatives indicated that they were not certain if the Phased Approach Alternative, if pursued and confined to the existing NC 12 easement, would have to undergo a Refuge compatibility review;
- The merits of studying alternatives for which funding is not currently allocated; and
- An engineering study of the Phased Approach Alternative would be conducted; the results of this study would determine whether it would be presented to the Merger Team for concurrence as a detailed study alternative.

8.8.1.2 September 21, 2006 Meeting

The purpose of the second NEPA/Section 404 Merger Team meeting was to discuss the Final Report of the Bonner Bridge Constructability Workshop (the engineering study discussed at the June 15 meeting), which took place from August 29 to 31, 2006 in Kill Devil Hills, and to decide whether a revised Concurrence Point 2 Agreement should be signed to include the Phased Approach Alternative so it could be evaluated in the SSDEIS.

Issues discussed at the meeting were:

- The purpose, process, and outcome of the Constructability Workshop;
- The NCDOT and FHWA's desire to conduct a full assessment of the Phased Approach Alternative that would be presented in a SSDEIS and compared with the alternatives assessed in the SDEIS;
- The merits of the Phased Approach Alternative in terms of whether its impacts would be comparable to the alternatives assessed in the SDEIS and, thereby, its reasonableness as a detailed study alternative;
- That the SSDEIS would focus on assessing the Phased Approach Alternative and that comments made on the SDEIS would be addressed together with comments on the SSDEIS in the FEIS;
- Issues related to the implementation of the Phased Approach Alternative, including: regular construction within the Refuge over the long-term as each phase is built; assurance of the long-term availability of construction funding; design features of a bridge that ultimately would be in the ocean; and procedures for meeting NEPA requirements in future phases;

- The desire of the Merger Team for more information on the potential impacts of the Phased Approach Alternative; and

- Whether the Phased Approach Alternative fit within the definition of the Parallel Bridge Corridor approved for detailed study in 2004.

The Merger Team agreed that the Phased Approach Alternative fit within the definition of the Parallel Bridge Corridor approved for detailed study in 2004. The NCDOT agreed to meet again with the Merger Team to brief them on details related to its characteristics and impacts at a future date.

8.8.1.3 December 14, 2006 Meeting

The purpose of the third NEPA/Section 404 Merger Team meeting was to present for discussion the functional designs of the two Parallel Bridge Corridor with Phased Approach alternatives (including the Preferred Alternative) and discuss potential impacts in advance of the release of the SSDEIS. Items discussed at the meeting included:

- Whether the life span of the Phased Approach alternatives' (including the Preferred Alternative) bridges would be shortened as a result of being in a harsh ocean environment; it was noted that an American Association of State Highway and Transportation Officials (AASHTO) task force is developing new specifications for the design of bridges subject to coastal storm events;

- For presentation in the SSDEIS, new costs for the replacement bridge corridor alternatives were being developed that update those presented at the June 15, 2006 Merger Team meeting;

- Beginning 10 to 20 years from now, the Phased Approach alternatives' (including the Preferred Alternative) bridges will be in the surf, that most of the bridges will be offshore by 2060, and that the actual shoreline location will depend upon the timing of future storms;

- Potential short-term changes to NC 12 are being considered in the Bonner Bridge cost estimates by assuming continued major maintenance to the Canal Zone Hot Spot and a round of nourishment at the Rodanthe 'S' Curves Hot Spot;

- AASHTO guidelines will be followed and the hydraulics will be modeled during bridge design to ensure adequate pile lengths;

- The Oregon Inlet bridge would have a series of navigation spans, which would be designed to withstand ship impact; fenders are generally used only at the navigation span in use and are moved as needed;

- The decision to place the Phased Approach alternatives' (including the Preferred Alternative) bridges on the ocean side of the existing NC 12 easement with the temporary traffic maintenance road on the sound side was made at the August 2006 workshop;

- Bridges would be closed by emergency management during a storm when sustained wind speeds are over 60 mph, as is the policy used for Bonner Bridge; and

- That a barge could be used to move the (former) Oregon Inlet US Coast Guard Station to a location north of the inlet.

At the conclusion of the meeting, it was noted that the SSDEIS would likely be distributed in early February 2007, followed by a Public Hearing and subsequent comment period. It was also noted that the Merger Team meeting to select the LEDPA would be held soon after the comment period ends.

8.8.2 Phased Approach Constructability Workshop

A Constructability Workshop was held August 29 to 31, 2006 in Kill Devil Hills, North Carolina. The purpose of the workshop was to examine the technical feasibility of the Phased Approach Alternative. Mike Bryant, the manager of the Refuge, spoke as a part of the opening welcome. The workshop is described in Section 2.7 of the FEIS.

8.8.3 US Secretary of the Interior Letter

The Secretary of the US Department of the Interior (DOI) sent a letter dated July 5, 2006 to US Senator Richard Burr in response to the Senator's concern for the need to replace Bonner Bridge. The letter is presented in Appendix A. In the letter, the Secretary noted that it is important for coordination to occur between DOI and the State of North Carolina in finding a way to replace the bridge as soon as possible to protect the health and safety of the public.

The Secretary indicated that he believed that the best way to proceed would be to separate the replacement of Bonner Bridge, a project whose delay could constitute a clear and present safety issue for all concerned, from the more difficult and less urgent issues of the realignment of NC 12. The letter indicated that DOI believes the replacement of the bridge itself could be accomplished in a way which is compatible with the National Wildlife Refuge System Improvement Act of 1997, and other laws, if it is constructed within the same easement or with minor changes to the current easement. With this understanding, the letter said that NCDOT could quickly conclude their planning and begin construction of a bridge to replace the existing bridge that Senator Burr stated is an imminent threat to public safety.

The Secretary pledged the support of DOI to allow replacement of the bridge, providing safe transportation while protecting important wildlife resources on the Refuge.

A similar letter also was sent to North Carolina Governor Michael F. Easley.

DOI sent an additional letter on September 11, 2007 to North Carolina Governor Michael F. Easley (see Appendix A). The Acting Assistant Secretary for Fish and Wildlife and Parks reminded the Governor of previous correspondence and of USFWS' participation on the NEPA/Section 404 Merger Team. He noted that USFWS requested additional information in DOI's SSDEIS comment letter (this information is included in this FEIS). He expressed concern about the effect on the Refuge of the construction of the Preferred Alternative in phases over a long period of time. He said that USFWS believes NCDOT will need to apply for a permit to build the Preferred Alternative in the existing NC 12 easement, and that USFWS would determine if the project was compatible with the mission of the Refuge in the context of considering that permit application. He also indicated that USFWS believes that building the Preferred Alternative in phases would result in continued maintenance outside of the existing road's right-of-way through the Refuge until each subsequent phase of bridge construction along NC 12 is completed.

8.9 2007 Supplement to the SDEIS Newsletter and Public Hearings

Two public hearings were held following the February 2007 publication of the SSDEIS. The first Public Hearing was held in Manteo on March 28, 2007, at the Dare County Justice Center. The second Public Hearing was held in Rodanthe on March 29, 2007, at the Rodanthe-Waves-Salvo Community Center. Both hearings were preceded by Citizens' Informational Workshops. The purpose of the hearings was to give citizens the opportunity to express their opinions about the project and all of the alternatives analyzed (including the two new Phased Approach alternatives [including the Preferred Alternative]) in the SDEIS and SSDEIS. Approximately 244 people attended the two Public Hearings, and 39 spoke. Representatives from the USACE, FHWA, NPS, and USFWS also attended these meetings. Written comments also were received from both the public and several state and federal agencies. Responses to these comments are provided in Section 8.11.

The NCDOT issued a third project newsletter to announce the SSDEIS in February 2007. The mailing list used to distribute the newsletter again contained approximately 10,000 individuals, including all property owners on Hatteras Island (based on current tax records), individuals on the Refuge's and Seashore's mailing list, and other individuals who requested to be on the mailing list. The newsletter also was made available to individuals who attended the 2007 Citizens' Informational Workshops and Public Hearings for the SSDEIS.

The newsletter included two summary tables comparing the replacement bridge corridor alternatives based on the detailed evaluations in the SDEIS and the SSDEIS for the Phased Approach alternatives (including the Preferred Alternative). The first table compared the alternatives based on: key community and cultural resource impacts; key natural resource impacts; and other considerations. The second table compared the alternatives based on estimated project costs. The newsletter also included: an announcement of the two upcoming Public Hearings and Citizens Informational Workshops along with there schedules and locations; a map showing the two replacement bridge corridor alternatives; a brief summary of the factors important to selecting a Preferred Alternative; information on how to comment on the project and how to contact the study team, including the toll-free phone number; locations at which the SSDEIS and corridor maps were available for public review; and information on the next steps in the project development process. A copy of the newsletter is included in Appendix E.

The SSDEIS and the public hearing announcement were posted on the Outer Banks Task Force web site (http://www.obtf.org/) for public review.

8.10 Merger Team Meetings Associated with Selection of the Preferred Alternative

8.10.1 Merger Team Meetings

Three meetings were held with the NEPA/Section 404 Merger Team to select the LEDPA. The following sections describe each of these meetings.

8.10.1.1 May 23, 2007 Meeting

The purpose of this NEPA/Section 404 Merger Team meeting was to present for discussion the detailed study alternatives and their potential impacts and to identify the LEDPA (Concurrence Point 3). The NCDOT sought consensus on the Parallel Bridge Alternative with Phased Approach/Rodanthe Bridge Alternative (Preferred) as the LEDPA. General discussion items included:

- Whether or not the alternative constituted a constructive use of the Refuge as a Section 4(f) resource. FHWA indicated that they had concluded there was no constructive use.

- Why the cost estimates for the Pamlico Sound Bridge Corridor increased by a much larger percentage from the SDEIS to the SSDEIS than for the Parallel Bridge Corridor alternatives.

- Why innovative financing could not be used to implement the Pamlico Sound Bridge. A handout titled "1989 Equity Formula" was distributed. The legislative intent of the formula is to spread funds throughout the state. The handout showed how NCDOT distributes funds between its geographic Divisions based on the 1989 Equity Formula, the amount of funding that Division 1 (which includes the project area) received in the 2007-2013 Transportation Improvement Program (TIP) (approximately $548 million), and that Division 1 would not exceed $1 billion in cumulative funding until 2021.

- If funding is not available for a particular alternative, the alternative is not reasonable and feasible and should not be put forth in NEPA documents.

- There are only two alternatives that cost less than $1 billion – the Nourishment Alternative and the Road North/Bridge South Alternative. However, the agencies have serious concerns related to sand compatibility issues with the Nourishment Alternative and the Road North/Bridge South has substantial impacts to the Refuge outside of the existing easement. These issues were also important in NCDOT's decision to recommend the Phased Approach/Rodanthe Bridge Alternative.

Individual agencies stated the following positions related to the selection of the Phased Approach/Rodanthe Bridge Alternative as the Preferred Alternative:

- DCM can support the Parallel Bridge (Phase I), but not the Phased Approach Alternative's NC 12 bridges that would be built in extremely threatened locations, eventually being located on the beach and in the surf zone. This concept goes against the fundamental management objectives of the Coastal Area Management Act (CAMA) related to not building on the beach and DCM cannot support it. The only exception they allow to this objective is public fishing piers.

- NMFS still has concerns that have not been addressed about the long-term impacts of the Phased Approach on the beach invertebrate community and the beach fisheries community. They did not agree with the assessment in the SSDEIS that there is no net loss of habitat for these species with the Phased Approach. They believe that there are concerns related to the eventual location of bridges in the surf zone not adequately addressed in the SSDEIS.

- USEPA had objected to the Parallel Bridge Corridor in writing. USEPA requested further information on the funding issue. Once they have this information, they will re-open their NEPA review and reconsider their determination of their Preferred Alternative.

- USFWS could not concur on the LEDPA at the meeting. They would like further information in response to their SDEIS and SSDEIS comments. In addition, although the Pamlico Sound Bridge has apparently been eliminated based on funding/costs, they would like further information to determine if other alternatives also should be eliminated from a cost basis. Also, although some alternatives are apparently not practicable from a cost basis, they do not have enough information to determine if other alternatives are practicable from a regulatory basis, including compatibility. The Parallel Bridge Corridor alternatives would not likely be compatible with the Refuge according to the Refuge manager.

- NPS could not concur on the LEDPA that day.

- FHWA could concur on the LEDPA as the Phased Approach/Rodanthe Bridge Alternative (Preferred).

- WRC was not represented at the meeting but indicated in a letter that WRC did not oppose NCDOT's selection of the Phased Approach/Rodanthe Bridge Alternative (Preferred) as the LEDPA.

- DMF also was not represented and their letter did not state whether DMF concurred with NCDOT's choice of the LEDPA. The letter indicated that recreational fishing opportunities should be provided equivalent to the current opportunities with the replacement bridge. It also stated that once Bonner Bridge is demolished, suitable rubble material should be used to create artificial fishing reefs in North Carolina's coastal fishing public trust waters.

- DWQ could concur with the Oregon Inlet bridge component of the Phased Approach Alternative, but not the components of the Phased Approach south of Oregon Inlet (i.e., the bridges that would be located in the ocean in the near future).

- State Historic Preservation Office could not concur on the LEDPA until they have further information from FHWA on whether the Phased Approach constituted a constructive use of Refuge lands.

- USACE is not ready to concur on NCDOT's LEDPA. They asked for more information, in writing, on the alternative funding/costs issues.

At the conclusion of the meeting, it was noted that the next step is for each of the agencies to provide written documentation to NCDOT as to what their specific concerns and needs for further information are at this point. NCDOT indicated that once they reviewed the concerns, they would decide whether to try and provide additional documentation to address the agency concerns and meet with the Merger Team again or to elevate the project to the Merger Implementation Team.

8.10.1.2 June 20, 2007 Meeting

At the second Concurrence Point 3 meeting of the NEPA/Section 404 Merger Team, NCDOT presented for discussion additional cost information on the alternatives, additional information on funding sources and the equity formula, and how that information relates to programming of the proposed project in the TIP. NCDOT engineers also answered cost-related questions that were included in the comments on the 2007 SSDEIS and in the Issue Briefs submitted by Merger Team members after the May 23 meeting. This only was an information meeting; concurrence on the LEDPA was not requested. Handouts discussed included:

- A Bonner Bridge Preliminary Estimates notebook, which included NCDOT's documentation for its cost estimates;

- A handout titled "Estimate-Related Issues" that addressed the estimate-related questions raised by the agencies during their review of the SSDEIS;

- A handout that outlined various funding sources, including the State Infrastructure Bank, GARVEE Bonds, and toll roads. It was noted that NCDOT had sought legislation that would have allowed for GARVEE Bonds to construct this project and other very costly projects; however, the statute that was approved by the NC General Assembly dictated that the bond money be distributed statewide according to the equity formula. With regards to use of toll financing, state law requires that a free route be available as an alternative to a toll road. Currently NC 12 to Bodie Island is the only free route connecting Hatteras Island to the mainland.

Other items discussed included:

- NCDOT's cost estimates were affirmed by two independent sources, the firm of Finley Engineering, which has experience in designing and building coastal bridges, and FHWA;

- The basis for cost estimates, including consideration of bids and plans for the I-10 bridge replacement on the Gulf Coast as put together by that project's Design-Build team;

- FHWA emergency relief funding procedures, including the emergency funds that come from a different funding source at FHWA than normal projects.

At the conclusion of the meeting, NCDOT requested that additional questions be provided. Also, NCDOT said they planned to meet with representatives from individual agencies (or groups of agencies) before the next meeting to discuss agency concerns further (see Section 8.10.2). NCDOT indicated that at the next meeting the Merger Team would either need to reach consensus or agree to elevate the decision.

8.10.1.3 August 15, 2007 Meeting

The purpose of the third Concurrence Point 3 NEPA/Section 404 Merger Team meeting was to decide on a LEDPA if a decision could not be reached, NCDOT would elevate the project. Items discussed at the meeting included:

- A review of the project's activity since the May 23, 2007 meeting, including the submittal of issue briefs; the material on costs and funding presented at the June meeting; additional questions on costs, including operations and maintenance costs, provided by USEPA after the June meeting; and individual agency meetings held between the June and August meetings.

- Review of the definition and components of the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) proposed as the LEDPA;

- A description of the FHWA NEPA procedures that would apply to each phase after Phase 1 (Oregon Inlet bridge) that would provide the flexibility to refine future phases of the project, if needed, as the project setting evolves.

Concurrence was not achieved on a LEDPA. The LEDPA decision was elevated based on the Section 404/NEPA Merger 01 Process Guidelines. Nonconcurring or abstaining Merger Team members were asked to prepare updated or new Issue Briefs, if needed. It was noted that the Merger Implementation Team, normally the first level in the elevation process, had agreed already to elevate the decision to the Review Board.

8.10.2 Individual Merger Member Meetings

Prior to the third Concurrence Point 3 meeting (August 15, 2007) for selection of the LEDPA, NCDOT and FHWA held five meetings with individual Merger Team members to discuss in detail their concerns with the LEDPA proposed by NCDOT. The sections that follow list the concerns discussed at each meeting.

8.10.2.1 June 11, 2007 Meeting with USFWS

Attendees at this meeting included representatives of the USFWS (Refuge and Raleigh Field Office), NPS, FHWA, and NCDOT. The following items were discussed:

- USFWS reiterated that any construction outside of the existing NCDOT easement through the Refuge, including emergency actions, would trigger a compatibility determination.

- USFWS said that they have to perform a NEPA analysis on any action that triggers a compatibility determination.

- NCDOT, on average, requests two special use permits per year to repair damage to NC 12 associated with overwash. USFWS can find such actions compatible only if they can assume that there is less than 10 years of impact because a long-term solution, such as the Pamlico Sound Bridge Corridor, is expected.

- USFWS said that because the Phased Approach/Rodanthe Bridge Alternative (Preferred) would constitute a long-term solution to NC 12 needs through the Refuge and the NCDOT says it will stay in the existing easement, USFWS would not be able to allow NCDOT to conduct any more “emergency repairs” or other activities that impact the Refuge outside of the NC 12 easement once the ROD for the Phased Approach is issued.

- USFWS said that NCDOT’s requests for emergency repairs to NC 12 are not really the USFWS’ concern; however, these requests, which have negative impacts on the Refuge and go against the Refuge’s mission, become a problem for USFWS because of the importance of keeping NC 12 open. USFWS feels that there have been too many impacts over too much time with short-term or emergency actions.

- USFWS said that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is supposed to stay within the existing easement through the Refuge so that impacts will be confined to the existing easement, but the NEPA document says that it will actually have impacts outside of the existing easement (e.g., the potential implementation of a short-term relocation of NC 12 in the Rodanthe area). If these impacts are more than “minor,” then the alternative would not be found compatible with the Refuge.

- USFWS said that in the past they have allowed minor changes in the NC 12 easement for safety improvements as long as appropriate mitigation also was provided.

- USFWS does not want to perpetuate the “emergency” in regards to accommodating NCDOT’s requests for emergency repairs to NC 12 that have negative impacts on the Refuge, and they believe that the Phased Approach/Rodanthe Bridge Alternative (Preferred) would cause this to happen.

8.10.2.2 July 5, 2007 Meeting with the NCDENR Division of Coastal Management (DCM)

Attendees at this meeting included representatives of the DCM, FHWA, and NCDOT. The following items were discussed:

- The purpose of the meeting was to discuss DCM’s comments on the design of the Phased Approach/Rodanthe Bridge Alternative (Preferred) that relied upon the estimated 2060 shoreline.

- The topic of shoreline erosion assumptions was discussed. NCDOT indicated that for the FEIS, the project team will need to develop “trigger” criteria for the implementation of the phases of the Phased Approach/Rodanthe Bridge Alternative (Preferred).

- The project team stated that the high erosion shoreline includes a “prediction interval” that accounts for shoreline erosion occurring faster than past trends. Though no additional factor was included for sea level rise trends, the 2060 high erosion shoreline was used in developing all of the Parallel Bridge Corridor Alternatives.

- Discussion included how the shoreline erosion rates used in the SDEIS compare to the DCM shoreline erosions rates. DCM’s rates take into account just two data points and no prediction interval. The two rates are comparable within 1 foot, although there is still some uncertainty in the predicted rates.

- DCM expressed concerns about whether the bridge would be built to withstand extreme conditions. If a bridge is a major evacuation route and its design does not hold up to coastal processes, it will be a detriment to the community. The new bridge design would have to meet any design guidelines being developed as part of the FHWA Wave Vulnerability Task Force. NCDOT recognizes the challenges of locating bridges within an eventual surf zone, but the placement of the bridges are limited by location of the existing NC 12 easement.

- DCM suggested an “Adaptive Management” that would allow NCDOT to proceed with the final design of the Oregon Inlet Bridge and defer the choice of the final option or options for the subsequent phases until a later date. The group discussed why this was not an applicable approach for this project.

- DCM’s position is that construction of permanent bridges in a location that is projected to be in the ocean on or before the project’s design year would be inconsistent with the most basic principles of the Coastal Area Management Act (CAMA) and the Rules of the Coastal Resources Commission (CRC). It is possible none of the alternatives studied could completely comply with the rules of the CRC. Therefore, it is possible that DCM will need to deny a CAMA permit application for any of the alternatives for procedural reasons. In that situation, NCDOT would have the option of petitioning the CRC for a variance to undertake a project that is prohibited by the CRC’s development standards.

- DCM is concerned with bridge piers and approach retaining walls used as they relate to erosion control and structure setback rules.

- DCM is concerned about the lower level of public access to the Refuge with the Phased Approach/Rodanthe Bridge Alternative (Preferred). NCDOT stated there would be more of a guarantee of access with the Phased Approach Alternative than the Pamlico Sound Bridge Alternative.

- DCM questioned what would be done with the Phased Approach/Rodanthe Bridge Alternative's (Preferred) bridges after they are demolished at the end of their service life. The project team said current policies and procedures would be discussed in the FEIS. The difference between the disposal of the Bonner Bridge and the Phased Approach would be the quantity of material to dispose.

- The USFWS sand compatibility criteria for beach nourishment is different than the DCM criteria. Both sets of sediment criteria would need to be satisfied.

8.10.2.3 July 12, 2007 Meeting with the National Marine Fisheries Service

Attendees at this meeting included representatives of the NMFS, USACE, FHWA, and NCDOT. The following items were discussed:

- NMFS stated concerns about structures in the surf zone and how modeling for coastal processes and the assessment of related impacts will be performed. NCDOT explained the modeling.

- NFMS stated concerns of scour at the base of coastal structures related to marine species that utilize the surf zone in general and specifically its value as Essential Fish Habitat (EFH) for red drum. However, the bigger-picture issue is the change over time in the physical makeup of approximately 10 miles (16.1 kilometers) of the beach itself and its ability to support the full range of invertebrates and fishes that utilize the nearshore waters and the surf zone as habitat.

- NMFS felt that surf zone habitat was not adequately addressed in the DEIS and asked how NCDOT would assess the related impacts based upon the information available. They asked whether this assessment would be performed before the next meeting of the Merger Team. NCDOT said that additional studies would be conducted after the LEDPA was selected.

- The NMFS position on the LEDPA is based on information currently available which indicates that impacts to fishery resources, including surf zone EFH and other nearshore habitats, have not been adequately addressed. Therefore, NMFS cannot concur on a LEDPA that directly, indirectly, and cumulatively impacts NMFS trust resources over time and on a large scale when a less damaging alternative is available.

- The USACE representative noted that there also are Clean Water Act Section 404 issues at the current time as well. The representative expressed concern about the lack of information needed in order to grant a Section 404 permit. The other Federal agencies' ability to elevate USACE permit decisions, under Section 404(q), is still available regardless of the Merger elevation process.

- On behalf of the DOI, USFWS has asked the NOAA if the US Department of Commerce (DOC) would join DOI in an informal discussion with the President's Council on Environmental Quality (CEQ) about the project and how CEQ might help resolve differences between the Departments and FHWA.

- The USACE was still wrestling with the Pamlico Sound Bridge Corridor Alternative versus the Parallel Bridge Corridor with Phased Approach Alternative and their main concern was the uncertain nature of the future funding sources.

- NMFS continues to support selection of the Pamlico Sound Bridge Corridor as the LEDPA.

8.10.2.4 July 19, 2007 Meeting with USEPA

Attendees at this meeting included representatives of the USEPA, USACE, FHWA, and NCDOT. The following items were discussed:

- The USEPA requested additional detail on the basis for the operations and maintenance (O&M) costs in the SSDEIS. NCDOT provided the EPA with the original unit cost estimate showing how the O&M costs were generated for the Pamlico Sound Bridge Corridor. Further information was provided at the third Concurrence Point meeting of the Merger Team on August 15.

- The USEPA questioned the accuracy of the project construction cost estimates when compared with those of I-10 on the Gulf Coast. FHWA indicated that they performed an independent review of the costs to verify their accuracy and applicability. Costs to construct other replacement bridges in the country were not complete reconstructions, but were more extensive repairs to existing structures.

- The USEPA asked if rehabilitation activities for the existing Bonner Bridge should have been disclosed in the SSDEIS since they have the potential to push out the schedule of the replacement project. NCDOT indicated that rehabilitation is a temporary solution and was not connected to the bridge replacement alternatives being considered. The rehabilitation would not push out the schedule of the replacement project. A NEPA Categorical Exclusion (CE) was completed for the rehabilitation project (TIP No. B-5014) in June 2007. NCDOT agreed to provide the CE to the Merger Team members at the next merger meeting.

- The USEPA was concerned that adding new bridges along the shore would set up the NCDOT and FHWA for a series of multi-million dollar replacement projects as the planned bridges failed or needed retrofitting prior to their planned design life. The USEPA was also concerned about the need to armor bridge piles once in the ocean.

- The USEPA did not believe that the project complied with the *Coastal Barrier Resources Act*.

- The USEPA suggested that NCDOT consider the need for revising the Concurrence Point 1 and 2 agreements. This was based on the idea that the Merger Team should go back to having the short bridge replacement project with no improvements to NC 12 as one of the alternatives being considered. The USACE representative stated that they did not think that the Merger Team was at that point at this time.

- The USEPA would like to see more information on sea level rise with respect to the coastal processes modeling, specifically for scour. They are concerned that the Phased Approach Alternative/Rodanthe Bridge Alternative (Preferred) may not be reasonable and feasible, if most of the structures will be in the ocean in the design year, and/or if the scour modeling shows significant issues. USEPA does not have adequate information on sea level rise projections or the scour modeling to support that it is a reasonable, feasible alternative.

- The USEPA was concerned with the water quality impact from stormwater runoff from any of the alternatives, and that any stormwater runoff from bridges would have to be treated. There is the potential that an NPDES permit would not be granted should the FEIS demonstrate that the runoff could or would not be treated.

- The USEPA noted there have been some projects where the LEDPA was agreed to without knowledge of future funding sources (e.g., Western Wake Expressway [I-540]), but recognized that some past projects had alternatives dropped because of funding issues (e.g., Blowing Rock). NCDOT noted that roadway projects can be built in parts but not a bridge. The USEPA suggested obtaining a waiver from the State General Assembly so the Pamlico Sound Bridge could be funded.

8.10.2.5 July 25, 2007 Meeting with the NCDENR Division of Water Quality

Attendees at this meeting included representatives of the DWQ, USACE, FHWA, and NCDOT. The following items were discussed:

- The purpose of this meeting was to discuss DWQ's concerns with the Phased Approach/ Rodanthe Bridge Alternative (Preferred) related to the cost estimates, and the loss of recreational uses and aquatic life uses of the Atlantic Ocean.

- The possibility of the finished project eventually being in the Atlantic Ocean is not ideal; however, the upfront construction cost of the Pamlico Sound Bridge Corridor makes it not practicable. The other Parallel Bridge Corridors utilize land from the Pea Island National Wildlife Refuge, a Section 4(f) resource. The FHWA said the NC 12 easement within the Refuge is not considered a Section 4(f) resource.

- The DWQ asked about the safety of a bridge that would eventually be in the surf zone. NCDOT consulted with engineers as part of the August 2006 Constructability Workshop and concurred that the project could be built and would be operationally safe.

- The DWQ was concerned about effects to fish, benthic organisms, and use of the beach.

- The DWQ asked if the Record of Decision (ROD) could acknowledge a plan to use phased permitting. FHWA stated this could be done, but the initial ROD must choose an alternative that addresses USFWS compatibility and Section 4(f).

- NCDOT asked if there is a difference between permitting a project that is built on land but later is in the ocean and permitting a project that is initially constructed over the ocean.

- The group discussed the potential to employ CEQ's phased approval process for the Phased Approach/Rodanthe Bridge Alternative (Preferred). NCDOT stated that the project very likely does not fall within the eligibility criteria for employing CEQ's phased approval process. It could have met the criteria if the problems on NC 12 were an anticipated future problem. However, problems on NC 12 exist today.

- The group discussed how a USFWS compatibility determination triggers a Section 4(f) evaluation. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is an avoidance alternative because it stays within the existing NC 12 easement.

- The group discussed the inherent flexibility of choosing a LEDPA that assumes the Oregon Inlet bridge is built now and decisions made on NC 12 later. The approach of choosing the Phased Approach/Rodanthe Bridge Alternative (Preferred) now and, if needed, revising it later offers similar flexibility.

- The approximately 50 acres of wetland impact associated with the Road North/Bridge South Alternative was discussed.

8.10.3 Meeting of the Merger Review Board

On August 27, 2007, representatives of NCDOT, FHWA, USACE, and NCDENR identified the Phased Approach/Rodanthe Bridge Alternative (Preferred) as the LEDPA for replacing Bonner Bridge under the project's NEPA/Section 404 merger process (see Appendix D for the signed agreement). Senior representatives of these four agencies selected the LEDPA because the NEPA/Section 404 Merger Team could not reach a consensus on a LEDPA. Agency representatives based their decision on each alternatives' ability to meet the project's purpose and need, environmental consequences, opportunities available to mitigate impacts, cost, public and agency comment on the findings of the SDEIS and SSDEIS, and other findings presented in this FEIS. Agency representatives concurred that the Pamlico Sound Bridge Corridor is not a practicable alternative because of the high cost estimates, and therefore is not the LEDPA. The LEDPA has been adopted as the Preferred Alternative. See Section 2.15 for a discussion of specific findings of these agency representatives.

8.11 Section 7 Consultation

The FHWA consulted with the USFWS and the NMFS under Section 7 of the Endangered Species Act of 1973 to address potential impacts to threatened and endangered species. In the case of the USFWS, this consultation marked the re-initiation of formal consultation that began in 1997 follow the release of the 1993 DEIS.

Formal consultation with the USFWS for the Preferred Alternative identified in this FEIS included:

- December 17, 2007—FHWA and NCDOT met with USFWS to discuss preparation of a Biological Assessment.

- March 6, 2008—FHWA requested formal consultation in a letter (See Appendix A). Also included was FHWA's Biological Assessment.

- March 13, 2008—USFWS sent a letter to FHWA stating that all information required for initiation of consultation was either included with FHWA's March 6,2008 letter or was otherwise available (See Appendix A).

- April 8, 2008—An addendum to the Biological Assessment was submitted to USFWS by FHWA that clarified several issues and provided revised figures.

- June 4, 2008—USFWS provided the FHWA and NCDOT with a draft Biological and Conference Opinions document.

- June 11, 2008—FHWA and NCDOT met with USFWS to discuss the draft Biological and Conference Opinions document and reasonable and prudent measures.

- July 9, 2008—USFWS met with FHWA and NCDOT to discuss the draft reasonable and prudent measures.

- July 10, 2008—USFWS provided FHWA with their *Biological and Conference Opinions* (USFWS, 2008) document (see Appendix E).

Consultation with the NMFS for the Preferred Alternative identified in this FEIS included:

- March 6, 2008—FHWA requested formal consultation in a letter (See Appendix A). Also included was FHWA's Biological Assessment.

- April 28, 2008—NMFS asked FHWA seven questions related to the Biological Assessment.

- May 30, 2008—FHWA provided responses to the seven questions and relevant pages of the SDEIS and SSDEIS related to the questions.

- August 4, 2008—NMFS provided a letter agreeing with NCDOT's conclusion that the Preferred Alternative may affect but is not likely to adversely affect protected species within their jurisdiction (see Appendix A).

8.12 Comments Received on SDEIS and SSDEIS and Responses

8.12.1 Public Comments and Responses

This section presents the comments on the SDEIS and the SSDEIS submitted by the public, interest groups, and businesses. These comments come from oral testimony, comment forms, and letters. The comments primarily included expressions of support or opposition to specific alternatives, expressions of opinion on the positive and negative aspects of a particular alternative or alternatives, thoughts on the ability of alternatives to satisfy future traffic need, and suggestions for additional alternatives. One hundred and fifty total written and oral comments were received during the November 9 and 10, 2005 public hearings. One hundred and forty six total written and oral comments were received during the March 28 and 29, 2007 public hearings.

8.12.1.1 Pamlico Sound Bridge Corridor Comments

There were 41 comments that expressed support for the Pamlico Sound Bridge Corridor at the November 9 and 10, 2005 public hearings. Included in this total were three comments that specifically supported the Pamlico Sound Bridge Corridor Curved Rodanthe Terminus and two comments that supported the Pamlico Sound Bridge Intersection Rodanthe Terminus. There were 42 comments that supported the Pamlico Sound Bridge Corridor at the March 28 and 29, 2007 public hearings. Included in this total were 15 comments that specifically supported no preference for the Pamlico Sound Bridge Corridor and 25 comments that supported the Pamlico Sound Bridge with Intersection Rodanthe Terminus.

Comments Against the Pamlico Sound Bridge Corridor Alternative

Comments: Those opposed to the Pamlico Sound Bridge Corridor gave the following reasons:

- Loss of public access to the Refuge (addressed in Section 4.5.3.1 of the SDEIS and the FEIS);
- Adverse impacts to Oregon Inlet navigation would occur because the groin would be removed (addressed in Sections 3.6.2.3 and 4.6.3 of the SDEIS and Sections 3.6.3.5 and 4.6.3 of the FEIS);
- The corridor is too expensive, primarily in contrast to the Oregon Inlet bridge component of the Parallel Bridge Corridor (addressed in Section 2.12 of the SSDEIS and the FEIS);
- Adverse impacts on the economy, primarily from non-road access to the Refuge (addressed in Section 4.1.5.3 of the SDEIS and the FEIS);
- Adverse impact to the environment (addressed throughout Chapter 4 of the SDEIS and the FEIS); and
- The bridge could be closed by high winds particularly during hurricane evacuation (a discussion of bridge safety, including the potential for bridge closure is included in the FEIS in Section 2.8).

> **Response:** *These positions are acknowledged. The sections in the SDEIS and the FEIS where these concerns are addressed are noted above.*

Comments in Support of the Pamlico Sound Bridge Corridor Alternative

Comments: Those that supported the Pamlico Sound Bridge Corridor gave the following reasons:

- Best option for long-term dependable/safe access to Hatteras Island because it would move NC 12 off Hatteras Island where NC 12 is subject to closure during storm events;
- Provides dependable hurricane evacuation that would reduce time needed to evacuate people (i.e., allow tourists to stay longer);
- Preserves character/natural environment/wildlife of the Refuge and allows for the natural erosion of the shoreline;
- More cost-effective over the long-term because it would move the road away from an ever-changing Hatteras Island;
- Would be a tourist attraction;
- Use of the Refuge is seasonal, so the impact on the economy of losing Refuge access would not be that severe, most tourists go to areas north of Refuge for most of the year; and
- Would reduce future unknowns—once it is built, it is done (e.g., funding, nourishment, interaction with USFWS, etc.).

While favoring the Pamlico Sound Bridge Corridor, some were concerned about the loss of land in Rodanthe to accommodate the southern terminus of the bridge. It is believed that many supporters of the Pamlico Sound Bridge also are concerned about access to the Refuge and keeping the groin to protect navigation of the channel.

> ***Response:*** *These positions are acknowledged. All of the alternatives were developed to provide long-term dependable/safe access to and evacuation from Hatteras Island. The difference between the Pamlico Sound Bridge Corridor bridge, Parallel Bridge Corridor with All Bridge, and Parallel Bridge Corridor with Phased Approach and the remaining alternatives is that these would bridge potential storm-related island breach locations, thereby avoiding potential damage from overwash. Impacts to the character/natural environment/wildlife in the Refuge were addressed in Sections 4.3, 4.5.2, and 4.7 of the SDEIS and the FEIS. Costs over the life of each alternative were presented in Section 2.3 of the SSDEIS and Section 2.12 of the FEIS. Economic impacts to tourism are addressed in Section 4.1.5 of the SDEIS and the FEIS.*

8.12.1.2 Parallel Bridge Corridor Comments

Seventy-three comments were received that expressed support for the Parallel Bridge Corridor in general during the March 28 and 29, 2007 public hearings. Forty comments supported the Parallel Bridge Corridor with no preference, while 21 comments supported the Parallel Bridge with Nourishment.

Ninety-four comments were received that expressed support for the Parallel Bridge Corridor in general during the November 9 and 10, 2005 public hearings. Six comments supported the Parallel Bridge Corridor with Nourishment, while 81 comments were non-specific to which corridor they supported.

Comments Against the Parallel Bridge Corridor Alternative

Comment: Several comments stated the long-term beach erosion/migration within the Refuge will continue and that there is potential for a breach to occur in the Refuge.

> **Response:** *This position is acknowledged. Shoreline erosion is a natural process and considered desirable by Refuge officials and preferable to artificially maintaining the shoreline, despite its threat to Refuge access and facilities (see Section 5.2.2.4 of the SDEIS and Section 4.5.3 of the FEIS). The Pamlico Sound Bridge Corridor bridge, Parallel Bridge Corridor with All Bridge, and Parallel Bridge Corridor with Phased Approach would bridge potential storm-related island breach locations. The Preferred Alternative, when complete, would both allow natural erosion of Hatteras Island in the Refuge to occur and bridge potential breach locations.*

Comment: Several comments were made expressing concern that continuing to maintain NC 12 through the Refuge will be too expensive and environmentally damaging.

> **Response:** *This position is acknowledged. Costs over the life of each alternative were presented in Section 2.3 of the SSDEIS and Section 2.12 of the FEIS. All of the alternatives were developed so as to minimize long-term maintenance to NC 12. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would necessitate maintenance of existing the NC 12 roadway until each phase is completed; the timing of the NC 12 phases was developed so that the sections requiring the most regular*

maintenance (because of their proximity to the ocean) would be constructed first. An assessment of the potential natural resource impacts of that maintenance is included in Section 4.7 of the FEIS. It is tied to a monitoring program and process for deciding when to implement each phase as the shoreline evolves presented in Section 2.10.2.5 of the FEIS. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement.

Comments in Support of the Parallel Bridge Corridor Alternative

Comments: Those that supported the Parallel Bridge Corridor gave the following reasons:

- Maintains current location of navigation channel and inlet by retaining the terminal groin (addressed in Section 4.6.3 of the SDEIS and the FEIS);

- Maintains Refuge access, with a paved road; loss of access to Refuge beaches with the Pamlico Sound Bridge Corridor will put strain on other beaches on Hatteras Island (e.g., overcrowding, too many vehicles) (addressed in Sections 4.5.1 and 4.5.3 of the SDEIS and the FEIS);

- Practical, expedient, economical in that it spreads the costs out over a longer period of time than the Pamlico Sound Bridge, which would need to be built all at once (addressed in Section 2.12 of the FEIS);

- Less cost impact on power supply to Hatteras Island, i.e., it would be very expensive to relocate the power supply on or parallel to a Pamlico Sound Bridge (addressed in Section 4.1.6.10 of the SDEIS and the FEIS; power supply costs are reflected in Section 2.3.3 of the SSDEIS and Section 2.12.3 of the FEIS);

- Time is getting short, construction of the new bridge needs to start soon; safety of existing bridge and keeping NC 12 open until project finished is a concern. Funds for that are needed, too;

- NC 12 has been in the Refuge for a long time, yet the Refuge has still appeared to thrive; and

- Some people have a fear of crossing long bridges (see Section 2.8 for the findings of a long bridge safety study conducted in response to SDEIS comment).

Reasons for supporting the Parallel Bridge Corridor with Nourishment Alternative included:

- Nourishment would preserve what tourists come to Hatteras Island for; other alternatives are unknowns in terms of economic impacts (addressed in Section 4.1.5 of the SDEIS).

- Opposition to any alternatives that would adversely impact Mirlo Beach subdivision at the north end of Rodanthe (addressed in Sections 4.1.4 and 4.3.1 of the SDEIS, SSDEIS, and FEIS). Support Nourishment Alternative to maintain community; it is only alternative with no impact on people and their properties;

A letter of support for the Phased Approach/Rodanthe Bridge Alternative (Preferred) indicated that it is the only reasonable and feasible alternative which provides necessary transportation linkage to Hatteras Island; it provides the least overall environmental damage to the Seashore and the Pamlico Sound Outstanding Resource Waters; and it protects public health and safety while ensuring good stewardship of limited fiscal resources. Regarding the Road North/Bridge South Alternative, one commenter said it is the best alternative and nourishment money could be spent elsewhere.

> **Response:** *These positions are acknowledged. The locations in the SDEIS and FEIS where these concerns are addressed are noted above as applicable. The Phased Approach/Rodanthe Bridge Alternative (Preferred), however, while achieving most of the objectives expressed in these comments, would only leave two access points within the Refuge, adversely affect the Mirlo Beach subdivision, and would result in approximately 13 miles (20.9 kilometers) of bridging.*

8.12.1.3 No Corridor Preference

Fifteen comments were received that expressed support for no specific corridor in general during the November 9 and 10, 2005 public hearings. Thirty-one comments stated no preference for a specific corridor during the March 28 and 29, 2007 public hearings. Some did identify concerns about project characteristics, which are included in the other comments discussed in the next section.

8.12.1.4 Other Comments

Comment: Pamlico Sound Bridge does not require a USFWS compatibility determination.

> **Response:** *This is true because this alternative is not within the boundaries of the Refuge*.

Comment: Nourishment is the only alternative that would hold up in court since there is precedence for the maintenance of NC 12; also, it does not impact any properties in Rodanthe.

> **Response:** *As noted in Section 5.1.2.2 of the SDEIS and Section 4.5.2 of this FEIS, under the National Wildlife Refuge System Improvement Act of 1997, proposed uses of refuges must be evaluated for compatibility with refuge goals, objectives, and the refuge's establishing legislation. Such a Compatibility Determination would be required with the Nourishment Alternative because the sand would be placed within the Refuge and outside of the existing NC 12 easement.*

Comment: A primary concern is the safe navigation through Oregon Inlet; the need to make the inlet safer and protect the inlet, including building a groin on northern side of inlet. The livelihoods of Oregon Inlet users are a concern. Keep the groin in place no matter which alternative is selected.

> **Response:** *The positions are acknowledged. Discussions related to the impact of the alternatives on Oregon Inlet users are contained in Section 4.1.7 of the SDEIS and this FEIS. NCDOT recognizes that it would need to re-apply for the terminal groin permit to construct the Oregon Inlet component of the Phased Approach/Rodanthe Bridge Alternative (Preferred).*

Comment: Cost and impact of various alternatives on Cape Hatteras Electric Cooperative must be considered (Pamlico Sound Bridge Corridor would have substantial impacts).

> **Response:** *This factor is addressed in Section 2.3 of the SSDEIS, Section 4.1.6 of the SDEIS, and Sections 2.12 and 4.5.4 of this FEIS.*

Comment: Selected alternative should accommodate bicycles.

> **Response:** *See Section 2.8.2 of the SDEIS and Section 2.10.2 of the FEIS for discussions of bicycle accommodations. The 8-foot (2.4-meter) wide shoulders on the proposed bridges would be safer for use by bicycle and pedestrian traffic than Bonner Bridge's existing 2-foot (0.6-meter) wide shoulders. In addition, the planned bicycle-safe bridge rail on the proposed bridges would also provide increased safety for bicyclists.*

Comment: Build four-lane Pamlico Sound Bridge to address safety and congestion.

> **Response:** *See Section 2.8.3 of this FEIS for a discussion of provisions for safe bridge operations.*

Comment: Icing on a Pamlico Sound Bridge is a concern.

> **Response:** *As part of a study of the safety features on long bridges, NCDOT noted actions that could be taken to mitigate for icy conditions. See Section 2.8 of the FEIS for a discussion of provisions for safe bridge operations.*

Comment: Unless NCDOT abandons its right-of-way in the Refuge, the cost of ongoing maintenance of NC 12 should be included in Pamlico Sound Bridge Corridor costs. Also, USFWS cost for continued public access and environmental impacts of access should be included.

> **Response:** *The costs of providing alternative access to the Refuge are presented in Section 2.3.3 of the SSDEIS and Section 2.12.3 of the FEIS. NCDOT examined these costs as part of an overall public cost estimate. The impacts of the provision of alternate access to the Refuge are not addressed in this FEIS because the USFWS has not developed any specific program of alternate access. It is presumed that any such program developed by the USFWS would be compatible with the Refuge under the National Wildlife Refuge System Improvement Act of 1997.*

Comment: Planning timeframe for the replacement bridge project is unclear in the SDEIS (i.e., is the design life 50 years or 100 years?).

> **Response:** *The design life assumed in the SDEIS and SSDEIS was 50 years. However, some bridge structure components of the alternatives could potentially last longer than 50 years.*

Comment: Keep part of old bridge for recreational uses, i.e., fishing. Fishing catwalks should be built on the new bridge, whichever bridge is built.

> **Response:** *See the associated discussion in Section 2.10.1.2 of the FEIS. It is impossible to leave a portion of Bonner Bridge for fishing with the Preferred Alternative; the part of Bonner Bridge with the catwalks has to be demolished to make room for the new bridge. One viable approach to provide new fishing access appears to be leaving a portion of a traffic maintenance bridge in place after the new bridge is complete. A "boardwalk" under and around the new bridge also is a possible option. This fishing facility would be on top of the riprap that currently blankets the northern shore of Hatteras Island. The viability of catwalks also will be considered. NCDOT recognizes the importance of providing continued recreational access to Oregon Inlet.*

Comment: Use demolished bridge as part of artificial reef (for fish) near Oregon Inlet.

> **Response:** *See the associated discussion in Section 2.9 of the SDEIS and Section 2.11 of the FEIS. Coordination also would be conducted with the NMFS in association with their regulation of several protected species.*

Comment: Use Bonner Bridge as a reef to help control erosion when it is torn down.

> **Response:** *The Coastal Resources Commission regulations generally prohibit the use of hardened structures, such as metal sheet piling, to protect houses, roads and other oceanfront construction from erosion (NC Division of Coastal Management website).*

Comment: Let nature take its course.

> **Response:** *The Preferred Alternative, once complete, would allow for natural movement of the shoreline (see Section 4.6.5 of the FEIS).*

Comment: Oregon Inlet bridge provides better back-up access to Hatteras Island (i.e., with a maintained road on both sides of Oregon Inlet, it would be easier to provide emergency access to island if the bridge were ever out for some reason).

> **Response:** *NCDOT's emergency ferry terminal is located in Rodanthe, so the emergency route would not be impacted by the selection of the Preferred Alternative.*

Comment: Parallel Bridge Corridor would leave residents to still deal with horrible road conditions through Refuge in bad weather.

> **Response:** *All alternatives, including the Preferred Alternative, include a long term solution to current and projected overwash problems on NC 12 between Rodanthe and the south end of Bodie Island.*

Comment: Opinions differ on which corridor is safer for evacuation. Road blocking accidents are a concern with the Pamlico Sound Bridge.

> **Response:** *All of the alternatives under consideration would allow for safe evacuation during a storm. Because of concerns regarding the safety of long bridges, a discussion of bridge safety, including the effects of weather, is included in Section 2.8 of the FEIS.*

Comment: Whichever alternative is chosen must maintain access to the entire Refuge.

> **Response:** *All the Parallel Bridge Corridor alternatives (including the Preferred Alternative) would maintain some type of access to portions of the Refuge. With the alternatives that involve bridges as a means for maintaining NC 12, the extent of access would be determined by Refuge officials. The Pamlico Sound Bridge Corridor does not include access to the Refuge.*

Comment: The Pamlico Sound Bridge and the Rodanthe bypass bridge associated with the Road North/Bridge South Alternative could have a negative impact on recreation in Pamlico Sound.

> **Response:** *This concern is discussed in Section 4.5.4 of the SDEIS and the FEIS.*

Comment: Resume ferry service (one person said that all bridges are unrealistic and doomed to failure, expenses are excessive, and ferry does not interfere with the environment).

> **Response:** *Ferry service would not provide a capacity to serve current and future travel demand and therefore would not meet the purpose of the project (see Section 2.2.6 of the SDEIS and the FEIS).*

Comment: Discounting should be shown in all materials presented to the public or costs are misleading (especially for the Nourishment Alternative, whose cost drops the most when discounted).

> **Response:** *This position is acknowledged. Discounted costs are included in Section 2.3.1 of the SSDEIS and Section 2.12 of the FEIS.*

Comment: Nags Head is currently not getting funding for beach nourishment, so how would NCDOT pay for nourishment?

> **Response:** *Tax dollars collected specifically for highway related projects would pay for nourishment if an alternative involving nourishment were implemented. These funds are separate from those used for beach nourishment projects.*

Comment: It is reasonable to assume that beach nourishment will continue no matter which alternative is selected because of pressure from various groups.

> **Response:** *Once the Phased Approach/Rodanthe Bridge Alternative (Preferred) is completed, NC 12 would be placed on a bridge for most of its length in the project area. Nourishment would not be needed to keep NC 12 open.*

8.12.1.5 Other Expressions of Preference and Opinion

The following additional preferences and opinions were expressed by the pubic. The positions of those commenters are acknowledged.

- Build the bridge now.
- Extend the Pamlico Sound Bridge (possibly as a toll road) to bypass Rodanthe, Waves, and Salvo, or just go with the Oregon Inlet bridge and improve NC 12.
- If Bonner Bridge is closed before it is replaced, the economic impact on Dare County would be substantial, as would the economic impact on the State. Dare County is a donor county (it generates more state tax revenue than it receives in state tax expenditures).
- Parallel Bridge Corridor supporters love the Refuge.
- Wildlife will adapt to elevated road in Refuge.
- Human interests should take precedence over wildlife.
- All necessary measures need to be taken to save Hatteras Island from erosion (levies, beach nourishment, etc.); place human environment concerns ahead of the natural environment.

- In 2003, over 700 petitions from the Pea Island Coalition were gathered in opposition to the Pamlico Sound Bridge. However, some commenters felt that petitions from non-residents of Hatteras Island favoring the Parallel Bridge Corridor should not carry any weight in the decision.

- Politicians that are for the Parallel Bridge Corridor do not have to be inconvenienced by road problems in the Refuge. Also, many people in the tourism industry that are for the Parallel Bridge Corridor do not live on Hatteras Island.

- The real estate community seems to be firmly behind the Parallel Bridge Corridor.

8.12.2 Government Agency Comments and Responses

This section responds to written comments on the SDEIS and the SSDEIS submitted by state and federal environmental resource and regulatory agencies as well as local governments and commissions. Each substantive comment requiring a response is listed below, followed by a response. The comments in the sections quote the correspondence received. The original correspondence is presented in Appendix A. The page number of each letter in Appendix A is included in the subheadings listing each letter.

8.12.2.1 Federal

United States Department of the Army Wilmington District, Corps of Engineers-December 14, 2005 (page A-4)

Comment: "Page 2-2, Section 2.1, No-Action Alternative. The SDEIS states that "a new small-scale ferry service from Bodie Island to Hatteras Island would be developed if, following public review of the document, this alternative were selected as the preferred alternative." It states "nine-hundred vehicles per day on a ferry is far less than the existing demand and the expected 2025 demand presented in Table 1-2 of Chapter 1, which shows an average annual daily traffic of 9,600 vehicles per day and peak traffic of 25,200 vehicles per day in 2025. While we agree that demand will exceed the capacity of a ferry service, we disagree with the statement that the "No-Action Alternative would not meet the project's purpose and need." The stated purpose and need for the project does not talk about capacity. If the "No-Action Alternative" includes the use of a ferry after the Bonner Bridge is demolished, then the statement that the alternative would not meet the project's purpose and need should be deleted."

> **Response:** *The need for access across Oregon Inlet, reliance of the permanent Hatteras Island population on mainland goods and services, Hatteras Island and Ocracoke Island emergency evacuation requirements, and travel demand are all addressed in the Statement of Purpose and Need (see Chapter 1 of this FEIS) approved by the NEPA/Section 404 Merger Team. The NCDOT is required to provide access with sufficient capacity if it is to meet the continued demand for convenient daily and emergency access across Oregon Inlet.*

Comment: "Page 2-82, Section 2.7.2 and Page 4-110, Section 4.13.6, Bridge Characteristics and Natural Resource Protection. The SDEIS states that piles for the bridge substructure would be jetted into place and/or in some cases driven. The SDEIS needs to address more thoroughly in section 4.13.6, the environmental impacts associated with jetting and the measures that will be taken to minimize and reduce these impacts."

Response: *Jetting characteristics are addressed further in Section 2.10.1.3 of the FEIS, including means for minimizing the distribution of material displaced by dredging where appropriate. The impacts of jetting are noted as appropriate in Sections 4.7.2, 4.7.4, and 4.7.6.*

Comment: "Page 2-108, Section 2.9, Demolition and Removal of Bonner Bridge. While the SDEIS addresses the demolition and removal of the Bonner Bridge for whatever alternative is selected, we didn't find information relating to the removal and disposal of NC 12 if the Pamlico Sound Bridge Corridor is selected and the Pea Island Wildlife Refuge requests the removal of NC 12."

Response: *Removing and disposing of current and temporary NC 12 pavement in association with implementation of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is addressed in Section 2.11.2 of the FEIS.*

Comment: "Page 3-38, Section 3.6.2.2, Potential Breach Locations. The SDEIS states "if a breach were to occur it would likely close eventually (although not necessarily immediately) and would likely not become a long-term phenomenon like Oregon Inlet." Was that determination part of the study or was it a prediction made by some other party?"

Response: *The determination was made by the expert panel described in the referenced section, which is also included in this FEIS.*

Comment: "Page 3-30, Section 3.6.2.3, Oregon Inlet Movement through 2085 (Terminal Groin). The SDEIS states "the NCDOT has no current plans to remove the terminal groin on Hatteras Island after Bonner Bridge is demolished." Other previous correspondence between the Service and NCDOT state "the right-of-way permit for the terminal groin may be terminated by the Regional Director for failure to comply with any or all terms and conditions of the grant, or for abandonment." Once the Bonner Bridge is demolished, by conditions contained in the permit, it appears the terminal groin would be required to be removed because of abandonment. The SDEIS states, "If a bridge were built in the Pamlico Sound Bridge Corridor, the terminal groin could serve parties other than the NCDOT and other immediate needs besides protecting Bonner Bridge or its replacement. It is conceivable, however, that circumstances could change at some time in the future, and it could prove prudent to remove the terminal groin if the Pamlico Sound Bridge Corridor is used for the replacement bridge." Clarification of this issue should be coordinated between the Service and NCDOT and contained in the document. In other locations (i.e. Section 4.6.3, Performance of the Terminal Groin) in the document discussions of the terminal groin are ambiguous."

Response: *The Parallel Bridge Corridor alternatives (including the Preferred Alternative) require the continued presence of the terminal groin in order to protect the southern terminus of the Oregon Inlet crossing; the Pamlico Sound Bridge Corridor Alternatives do not require the terminal groin. Other parties were also interested in keeping the groin because of the perceived benefits to Oregon Inlet navigation.*

Comment: "Page 4-23, Section 4.1.7, Oregon Inlet Users. The SDEIS states that the use of "the crack" navigation channel shortens the distance traveled by vessels operating between the fishing center and the Bonner Bridge navigation span from approximately 5 miles to about 2.5 miles but that the travel time would be increased by approximately 30 minutes. Please clarify why the additional time is so long. A boat traveling at 10 mph could travel a distance of 2.5 miles in 15 minutes and from personal observations it appears most boats traveling between the fishing center and Oregon Inlet typically run faster than 10 mph."

> **Response:** *According to management with the Oregon Inlet Marina, the distance from that facility to Bonner Bridge is approximately 2.5 miles (4.0 kilometers) using the crack channel and 5 miles (8.0 kilometers) using USACE maintained channels (Old House Channel and Oregon Inlet Channel). Though charter boats traveling from the Marina can travel up to 18-25 mph, the boats cannot always travel at full speeds for parts of the trip. The staff interviewed stated it would take an estimated 15 minutes to travel the 2.5-mile (4.0-kilometer) distance of the crack channel and an extra 30 minutes to travel via the USACE channels.*

Comment: "Page 4-79, Section 4.7.8.3, Compensatory Mitigation. The SDEIS states "if temporary impacts to wetlands were to occur, such impacts would be mitigated on a 1:1 basis by restoring these areas to their pre-construction condition." Until these impacts can be more thoroughly assessed we are unable to agree that a 1:1 ratio for temporary impacts is appropriate. Factors such as compaction sometimes limit how these areas can be restored. Mitigation ratios for temporary impacts will be assessed during the permit process."

> **Response:** *The commenter's position is acknowledged, and this issue will be revisited during the Section 404 permitting process.*

Comment: "Page 4-7, Section 4.1.2.4, Pea Island National Wildlife Refuge Master Plan. As you are aware, a major factor in determining the range of alternatives which can be considered in the selection of the LEDPA for this project are dependent on a Compatibility Determination being reviewed by the USFWS under the provisions of the National Wildlife Refuge System Improvement Act of 1997. The SDEIS states, "The USFWS compatibility determination will be presented in the Final Environmental Impact Statement (FEIS)." Potential delays in obtaining a decision concerning compatibility may lead to delays in the project."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is confined to the existing NC 12 easement authorized by USFWS. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement. The operation of the Phased Approach is consistent with the purpose of the permanent easement; therefore, a compatibility determination is not required for the Preferred Alternative.*

Comment: "Section 2.7.5.1, Construction Procedures. Construction related impacts due to dredging of the Pamlico Sound for barge access is a permanent impact that must be adequately described in the SDEIS. This description should include impacts to SAV, shellfish, benthic communities, fisheries resources, and should provide information concerning proposed disposal area(s) and method of excavation."

> **Response:** *The construction-related natural resource impacts are discussed in Sections 4.7 and 4.13 of the SDEIS and the FEIS. Additional natural resource impact discussions related to the topics listed in the comment have been added in response to SDEIS and SSDEIS comments.*

United States Department of the Army Wilmington District, Corps of Engineers-April 17, 2007 (page A-6)

Comment: "Page 2-18, Section 2.3.1.2, **Changes in Bridge Cost Assumptions Since the SDEIS**. Further more in-depth documentation is needed as to why the original cost estimates were so grossly underestimated in the original document. The paragraph describes some justification (project delivery method, inflation) as to the rise in costs but the estimated cost of construction per square meter rose 57 to 73 percent. Why does the replacement bridge construction cost (single line item in cost charts) go up 36 percent (191,000,000 to 260,000,000) for the parallel bridge and 123 percent (416,800,000 to 933,500,000) for the Pamlico Sound Bridge?"

> **Response:** *Section 2.3.1.2 of the SSDEIS and Section 2.12.1.2 of this FEIS summarize in full the changes to the cost assumptions made between the SDEIS and the SSDEIS. The new costs prepared by NCDOT were verified by both an independent consultant with bridge construction experience and the FHWA. In the context of the selection of the LEDPA, members of the NEPA/Section 404 Merger Team, including those of the USACE, were provided notebooks containing all the cost estimates and their underlying assumptions. NCDOT staff discussed the cost estimates with the Merger Team in June 2007 (see Section 8.10.1), and the members indicated that their questions related to the cost estimates were satisfactorily resolved.*

Comment: "Page 2-19, Section 2.3.1-3, **Cost Comparison**. Further information/data/analysis to be presented pertaining to the projected life-spans of the two bridge corridors and their relative costs projected over time to reflect the true costs of the projects (i.e. if the sound bridge provides service for 100 years at a cost of 1.3 billion vs. a 50 year service life parallel bridge with NC 12 maintenance at a cast of 900 million, which one would be more practicable to construct?). The SDEIS states on page xxiii the expected full Life of the Pamlico Sound Bridge to be as much as 100 years."

> **Response:** *The design life assumed in the SDEIS and SSDEIS was 50 years. However, the bridge structure components of the alternatives could potentially last longer than 50 years. NCDOT included revised cost estimates in the SSDEIS to show the total cost of each alternative through the year 2060. For further discussion, see Section 2.12 of the FEIS.*

Comment: "Page ix, **Other Alternatives Considered, East Bridge Corridor**. The 1991 feasibility study recommended that an East Bridge Corridor did not warrant detailed study because cost savings resulting from a shorter structure would be offset by costs related to the risk introduced by construction in an area of greater wave activity, by faster currents during storm surges, and by a location less protected from storms. While it is understood that the phased approach bridge construction is projected to take place before shoreline erosion creates construction situations as described above, realistically these scenarios could occur with the phased approach alternative. The phased approach alternative eventually puts a bridge structure in areas of greater wave action, in areas with faster current potential and in an area less protected from storms. The phased approach alternative puts a structure in a location that was deemed not warranted for study in the 1991 feasibility study. The concerns reflected in the study are still concerns today."

> **Response:** *The East Bridge Corridor was dropped because its more dynamic setting within Oregon Inlet would offset construction cost savings that might be realized by building a bridge shorter than the Parallel Bridge Corridor Alternative. Also, it would have greater natural resource impacts and have greater impacts to the Seashore on Bodie Island (see Section 2.2.8 of the SDEIS and the FEIS). Though the Phased Approach/ Rodanthe Bridge Alternative (Preferred) includes bridges that would be eventually located within areas of greater wave action, this alternative can be constructed within the existing easement on dry land.*

Comment: "Page xiii and page 2-3, Section 2-1, **2006 Parallel Bridge Corridor with Phased Approach Alternatives Studies**. The supplement uses the term "technically feasible" when describing the phased approach alternative. The Bonner Bridge Constructability Workshop written document uses the same term. Further explanation is needed describing what "technically feasible" means in terms of the phased approach alternative. It should be documented in the EIS that the workshop document states, "It should be emphasized that this approach, although feasible, is still quite technically challenging."

> **Response:** *It was determined through bridge engineering and construction engineering evaluations that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is technically feasible. Technical feasibility means that design and construction of the Phased Approach physically can be performed under the constraints prescribed. Conventional construction techniques are available for heavy/highway contractors to use to build these bridges while maintaining traffic, remaining inside of the existing right-of-way, and not substantially affecting areas of SAV or wetlands, etc. The project constraints present unique complexities to the construction of the project. However, it is known that these complexities can be effectively addressed. Further explanation of construction techniques is provided in Section 2.10.2.4.*

Comment: "Page xvii and page 4-16, Section 4.5.3.1 **Pea Island National Wildlife Refuge Access**. A major concern expressed for the inclusion of the phased approach alternative was to continue to have access to the 10 plus miles of shoreline along the Pea Island Wildlife Refuge. While initial construction of a parallel bridge will provide for this access along NC 12 as it currently exists, future construction with this alternative will further limit access to the island. Once the phased approach is built out, only two access points will remain along the NC 12 corridor. An original constraint (Constructability Workshop document) for the phased approach was to maintain accessibility to NC 12 and all access points on NC 12. This alternative does not meet this constraint."

> **Response:** *While this statement is true, the only way to maintain full access to the Refuge from NC 12 would be to move NC 12 west of its current location or select the Nourishment Alternative. Moving NC 12 west would constitute a use of Section 4(f) property under the Department of Transportation Act of 1966, as amended and would likely be found incompatible with the National Wildlife Refuge System Improvement Act of 1997. It is likely that the Nourishment Alternative also would be found incompatible. The Phased Approach/Rodanthe Bridge Alternative (Preferred) does not constitute a Section 4(f) use or require compatibility as it is entirely within the existing NC 12 easement. The Phased Approach/Rodanthe Bridge Alternative (Preferred) includes access to the Refuge at the only two points where NC 12 still would be within the Refuge (rather than the ocean) in 2060.*

Comment: "Page xxiv, Section 7, **Areas of Controversy**. As stated in our original November 28, 2005 correspondence for the Supplemental Draft Environmental Impact Statement, a major factor in determining the alternatives which can be considered in the selection of the LEDPA for this project are dependent on a compatibility determination being approved by the USFWS under the provisions of the National Wildlife Refuge System Improvement Act of 1997. The SDEIS states, "The USFWS compatibility determination will be presented in the Final Environmental Impact Statement (FEIS)." The supplemental document is unclear whether or not a compatibility determination would be needed to construct the phased approach beyond phase 1. The supplemental document states that the Secretary of the US Department of Interior (DOI) response to US Senator Burr "indicates that DOI believes the replacement of the bridge itself could be accomplished in a way which is compatible with the National Wildlife Refuge System Improvement Act of 1997, and other laws, if it is constructed within the same easement." While we agree that is the position stated in the letter in regard to the replacement of the bridge itself, we are unclear if that means that DOI considers phase II, III, and IV to be compatible as well. Secretary Kempthorne stated in his July 5, 2006 letter that "we believe the replacement of the bridge itself could be accomplished in a way which is compatible with the Refuge Act, and other laws, if it is constructed within the same alignment or with minor changes to the current alignment." Potential delays in obtaining a decision concerning compatibility may lead to delays in the project and cause the project to backtrack resulting in loss time and monies. Although we are unsure of when the compatibility determination must be made in the context of NEPA planning, it appears that it may be premature to select a LEDPA for the project until the compatibility determination has been completed."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is confined within the existing NC 12 easement for which NCDOT has a permit and can utilize for maintaining NC 12. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement. A compatibility determination is not required because the Preferred Alternative falls within the terms of the easement permit.*

Comment: "Page xix, **Natural System**. The wetland impacts are incorrectly stated in numerous places in this section of the document. The numbers presented are in most cases the total fill which is occurring in Department of Army jurisdiction areas which includes open water impacts. The actual wetland impact numbers need be changed to reflect the true impacts to jurisdictional wetlands. There is a discrepancy in the document also relating to temporary wetland impacts. The last paragraph states the two phased approach alternatives would have 12.5 acres of temporary construction period wetland impacts, including 3.1 acres of CAMA wetland impact. Table 4-2 (Temporary Construction Fill and Pile Placement Impacts to Biotic Communities with the Parallel Bridge Corridor with Phased Approach Alternatives) on page 4-30 shows 5.6 acres of temporary construction wetland impacts. Table 4-4 on page 4-33 shows 7.12 acres of temporary wetland impacts. The correct temporary wetland impacts need to be included in the final document."

> **Response:** *The tables have been corrected and are included in Section 4.7.4 of this FEIS.*

Comment: "Page xxii and page 4-50, Section 4.12, **Indirect and Cumulative Impacts**. Further in-depth analysis needs to be presented pertaining to the indirect and cumulative impacts of the phased approach associated with this alternatives extended construction time frame. We do not agree with the statement in the supplement that States, "Because the proposed project would consist of the replacement of an existing bridge, as well as an existing road in the case of the Parallel Bridge Corridor, indirect and cumulative impacts would be minimal."

> **Response:** *In response to this comment, Section 4.7 of this FEIS includes an expanded discussion of the direct natural resource impacts associated with the Phased Approach/Rodanthe Bridge Alternative (Preferred) over the extended time frame of construction. NCDOT and FHWA consider these impacts first to be direct impacts (not indirect and cumulative impacts) since they are directly associated with the proposed action.*

Comment: "Because the potential for adverse impacts from long term construction and different construction techniques (replacing an on-grade road with a 30-foot high bridge over almost the entire length of the project) exist, we feel the current supplement does not adequately address indirect and cumulative impacts sufficiently."

> **Response:** *In response to this comment, Section 4.7 of this FEIS includes an expanded discussion of the direct natural resource impacts associated with the Phased Approach/Rodanthe Bridge Alternative (Preferred) over the extended time frame of construction. NCDOT and FHWA consider these impacts to be direct impacts (not indirect and cumulative impacts).*

Comment: "A more in-depth analysis is warranted as it relates to the purpose of the Pea Island National Wildlife Refuge and what long term construction does to the operation and purpose of the Refuge."

> **Response:** *Additional direct impact analysis related to the natural environment managed by the Refuge is included in Section 4.7 of the FEIS. Recreation use impacts, including those related to loss of access, are addressed in Section 4.5.3 of the SDEIS, SSDEIS, and this FEIS.*

Comment: "Page 2- 10, Section 2.2-2, **<u>Phased Approach NC 12 Maintenance Characteristics</u>**. The amount of sand needed for the Rodanthe Nourishment Alternative is estimated at 2.3 million cubic yards beginning in 2007 and 1.5 million cubic yards every four years throughout the life of the project (through 2060). Available and suitable sand sources should be identified for the life of the project and options available if future sand sources aren't readily available should be provided."

> **Response:** *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have provided additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.6.3.4 of the FEIS pertaining to available and suitable sand sources.*

Comment: "Page 2-12, Section 2.2.2.1 **<u>Design Features</u>**. Additional costs could be realized for the phased approach alternatives based on structural design assumptions recommended by the AASHTO/FHWA Joint Wave Task Force. It would be beneficial prior to the selection of the LEDPA for this project to have accurate cost estimates for each alternative based on the most current design standards. It is a concern that costs could increase substantially for the phased approach if recommendations from the task force require design standards to be upgraded for bridges constructed in high energy areas such as the Atlantic Ocean. While we realize there is discussion in the cost and funding section (Section 2.3) of the supplement which addresses this issue, cost is a major concern with this project and a factor in the selection of the LEDPA and the best available information needs to be available prior to this decision point."

> **Response:** *The costs for all alternatives were revised for the SSDEIS based on the best available information at that time. They remain the most accurate known reflection of potential costs of the alternatives and are presented again in this FEIS.*

Comment: "Page 2- 16, Tab1e 2-1 and 2-2, **Highway Cost to 2060 (High and Low)**. Right-of-way costs for Phased Approach/Rodanthe Bridge and Rodanthe Nourishment appear to be switched. Higher right-of-way costs should be realized for the bridge alternatives since more property would he to be purchased. The chart has right-of-way costs higher for the nourishment alternative.

> **Response:** *This information was corrected in the FEIS (see Tables 2-9 and 2-10).*

Comment: Page 2-24, Section 23.4, **Capitol Funding.** Can it be assumed by this section that all the alternatives currently being studied could be funded and constructed if selected?"

> **Response:** *No; further information developed by NCDOT after the release of the SSDEIS indicated that the State of North Carolina only has adequate funds to implement an alternative that could be phased.*

Comment: "Page 4-15 and 4-31, Section 4.5.2 and 4.7.4, **Pea Island National Wildlife Refuge Land Use Impacts on Hatteras Island and Wetlands and Own Water Habitat**. Jurisdictional wetland impact numbers need to be corrected."

> **Response:** *The wetland impact totals have been corrected in Sections 4.5.2 and 4.7.4 of the FEIS.*

Comment: "Page 4-32, Section 4.7.4, **Wetland and Open Water Habitat**. The Supplement states "because of the phased timeline of construction with the Phased Approach alternatives (including the Preferred Alternative) , wetland impacts could be less in Phases III and IV since sand movement within the Refuge could fill what are now considered wetlands in the NC 12 easement before bridge construction begins. It should be documented that wetland impacts as well as jurisdictional impacts could increase also as a result of sand movement."

> **Response:** *It is highly unlikely that wetland impacts, as well as jurisdictional impacts, of the Phased Approach alternatives (including the Preferred Alternative) could increase as a result of sand movement, given that sand movement over the long term is from the ocean to the sound.*

Comment: "Page 4-41, Section 4.7.8, **Avoidance Minimization, and Compensatory**. The 12.5 acres of temporary impacts to wetlands is incorrect based on the table on page 4-33. There are 12.5 acres of jurisdictional impacts with 7.12 acres of wetland impacts. It appears "Mitigation of Permanent Wetland Impacts" is incorrectly labeled. It appears that it should be labeled "Mitigation of Temporary Wetland Impacts for the Hatteras Island Temporary Traffic Maintenance Road."

> **Response:** *This information has been corrected in Section 4.7.10 of the FEIS.*

Comment: "Page 5-9, Section 5.2.2.3, **Facilities and Activities**. In the second paragraph you need to change the new linear man-made feature from 1 mile to 10 miles."

> **Response:** *This information has been corrected and is now in Section 4.5 of the FEIS.*

Comment: "Page 5-11, Section 5.2.2.5, **Natural Systems**. Please explain more clearly why temporary traffic management roads built within the existing NC 12 easement would affect 10.4 acres twice. The document implies that once Phase IV is ready for construction, all traffic would be removed from the bridge structures to temporary roads below the constructed bridges. How would these temporary roads be constructed if the shoreline has eroded westward of the bridges constructed in phases II and III?"

> **Response:** *Phases III and IV would be constructed before the end points of Phases II and III (to which they have to connect) are on the beach or in the ocean.*

Comment: "It is our understanding that NCDOT is preparing to expend approximately 42 million dollars to conduct repairs to Bonner Bridge, thus extending its usable life by approximately 10 years. It is our assumption that this will have no effect on implementation of the selected alternative (LEDPA). However, if this is not the case, such changes should be identified in the final EIS."

> **Response:** *The repairs (TIP Project No. B-5014) will have no effect on the timing of project implementation and are being implemented so that the existing bridge can remain open until a new crossing is completed.*

US Department of Commerce-National Oceanic and Atmospheric Administration-National Marine Fisheries Service- April 17, 2007 (page A-9)

Comment: "The impact analysis provided in the SDEIS does not adequately address the significant environmental consequences of the alternatives to NOAA trust resources. The project area includes categories of essential fish habitat (EFH), which have been designated by the Regional Fishery Management Councils pursuant to the Magnuson-Stevens Act.

> **Response:** *The Essential Fish Habitat analysis was revisited for the FEIS. Revisions are presented in this FEIS, with additional detail presented in an Essential Fish Habitat Assessment (CZR, Incorporated, 2008).*

Comment: The North Carolina barrier island system is an important resource providing valuable habitat for fish and wildlife. The 12.5-mile section of NC 12 that bisects the Pea Island National Wildlife Refuge (Pea Island Refuge) fragments the habitat and disrupts natural coastal processes. Most alternatives for the Parallel Bridge Corridor involve the periodic discharge of dredged material to control beach erosion at identified "hot spots." Historically, this practice has led to changes in the composition of the beach sediments (such as more finer-grained sands and a greater percentage of heavy minerals within the sands) and changes in the invertebrate community that inhabits the intertidal beach.

The value of surf zone habitat and the impacts to it are not addressed nor are the impacts of dredging in offshore borrow sites for beach fill. Long-term beach nourishment would be required for the Parallel Bridge Corridor With Nourishment alternative. However, the feasibility and potential long-term impacts of dredging offshore and deposition of sand on the ocean beach within the Pea Island Refuge are not adequately addressed.

The SDEIS assumes that sand of a suitable quality and quantity will be available for beach nourishment for the 50-year life of the project. This assumption is not supported by the information provided. Both the need for and availability of suitable beach stabilization material appears to be significantly understated and could affect conclusions about the suitability of the alternatives that have beach nourishment as a component.

> **Response:** *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have gathered additional information on the source, availability, and suitability of sand for nourishment. Additional impact assessment on its extraction would have been conducted in light of the findings.*

Comment: The document includes an EFH assessment; however, the assessment is inadequate and does not provide a sufficient level of detail regarding impacts to EFH to allow for a detailed comparison of the alternatives."

> **Response:** *The Essential Fish Habitat analysis was revisited for the FEIS. Revisions are presented in this FEIS, with additional detail presented in an Essential Fish Habitat Assessment (CZR, Incorporated, 2008).*

Comment: "Page 1-5, 1.1.3, Erosion of the Hatteras Island Shoreline. This section does not take into account the volume of sand, which frequently exceeds 500,000 cubic yards per year that has been placed on the beach as a result of dredging Oregon Inlet over the past 12 to 14 years and its effect on the erosion rates at the hot spots. In view of the potential impacts of beach nourishment on NOAA trust resources, we do not view beach nourishment as an acceptable long-term alternative for maintaining NC 12."

> **Response:** *Position acknowledged. An alternative that involves beach nourishment was not selected as the Preferred Alternative.*

Comment: "Page 2-67, 2.6.3.2, Design Assumptions. The discussion assumes that all sand is biologically suitable for beach nourishment. This is not the case. Maintenance of important invertebrate communities in the surf zone that support NOAA trust resources is an essential component of any beach nourishment project. Compatibility of the borrow sands with those at the natural beach is a key issue and is insufficiently addressed. This section assumes that suitable sand will be available through the year 2060. This may not be the case since sand dynamics within the proposed borrow areas could change and affect their suitability for beach nourishment. If the availability of compatible sand cannot be assured for the life of the project, it could present a major obstacle to implementing the alternatives that involve beach nourishment."

> **Response:** *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have provided additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.6.3.4 of the FEIS pertaining to available and suitable sand sources.*

Comment: "Pages 2-104, 2.8.2.1, Nourishment. The SDEIS states that beach nourishment would occur in four locations and likely be repeated at four-year intervals. The volume of sand needed appears to substantially underestimate what would be needed for beach and dune construction. Over 500,000 cubic yards of sand from Oregon Inlet have been deposited along and adjacent to the "Canal Zone Hot Spot" annually for the past four years, and it has not been sufficient to protect the highway from overwash. The estimated volumes of material needed for beach stabilization for those alternatives involving beach nourishment appear to be understated."

Response: *An alternative that involves beach nourishment was not selected as the Preferred Alternative. Past deposition of sand from Oregon Inlet was not done as a part of a systematic program to maintain the shoreline. The sand quantities presented for the alternatives involving nourishment reflect such a program.*

Comment: "Page 2-70, Sand Requirements. Sand availability is not adequately described. Throughout the document when sand availability is discussed, little information is provided regarding its suitability for beach nourishment and the standard used to determine suitability for beach placement are not clear."

Response: *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have provided additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.6.3.4 of the FEIS pertaining to available and suitable sand sources.*

Comment: "Pages 2-80, Bridge Characteristics and 2-96, 2.8.1.2 Design Characteristic. These sections are inconsistent when describing the shoulder requirement for the two bridge corridors. The Parallel Bridge Corridor has a shoulder width of 6 feet while the Pamlico Sound Bridge Corridor has a shoulder width of 8 feet. Wider shoulders on the longer bridge increase the cost versus more narrow shoulders on the short bridge. Since this scenario provides for an unequal cost comparison, the difference should be explained."

Response: *Six-foot (1.8-meter) shoulders were used in the 1999 final design for the Oregon Inlet bridge in the Parallel Bridge Corridor. The cost estimates included in Section 2.3 of the SSDEIS and Section 2.12 of the FEIS assumed 8-foot (2.4-meter) shoulder widths for all bridges for the replacement bridge corridor alternatives. The final design for the Phased Approach/Rodanthe Bridge Alternative (Preferred) includes 8-foot (2.4-meter) shoulders for all bridges.*

Comment: "Page 4-45, Section 4.7 through Page 4-95, Section 4.12. These sections provide an inadequate analysis of actual impacts to fishery resources. Although beach nourishment is a significant component of several alternatives, there is limited analysis of long-term impacts to the beach invertebrate community or the fishery species that utilize the invertebrates as prey. Also, no specific information is provided concerning offshore borrow sites or the potential impacts of the removal of sand for beach fill."

Response: *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative.*

Comment: "Pages 4-96, Indirect and Cumulative Impact. The SDEIS states that the indirect and cumulative effects of the Parallel Bridge Corridor would be minimal. Information provided in the SDEIS does not support this conclusion. For example, the Parallel Bridge Corridor With Nourishment alternative would result in potential cumulative impacts at offshore borrow sites. The document indicates that beach nourishment will occur every four years; however, frequent storms could result in an increased frequency of beach erosion, resulting in potential cumulative impacts to surf zone invertebrate communities and benthic communities at offshore borrow sites. Therefore, alternatives that involve beach nourishment could have substantially greater adverse impacts to EFH and associated fishery resources than alternatives that do not require beach nourishment.

The document does not provide an adequate comparison of the cumulative adverse effects of the Pamlico Sound Bridge Corridor versus the Parallel Bridge Corridor. The Pamlico Sound Corridor alternatives would impact submerged aquatic vegetation (SAV), a category of EFH. However, this resource can be mitigated and would likely result in less long-term impact to EFH than the Parallel Bridge Corridor With Nourishment alternative and Road North /Bridge South alternative that includes beach nourishment.

> **Response:** *NCDOT and FHWA consider all impacts associated with the proposed action, including construction, to be direct impacts and not indirect and cumulative impacts. As such, the impacts identified by the commenter were addressed in the direct impact discussions by environmental topic.*

Comment: Selection of the Pamlico Sound Corridor with adequate mitigation would eliminate the need for beach nourishment and allow natural beach processes to occur within the Pea Island Refuge, which would benefit marine and estuarine dependent fishery resources that utilize the surf zone and nearshore habitats.

> **Response:** *This observation was addressed in the SDEIS, SSDEIS, and FEIS.*

Comment: Also, over the 50 year life of the project, hopper dredging in offshore borrow sites could affect sea turtles, which are under the purview of the NMFS Southeast Regional Office Protected Resources Division."

> **Response:** *Hopper dredging was not intended with the nourishment alternatives.*

Comment: "The cumulative and/or additive effects of the "mixed and matched" approach stipulated in the SSDEIS are not adequately explained. If additional alternatives that are the result of the "mix and match" approach are proposed, the impacts to NOAA trust resources must be fully evaluated for comparison with other alternatives."

> **Response:** *A "mixed and matched" approach was not selected as the Preferred Alternative. The Phased Approach/Rodanthe Bridge Alternative (Preferred) was assessed in the SSDEIS and in this FEIS.*

Comment: "The Phased Approach would over time result in bridge sections in the surf zone. We believe that scour and altered energy regimes around these structures would degrade important surf zone habitat for fish and invertebrate species and alter the value as EFH for federally managed fishery resources. The SSDEIS does not recognize that this area is EFH and does not adequately address potential adverse impacts to fishery resources that use this area as habitat."

> **Response:** *The essential fish habitat analysis was revisited for the FEIS. Revisions are presented in this FEIS, with additional detail presented in a Essential Fish Habitat Assessment (CZR, Incorporated, 2008).*

Comment: "The SSDEIS contains several references to the Outer Banks Task Force (OBTF). Because of the emphasis placed on the OBTF, the supplement should describe the OBTF and explain the role of that organization in the overall planning process."

> **Response:** *The OBTF and its role are described in Section 2.2.5 of the SDEIS and Section 2.3 of this FEIS.*

Comment: "There are references to the Constructability Workshop held on August 29 to 31, 2006, with regards to the Phased Approach alternatives (including the Preferred Alternative). The purpose of the workshop was to assess the feasibility of constructing the multiple bridges, roads, and other structures within the existing right-of-way. While the workshop did determine that construction of the Phased Approach bridges were technically feasible, it did not address the practicability or environmental effects of such construction."

> **Response:** *The purpose of the workshop was to determine only whether the Phased Approach was technically feasible. The practicability and the environmental effects of construction of the Phased Approach bridge are addressed in the SSDEIS and the FEIS.*

Comment: "During the 50-year life of the project all but 2.1 miles of surf zone could end up underneath bridge spans. The effects of this on benthic invertebrate communities and fishery resources in the surf zone are not adequately addressed."

> **Response:** *Documentation of the extent to which the Phased Approach (including the Preferred Alternative) bridges would be in the surf zone was added to Section 4.7.3 of the FEIS as Table 4-23. Benthic and fisheries impacts also are discussed in a new Essential Fish Habitat Assessment (CZR, Incorporated, 2008).*

Comment: "Page 2-4, Section 2.2.1, Phase I of the Phased Approach involves the construction of a parallel bridge over Oregon Inlet. NMFS is concerned that completion of Phase I could be used as justification to return to the status quo of repeatedly reacting to storm damage to NC 12. Since the Phased Approach alternatives would be built in four phases over many years, we are concerned that after the bridge over Oregon Inlet is completed, a decision could be made to not proceed with Phases II, III, and IV. The following passage from page 2-4 suggests this may be the case: "Although the Phased Approach alternatives (including the Preferred Alternative) are described and addressed in this Supplement as a phased alternative with specific locations and lengths for the phases…these details could be adjusted based on funding availability and the changing conditions within the project area…implementation of any individual phased could be accelerated or delayed." Due to the high costs of this project, we are concerned that the Phased Approach could lead to only replacing the bridge and using beach nourishment to repair NC 12 and maintaining the dune system in the Pea Island Refuge."

> **Response:** *The statement quoted was made only to acknowledge that conditions would change over time and was not intended to imply NCDOT planned to not proceed with the later phases once Phase I was completed. The need to consider changing conditions prior to implementing future phases also was emphasized by the environmental resource and regulatory agencies during meetings that sought to reach concurrence on the LEDPA. A monitoring program and process for deciding when to implement each phase as the shoreline evolves is presented in Section 2.10.2.5 of the FEIS.*

Comment: "Page 2-20, Potential Cost Sharing Opportunities with Beach Nourishment. The discussion in section 2.3.1.4 regarding potential cost sharing with COE for navigational dredging and beach nourishment assumes that dredged sand is available and biologically suitable. These assumptions may not be valid. Allowing sand on the beach that is not compatible would be disruptive to the ecological processes and would degrade surf zone EFH. This section also seems to assume that funding will be available to the COE to continue pipeline dredging on an annual basis. This has not been the case in the past and is not likely to be the case in the future. Also, due to differences in hydraulic sorting that occurs in different segments of Oregon Inlet, the sand from certain reaches of the Oregon Inlet navigation channel is not likely to be compatible for placement on the beaches at the Pea Island Refuge."

> **Response:** *This section noted a potential opportunity and not a firm intent. As stated, the use of sand from ocean bar dredging was assumed for nourishment, not sand dredged from the inlet. It was assumed that if sand dredged from the ocean bar were not biologically compatible, then it would not be used with the nourishment alternatives. Cost sharing arrangements could have made it more feasible for the USACE to continue dredging on an annual basis. It was not assumed, however, that under such an arrangement that all of the sand used in nourishment would come from that single source. The Phased Approach/Rodanthe Bridge Alternative (Preferred), however, does not include a nourishment component.*

Comment: "Page 3-63-Section 3.7.6.3, Fish and Shellfish. This section does not identify marine surf zone species that could be affected by beach nourishment alternatives under the Phased Approach."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred), does not include a nourishment component.*

Comment: "Page 3-71-Section 3.7.6.4, Benthic Communities. No information is provided on the benthic invertebrate communities (e.g., Donax sp. and Emerits talpoida) in the surf zone. This community is an important food source for fish and is at substantial risk for the Phased Approach alternative."

> **Response:** *Documentation of the extent to which the Phased Approach (including the Preferred Alternative) bridges would be in the surf zone was added to Section 4.7.3 of the FEIS as Table 4-23. Benthic impacts also are discussed in a new Essential Fish Habitat Assessment (CZR, Incorporated, 2008).*

Comment: "Pages 4-21 through 4-22, Offshore Coastal Processes with the Phased Approach. Section 4.6.3 does not fully address the issue of scour around bridge piles. The follow up discussion does not provide a detailed analysis of the ecological impacts of scour. With bridges that are over land and gradually transition to the ocean environment, the impacts from the Phased Approach will occur on a continuum along and across the beach through time. Impact assessment should include impacts to EFH quantity and quality over time. Additional analysis should also be conducted for maintenance and/or repair of bridge piles, to include the potential placement of revetment or other stabilizing structures adjacent to the piles, and their impacts on fish and wildlife resources."

> **Response:** *Documentation of the extent to which the Phased Approach bridges (including the Preferred Alternative) would be in the surf zone was added to Section 4.7.3 of the FEIS as Table 4-23. Additional material on fish habitat impacts is included in a new Essential Fish Habitat Assessment (CZR, Incorporated, 2008). New material addressing design criteria for establishing pile lengths so new revetments and stabilizing structures would not be expected is included in Section 2.10.1.2 of the FEIS.*

Comment: "Page 4-34-Section 4.6.1, Fish and Shellfish. This section does not address impacts to the invertebrate surf zone community that could be significantly altered by bridge supports in the surf zone. This community is an important food source for fish that utilize the surf zone as habitat. We disagree with the assumption that bridge supports in the surf zone will not affect fishery resources. Relocation of fish to other areas depend upon many factors, such as species impacted, population density within the impacted area as well as adjacent habitat, and the quantity and quality (or suitability) of the adjacent habitat. It is incorrect and potentially misleading to discount impacts to fisheries by implying the affected species can simply move to adjacent habitat. The project area consists of a very narrow strand of intertidal and shallow subtidal habitat, making it unlikely that species displaced by project-related impacts would be able to easily locate suitable alternative habitat."

> **Response:** *Documentation of the extent to which the Phased Approach (including the Preferred Alternative) bridges would be in the surf zone was added to Section 4.7.3 of the FEIS as Table 4-23. Additional material on benthic and fisheries impacts are included in a new Essential Fish Habitat Assessment (CZR, Incorporated, 2008).*

Comment: "Page 4-34-Section 4.7.6.2, Essential Fish Habitat. Surf zone EFH would be significantly altered by the presence of bridge pilings that would likely result in an even more dynamic environment that may not support surf zone invertebrates. The eventual degradation of this important habitat along approximately 10 miles of beach should be addressed in greater detail."

> **Response:** *Documentation of the extent to which the Phased Approach (including the Preferred Alternative) bridges would be in the surf zone was added to Section 4.7.3 of the FEIS as Table 4-23. Additional aquatic-related impacts material is included in a new Essential Fish Habitat Assessment (CZR, Incorporated, 2008).*

Comment: "Page 4-58-Table 4-12. This table does not include any adverse impacts (dredging or filling) as a result of beach nourishment."

> **Response:** *Table 4-12 in the SDEIS only includes impacts to wetlands and open waters; any beach nourishment project would be designed to avoid placement of sand within wetlands. However, the Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "Page 4-63, Essential Fish Habitat. This section does not address impacts to surf zone EFH or marine water column EFH as a result of beach nourishment."

> **Response:** *Further discussions of Essential Fish Habitat are included in Section 4.7.6.2 of this FEIS and in a new Essential Fish Habitat Assessment (CZR, Incorporated, 2008). The Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "Page 4-64-Table 4-13. This table does not include any adverse impacts to EFH associated with beach nourishment."

> **Response:** *Further discussions of Essential Fish Habitat in the context of the Preferred Alternative are included in Section 4.7.6.2 of this FEIS and a new Essential Fish Habitat Assessment (CZR, Incorporated, 2008). The Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "Page 4-65, Parallel Bridge Corridor with NC 12 Maintenance. This paragraph does not address any habitat impacts as a result of beach nourishment."

> ***Response:*** *Impacts of nourishment are noted in the section referenced. The Parallel Bridge Corridor with Nourishment Alternative and with Phased Approach/Rodanthe Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "4-66, Parallel Bridge Corridor with NC 12 Maintenance. See comments for page 4-65."

> ***Response:*** *Impacts of nourishment are noted in the section referenced. The Parallel Bridge Corridor with Nourishment Alternative and with Phased Approach/Rodanthe Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "NMFS is concerned that bridge replacement alternatives that require long-term beach nourishment and construction and maintenance of bridge structures in the beach zone would result in long-term adverse impacts to NOAA trust resources. In stating this, we acknowledge that alternatives that involve direct impacts to SAV are problematic. We also recognize the desire to maintain access to the northern end of Hatteras Island for recreational use. However, we believe that the Pamlico Sound Bridge Corridor alternatives best support the purpose and need for this project with the least impact to important estuarine and marine resources in the project area."

> **Response:** *The position is acknowledged. The reasons for selecting the Preferred Alternative are discussed in Section 2.15 of the FEIS and included in the NEPA/Section 404 Merger Agreement included in Appendix D.*

United States Department of the Interior-February 13, 2006 (page A-12)

(This letter includes the comments from the National Park Service, the US Fish and Wildlife Service, and the Pea Island National Wildlife Refuge.)

Comment: "Due to shortcomings in impact analysis, the SDEIS does not appear to accurately present or evaluate each of the alternatives. Direct, indirect and cumulative effects of this project are significant, but the SDEIS fails to accurately depict the full range of effects of each alternative."

> **Response:** *As explained later by the commenter in this letter, indirect and cumulative impacts they refer are those associated with proposed actions outside the project right-of-way. The NCDOT considers any impact associated with the construction and operation of the proposed action to be a direct impact. Expanded discussions of direct impact on natural resources are included in Section 4.7 of this FEIS.*

Comment: "One important omission in the SDEIS is a presentation of positive benefits to the environment and to the Refuge from removing the roadbed associated with the Pamlico Sound Bridge Corridor alternatives."

> **Response:** *Comment acknowledged; removing the existing roadbed is noted in Section 4.7.3.1 of the FEIS for the Pamlico Sound Bridge Corridor.*

Comment: "The Department found that some of the information presented in the SDEIS is inaccurate, misleading and confusing. As a result, the reader is left with no clear concept of the consequences the bridge project will have on the ecosystem. The final document should clearly identify the selected plan's effects on the environment. Specific comments addressing the shortcomings of the SDEIS are provided in the following sections."

> **Response:** *Comments and concerns are noted and acknowledged. The specific comments have been addressed below.*

Comment: "The identified deficiencies in the SDEIS and Draft Section 4(f) Evaluation should be rectified and a revised SDEIS and section 4(f) Evaluation issued for review. We recommend the Federal Highway Administration (FHWA) and NCDOT provide revised documents that equally assess and clearly analyze the environmental impacts of both alternatives, thereby ensuring compliance with CEQ Implementing Regulations and NEPA procedures. If the FHWA and NCDOT do not revise the documents, the Department may recommend referral of this project to the CEQ."

> **Response:** *The Department of Interior's comments are addressed in the FEIS.*

Comment: "The purpose of the Refuge is defined as, "…a refuge and breeding ground for migratory birds and other wildlife …" (Executive Order 7864, dated April 8, 1938) and "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 U.S.C. § 715d, Migratory Bird Conservation Act). Furthermore, the *National Wildlife Refuge System Improvement Act of 1997* states "The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." Therefore, fish and wildlife must be considered first and foremost during considerations of use of Refuge lands and management thereof. Visitor access, though important, is secondary to the Refuge's primary mission.

The barrier island system has long been recognized as an important resource providing valuable habitat for migratory birds and other wildlife. The existing NC 12 corridor, which bisects the length of the Refuge for approximately 12 miles, fragments this important habitat and disrupts the natural coastal dune processes. Past maintenance of the NC 12 corridor and disposal of dredged sand have significantly impacted the natural biota of this system. Disposal of dredged sand has increasingly led to finer-grain sized sand, a greater percentage of heavy (dark) minerals and a resulting decrease in beach-face invertebrates. Efforts to maintain the NC 12 corridor through the Refuge (e.g. artificial dune construction, etc.) have altered the natural geological processes of the barrier island system, and thus have reduced and altered habitat available for fish and wildlife resources. The existing NC 12 corridor thus presents major challenges to the Refuge in implementing its mission and maintaining important ecological values. The need for an increasing intensity of maintenance under the Parallel Bridge Corridor alternatives must be viewed as a source of continued and expanded degradation of the ecological values of the Refuge."

> **Response:** *Position acknowledged. The objective of all of the alternatives considered in the Parallel Bridge Corridor was to substantially reduce the amount of NC 12 weather-related maintenance through 2060. For example, the Road North/Bridge South and All Bridge alternatives would move NC 12 west of the forecast 2060 high erosion shoreline. With the Phased Approach alternatives (including the Preferred Alternative), NC 12 weather-related maintenance activities within the Refuge would not be fully addressed*

until the completion of Phase IV. Section 4.6.8.6 describes the extent of NC 12 storm-related maintenance that would be expected prior to the implementation of Phases II to IV and its location, and section 4.7.8 discusses impacts. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement. Phase I would not change the level of NC 12 storm-related maintenance.

Comment: "The viability of the Parallel Bridge Corridor alternatives depends on continued protection of NC 12 between Oregon Inlet and Rodanthe through beach stabilization. The analysis presented in the SDEIS assumes that sand of suitable quantity and quality will be available throughout the 50-year life of the project. This assumption is not supported by the information provided in the SDEIS and other information available. Indeed, both the need for and availability of suitable beach stabilization material appear to be significantly understated, which biases the analyses of both the feasibility and costs of the Parallel Bridge Corridor alternatives. Furthermore, it is our view that a more balanced evaluation of these factors might lead to the conclusion that the Parallel Bridge Corridor alternatives will fail to meet the project purpose of providing 'a replacement crossing that will not be endangered by shoreline movement through year 2050.'"

Response: *Only the alternatives involving nourishment rely on beach stabilization to protect NC 12. None of the nourishment alternatives were selected as the Preferred Alternative.*

Comment: "The NPS requests to review all NCDOT projects near, adjacent, or within the boundary of a unit of the NPS. Review of proposed projects should be mailed to the closest unit of the NPS and the Southeast Regional Office, Planning and Compliance Division, 100 Alabama Street, 1924 Building, Atlanta, Georgia 30303. The NPS will determine the level of environmental analysis required for all projects, including NCDOT projects that are within the boundary of a unit of the NPS. All Environmental Assessments and EIS's must adequately address all NPS resources within the park and receive park and regional review prior to public release. Impairment determinations are made by the park superintendent. All surveys and studies/modeling must be coordinated with park superintendent. All NPS NEPA documents must contain: a definition of impact thresholds (minor, moderate and major impacts), state whether the impact is beneficial or adverse, and state anticipated duration of impact."

Response: *The NCDOT has provided NPS the opportunity to review projects affecting units of the NPS. For this project, that includes participation on the NEPA/Section 404 Merger Team and opportunities to comment on the SDEIS, SSDEIS, and FEIS. NCDOT acknowledges that impairment determinations must be made by the park superintendent.*

Comment: "Pages v, 2-104 and 2-105 of be SDEIS state that beach nourishment would occur in four locations and likely be repeated at four-year intervals. We stress that this is highly dependent upon storm events and unprovable assumptions. Also, the discussion does not make reference to how volumes of sand were determined. Volumes presented appear to be substantial underestimates of what would be needed for beach and dune construction. For example, over 500,000 cubic yards of Oregon Inlet sand have been placed along and adjacent to the 'Canal Zone Hot Spot' annually for the past four years, and it has not been sufficient to protect the highway from overwash and sand deposition impacts. Based upon characteristics of material dredged from the Bodie Island Spit section of the Oregon Inlet navigation channel, the sand is marginally suitable, at best, for placement on the Refuge beach and would not likely remain in place to protect the highway for four years, given the annual cycle of destructive wind and water events. As such, it appears that the estimated beach stabilization and associated costs are understated.

Response: *An alternative that involves beach nourishment was not selected as the Preferred Alternative. Past deposition of sand from Oregon Inlet was not done as a part of a systematic program to maintain the shoreline. The sand quantities presented for the alternatives involving nourishment reflect such a program. It was not assumed that the sand used would come from the Bodie Island spit, but rather the ocean bar.*

Comment: Page 1-5, section 1.1.3 does not appear to take into account the volume of sand that has been placed on the beach as a result of dredging Oregon Inlet over the past 12 to 14 years. Volumes frequently exceed 500,000 yd^3 per year. This has certainly affected estimates of erosion rates for the Canal Zone Hot Spot and segments of beach further south due to longshore transport. It should not be assumed that these volumes of sand be placed on the beach throughout the project life. As most of the sand is fine grained with a relatively high percentage of heavy minerals, it is marginally suitable for placement on the Refuge beach. Without the ability to mix the sand with medium to coarse sand there may come a time when disposal of the fine-grained, high percent heavy mineral sand will not be allowed on the Refuge beach."

Response: *The purpose of this section was to summarize past erosion rates. The high erosion rate estimates used to develop the alternatives are described in Section 3.6.3.1 and took into account 58 years of shoreline data. It was not assumed that the sand used would come from the Bodie Island spit (where fine sand, with a relatively high percentage of heavy minerals, is found) but rather the ocean bar.*

Comment: "Page 2-70 under the heading "*Sand Requirements*" refers to sand availability. Sand availability is only minimally described in Section 2.6.3.4, not 2.6.3.2. Throughout the document, when sand requirements or beach stabilization are discussed, little meaningful information is presented with regard to suitability of sand for disposal on the Refuge beach. Also, when there is limited information on sand suitability, it is not clear what standards are being used. Standards for placing suitable sand on the Refuge beach may be different than standards established by other state or Federal agencies."

Response: *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have provided additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.6.3.4 of the FEIS pertaining to available and suitable sand sources.*

Comment: "Page 2-73 refers to sand availability for beach stabilization. This discussion seems to assume that the sand is biologically suitable (e.g. correct color, mineral content and particle size) for nesting sea turtles and beach-face and swash-zone invertebrates that provide the base of the food web for many migratory bird species. If the sand is not biologically suitable, the issue could be a fatal flaw for one or more alternatives. Even if the sand currently available is biologically suitable, this does not mean the available sand will be suitable through the year 2060. Sand dynamics within the proposed source areas could change significantly. New information could change suitability criteria. It must be understood that sand determined to be not suitable by Refuge standards cannot be placed on the Refuge beach as it would compromise the purpose of providing quality habitat for migratory birds and other wildlife."

Response: *The nourishment alternatives assumed that only biologically suitable sand could be used.*

Comment: "Page 2-73 states "…and from Oregon Inlet dredging could be used for beach nourishment …" In this consideration, were existing dredging rates with the existing Bonner Bridge used or were forecast dredging rates with a new parallel bridge used? If the former, then available sand may be less with a new parallel bridge since the new bridge would have more and longer navigation spans, thus possibly reducing the need for channel dredging."

> **Response:** *This section noted a potential opportunity and not a firm intent. It was not assumed that under such an arrangement that all of the sand used in nourishment would come from that single source.*

Comment: "Page 2-105 in Section 2.8.2.1 gives no consideration to the biological suitability of sand for either nesting sea turtles or beach invertebrates providing the base of the food web for migratory birds and surf zone fish. The discussion does mention grain size, but it is important to note that grain size is not the only consideration. Other suitability factors to consider include heavy mineral content, color, and presence of contaminants, volume, timing and placement methodology."

> **Response:** *The nourishment alternatives assumed that only biologically suitable sand could be used, including all suitability factors.*

Comment: "Page 4-49 states 'Where dredging is needed, the dredging would be to a depth of 8.0 feet (2.4 meters) to provide more flexibility for construction barge operations.' Please elaborate on why 8 feet of dredging is needed for more flexibility while other areas already 6 feet deep are sufficient for barge operation and will not be dredged."

> **Response:** *The proposed extra depth is needed to reduce the frequency of re-dredging during project construction as the channel naturally fills in.*

Comment: "Page 4-67 states 'One of the most important mitigation measures for beach replenishment is to replenish with sand similar to existing conditions.' We agree, but this discussion should be expanded."

> **Response:** *The nourishment alternatives were not selected as the Preferred Alternative.*

Comment: "On page 4-67, hopper dredges are unable to place sand directly on the beach. They can put the sand near-shore typically in 18-20 feet of water. At such depths, only the finest component of this sand reaches the beach and then only during significant storm events. This process results in a 'fining' of native beach sand over time and has detrimental effects on beach biota. Also, if the sand source is the ocean bar then ocean disposal (even near-shore disposal) reduces the volume of naturally bypassed sand, thus causing increased erosion rates on the Refuge beach."

> **Response:** *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have provided additional information on potential coastal process impacts that might be associated with nourishment.*

Comment: "Page 4-109 refers to dredged material from the Ocean Bar channel at Oregon Inlet being suitable for beach nourishment. Is this material biologically suitable for nesting sea turtles and beach face or swash zone invertebrates? Also, there are no references to the negative impacts associated with using sand from the Oregon Inlet channel having a higher percentage of heavy mineral content."

> **Response:** *The nourishment alternatives assumed that only biologically suitable sand could be used and that based on available data, that there is an adequate supply.*

Comment: "Pages vi, xxiii, 2-16, 2-80 and 2-96 of the SDEIS state that the Pamlico Sound Bridge Corridor bridge will have two 8-foot shoulders while the Parallel Bridge Corridor bridge will have two 6-foot shoulders. The SDEIS does not explain why the longer bridge requires 8-foot shoulders while the short bridge requires 6-foot shoulders. Furthermore, page xxiii states that the bridges south of the Parallel Bridge at Oregon Inlet will have 8-foot shoulders to accommodate bicycles. This makes the 6-foot shoulders on the Parallel Bridge even more confusing. This effectively eliminates accommodations for bike riding or makes it more dangerous on the Parallel Bridge without explanation. Obviously the wider shoulders on the longer bridge raise the cost versus more narrow shoulders on the short bridge. Since this scenario provides for an unequal cost comparison, the difference should be explained."

> **Response:** *Six-foot (1.8-meter) shoulders were used in the 1999 final design for the Oregon Inlet bridge in the Parallel Bridge Corridor. The cost estimates included in Section 2.3 of the SSDEIS and Section 2.12 of the FEIS assumed 8-foot (2.4-meter) shoulder widths for all bridges for the replacement bridge corridor alternatives. The final design for the Phased Approach/Rodanthe Bridge Alternative (Preferred) includes 8-foot (2.4-meter) shoulders for all bridges.*

Comment: "Page 2-69 states 'The cost estimates for the Oregon Inlet Bridge were based on the 1999 estimate revised to take into account the changes at the southern end, then escalated to 2005 dollars.' We assume that this means that 1999 dollars were translated to 2005 dollars by applying an inflation multiplier. If so, was a construction index used to derive the multiplier?"

> **Response:** *The cost estimates for the various alternatives were revised for the FEIS. Current year construction dollars were applied to separate estimates of material quantities. Simple escalation of past total costs was not done. These revised cost estimates also are presented in the FEIS in Section 2.12.1.*

Comment: "In Table 2-9 on page 2-110, do future costs of stabilizing beaches through 2060 account for inflation or are they in 2005 real dollars? All cost should reference the base date. Do cost figures account for TIP Nos. R-3116D, R-3116E and R-3116F not having to be implemented with the Pamlico Sound Bridge Corridor alternatives? It seems that a substantial savings would be realized from not having to construct these three projects at 'hot spots' within the Refuge. Also, do cost figures for the Parallel Bridge Corridor Nourishment Alternative include the cost of removing sand and water after each storm event, dune reconstruction, sand fencing, dune sprigging (usually several times per year), or repairing a breach or newly formed inlet in NC 12?"

> **Response:** *Costs are in current-year dollars, except for the design-build escalation factor added with the SSDEIS and discussed in Section 2.12.1.2 in the FEIS. Costs reference the base date in Section 2.12. The discussion of capital funding in Section 2.12.4 reflects the projects in the 2009-2015 TIP in considering the availability of funds. TIP Nos. R-3116D, R-3116E, and R-3116F are not in the current (2009-2015) TIP. The*

Nourishment Alternative costs are for a systematic nourishment and dune enhancement program that would substantially reduce or eliminate the need for regular weather-related maintenance. Thus, such costs are not included in the Nourishment Alternative's cost estimates.

Comment: "Pages 2-110 and 2-111 identify several observations from Table 2-9. The first observation is an irrelevant and misleading statement since the bridge structure is obviously not a stand-alone component of the project. This statement inappropriately biases the discussion toward the Parallel Bridge Corridor alternatives and should be removed."

Response: *The cost discussion was revised in the SSDEIS and is presented in Section 2.12.1.3 in the FEIS. The statement noted in the comment has been revised.*

Comment: "Page 2-112 refers to potentially reducing costs of nourishment by using sand from the U.S. Army Corps of Engineers (USACE) ocean bar maintenance. Again, this would only be true if the sand were biologically suitable for nesting sea turtles and beach face invertebrates. It should be noted that the USACE may do less dredging in the inlet with the longer spans of the parallel bridge as stated in the document. While some sand may be available from the outer bar, quantity would likely be far less than what is needed. Sand would have to be brought from farther away, thereby negating the inferences about cost reduction."

Response: *This section noted a potential opportunity and not a firm intent. Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have provided additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.6.3.4 of the FEIS pertaining to available and suitable sand sources.*

Comment: "Page 2-112 states: 'The new Oregon Inlet Bridge … could eliminate or greatly reduce navigation span maintenance requirements, reducing the USACE'S dredging costs.' This would also be true of the longer bridge in the Pamlico Sound Bridge Corridor. Also, reduced maintenance dredging with the Parallel Bridge would provide less sand for potential use for beach stabilization, assuming biological suitability. The Pamlico Sound Bridge would be located in a lower energy environment which would reduce overall maintenance costs and improve navigational safety as boats and barges would not have to negotiate the hazardous inlet channel and a relatively narrow navigation span at the same time in the strong currents of the inlet."

Response: *Observations acknowledged.*

Comment: "The SDEIS fails to adequately evaluate the effects of the Parallel Bridge Corridor alternatives to fish and wildlife resources. In fact, the SDEIS is so bereft of information regarding the effects of continued and increasing fortification, maintenance and repair of NC 12 on Federal trust resources as to render the SDEIS inadequate as a basis for informed decision making."

Response: *The objective of all of the alternatives considered in the Parallel Bridge Corridor was to substantially reduce the amount of NC 12 weather-related maintenance through 2060. For example, the Road North/Bridge South and All Bridge alternatives would move NC 12 west of the forecast 2060 high erosion shoreline. With the Phased Approach alternatives (including the Preferred Alternative), NC 12 weather-related maintenance activities within the Refuge would not be fully addressed until the completion of Phase IV. Section 4.6.8.6 describes the extent of NC 12 storm-related* *maintenance that would be expected prior to the implementation of Phases II to IV and its location, and section 4.7.8 discusses impacts. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement. Phase I would not change the level of NC 12 storm-related maintenance.*

Comment: "Pages xix and 4-96 of the SDEIS state that indirect and cumulative effects of the Parallel Bridge Corridor would be minimal. Information provided in the SDEIS and other available information does not support this conclusion. The existing right-of-way footprint within the Refuge will remain an identifiable landscape feature with less than desirable wildlife habitat values for many years, even after the roadbed has been removed. The Parallel Bridge Corridor will result in adverse effects to habitat quantity and quality for the total 'zone' of effects. This 'zone' includes the footprint of the old roadbed, the footprint of the new roadbed, the area between the old and new roadbed, and an area adjacent to each side of the total footprint that will be affected by construction, maintenance or other activities. This total 'zone' of effects would be up to several hundred feet wide along 12 miles of Refuge, resulting in hundreds of acres of impact to the Refuge. This represents significant direct, indirect and cumulative impacts to the Refuge."

Response: *It is our understanding that the Refuge is concerned that the potential indirect impact (which would contribute to cumulative impacts) of storm-related NC 12 maintenance would continue at current levels or worse through 2060 with the Parallel Bridge Corridor alternatives (including the Preferred Alternative), and thus, over the course of time, all parts of the Refuge east of the 2060 high erosion shoreline (the comment's 'zone' of effect) would be affected by storm-related maintenance activities. This would not be the case. As noted in the response to the previous comment, the objective of all of the alternatives considered in the Parallel Bridge Corridor was to substantially reduce or eliminate the amount of NC 12 weather-related maintenance through 2060. Therefore, the indirect and cumulative impacts in the 'zone' described in the comment would not occur.*

However, because the Preferred Alternative is phased, some NC 12 maintenance would continue to occur until the final phase is completed. Section 4.6.8.6 describes for the Preferred Alternative the extent of the remaining NC 12 storm-related maintenance (the concern of this comment) that would be expected prior to the implementation of Phases II to IV and its location. Section 4.7.8 discusses the impacts of this maintenance. Both sections address this concern as a direct impact. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement. Phase I would not change the level of NC 12 storm-related maintenance from what is currently experienced.

Comment: "The document also fails to address the positive indirect and cumulative effects of the Pamlico Sound Bridge Corridor. The Department believes that the Pamlico Sound Bridge Corridor would produce beneficial indirect and cumulative effects on the Refuge by eliminating paved access through the Refuge, thereby reducing disturbance to wildlife and improving habitat conditions by returning the right-of-way and adjacent areas to natural conditions."

Response: *This is now addressed in Sections 4.7.7 and 4.12.5.8 of the FEIS.*

Comment: "The SDEIS also fails to adequately address the indirect and cumulative effects of repeated beach stabilization and disruption of normal coastal processes. These processes include geological effects and ecological effects to the beach biota at all trophic levels, including marine invertebrates."

> **Response:** *The objective of all of the alternatives considered in the Parallel Bridge Corridor was to substantially reduce the amount of NC 12 weather-related maintenance through 2060, including beach stabilization. Thus, there would be no indirect and cumulative effects of repeated beach stabilization and disruption of normal coastal processes beyond that defined as a part of each alternative, e.g., nourishment that is associated with the nourishment alternatives. Discussion of expected weather-related maintenance prior to the completion of each phase of the Preferred Alternative is presented in Section 4.6.8.6.*

Comment: "Overall, Section 4.7 beginning on page 4-45 and Section 4.12 beginning on page 4-95 present very weak analyses of actual impacts to biotic communities with any alternative. Also, there is no discussion of the effects of habitat loss, degradation and fragmentation on the diversity, biological integrity and ecological integrity of the barrier island system as a result of possible various combinations of alternatives with the Parallel Bridge Corridor. The FWS and the NPS would be willing to work with you to better define these effects so that they may be appropriately considered in any revised document."

> **Response:** *A discussion of the larger issue of potential habitat loss as it relates to the scarcity of the remaining natural habitat on the Outer Banks is included in Sections 4.12.4.8 and 4.12.5.8 of the FEIS.*

Comment: "Pages xvii and 4-46 refer to 'soon-to-be-listed threatened and endangered species in Dare County.' Please specifically clarify what this statement means."

> **Response:** *This statement was removed from these sections in the FEIS.*

Comment: "Pages xxiv and 4-107 state 'Night lighting would not occur near turtle nesting areas ....' The definition of 'near' would need to be determined through consultation with the FWS."

> **Response:** *NCDOT has completed formal consultation under Section 7 of the Endangered Species Act of 1973, which addressed impacts to sea turtles. (See Section 4.7.9.)*

Comment: "Pages xxiv and 4-74 refer to the FWS's *Precautions for General Construction in Areas Which May be Used by the West Indian Manatee in North Carolina*. This document has been revised and is now referred to as *Guidelines For Avoiding Impacts To The West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters*. This document can be found at http://ncus.fws.gov/mammal/manatee_guidelines.pdf."

> **Response:** *The revised guidance is referenced in the summary and Section 4.7.9 of the FEIS.*

Comment: "Page xxvi fails to give consideration to the leatherback sea turtle (*Dermochelys coriacea*), which potentially could nest within the project area."

> **Response:** *The biological conclusion for the leatherback sea turtle is now May Affect – Likely to Adversely Affect when on land based on formal consultation with USFWS and May Affect –Not Likely to Adversely Affect when in the water based on formal consultation with NMFS. This is noted in the FEIS summary and in Section 4.7.9.*

Comment: "Pages 2-47, 3-46 and 4-71 and Figure 3-6 refer to critical wintering habitat for piping plovers (*Charadrius melodus*). North Carolina piping plover Critical Habitat Units 1, 2, 4 and 5 were recently invalidated by Federal court order. Therefore, no designated critical habitat for the piping plover occurs within the project area. However, piping plovers are still known to use suitable habitat within the project area and effects to this species must be adequately considered. It should be noted that the FWS is currently reviewing the judge's order and may propose re-designation of these units. Also, it should be noted that the Pamlico Sound Bridge Corridor alternatives could have a beneficial effect on piping plovers and that habitat would be restored within the existing NC 12 right-of-way in the form of overwash. Abandoning the existing NC 12 right-of-way would benefit piping plovers by reducing the amount of disturbance from humans and pets. Pet dogs and cats can be a significant source of mortality and harassment for piping plovers."

> **Response:** *FHWA and NCDOT have completed formal consultation under Section 7 of the Endangered Species Act of 1973, which addressed impacts to piping plovers. Critical habitat is discussed in the resulting Biological Assessment (FHWA and NCDOT, 2008) in Section 4.7.9 of the FEIS as potential critical habitat, as well as the Biological and Conference Opinions (USFWS, 2008) of USFWS (see Appendix E).*

Comment: "Page 2-116 addresses permits and the compatibility determination required by the FWS. In addition, ESA Section 7 consultation will be required for federally endangered and threatened species."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is allowed by its NC 12 easement agreement and a compatibility determination is not required. FHWA and NCDOT have completed formal consultation under Section 7 of the Endangered Species Act of 1973 with USFWS.*

Comment: "Pages 4-39 and 5-31 address loggerhead sea turtles, but fail to address green sea turtles (*Chelonia mydas*) and leatherback sea turtles as potential nesters within the project area."

> **Response:** *These species were addressed during formal consultation with USFWS and the results are presented in Section 4.7.9 of the FEIS.*

Comment: "Page 4-47 refers to a 'May Affect – Likely to Adversely Affect' determination for piping plover and green sea turtle with the Parallel Bridge Corridor. A 'Likely to Adversely Affect' determination would trigger a formal Section 7 consultation. This determination may or may not be prudent for nesting sea turtles depending upon whether sea turtle nests are present at or near the project footprint and depending upon other factors such as the time of year when work activity would occur. The same determination may be prudent for loggerhead and leatherback sea turtles, if nests are present within or near the project footprint."

Response: *These species were addressed during formal consultation with USFWS, and the results are presented in Section 4.7.9 of the FEIS.*

Comment: "Page 4-67 refers to adverse effects to loggerhead turtles from hopper dredges. This needs to be expounded upon."

Response: *The SDEIS, SSDEIS, and FEIS include a commitment not to use hopper dredges because of their potential impact on sea turtles in the "Project Commitments" section.*

Comment: "Pages 4-72 and 4-73 address effects to leatherback, green and loggerhead sea turtles. It is possible that any of these three species could nest within the project area. The most likely species to nest in the project area is the loggerhead sea turtle. Effects to nesting sea turtles can be avoided or minimized if beach stabilization occurs outside the nesting period (May 1 through November 15). If work were to occur on the beach during the nesting season, a vigorous monitoring plan would need to be developed to determine if any sea turtle nests occur within the project area prior to and during project construction. This determination may or may not be prudent depending upon several variables. In general, more information needs to be provided as to the potential effects to sea turtles. Issues such as lighting effects of long-term NC 12 work, the effect of sand particles and color, and dredging need to be addressed. Please note that the FWS has jurisdiction over sea turtles when they nest on the beach, while the National Marine Fisheries Service has jurisdiction when sea turtles are at sea."

Response: *The SDEIS, SSDEIS, and FEIS include a commitment to a watch program for nesting sea turtles in the "Project Commitments" section. This comment focuses on the impacts of beach nourishment. None of the alternatives involving beach nourishment was selected as the Preferred Alternative.*

Comment: "On page 4-74 the Department disagrees with the statement: 'No habitat for the manatee occurs within the project area…' This needs to be readdressed since manatees periodically appear near the project area."

Response: *This statement is revised in Section 4.7.9 of the FEIS.*

Comment: "In general, the SDEIS fails to address potential environmental impacts to federally listed species as a result of maintenance, dune reconstruction, sand fencing, sprigging, removing sand and water, closing a newly formed inlet, or repairing a breach in NC 12 should the Parallel Bridge Corridor Nourishment Alternative be chosen."

Response: *The Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "Page 5-1 5 lists the peregrine falcon (*Falco peregrinus*) in a list of federally endangered and threatened species. The peregrine falcon is no longer federally listed."

Response: *This change is reflected in the SSDEIS and FEIS in Section 3.3.*

Comment: "Page xii of the SDEIS states: '…would likely result in the Refuge providing some form of alternative access to the Refuge rather than the paved road desired by Dare County officials and their constituents.' The sentence should read '…Dare County officials and some of their constituents.'"

> **Response:** *This statement was revised in the SSDEIS, and the revision is included in the FEIS.*

Comment: "Pages xix, 4-39 and 4-90 state that the Parallel Bridge Corridor with Road North/Bridge South Alternative would generally support the Refuge's and Cape Hatteras National Seashore's (Seashore) policy to not stabilize the Outer Banks artificially. This statement is misleading because the information presented suggests extensive stabilizing features but does not include protective features such as groins or revetments that would most likely be required to maintain the road/bridge system. It is stated 'Exceptions would be the three dunes that would eventually be built and any breach closure that may be needed to maintain the transportation corridor within the Refuge.' These exceptions are so significant that they preclude this alternative from supporting Refuge and Seashore policy."

> **Response:** *Other than the existing terminal groin, protective features such as groins or revetments would not be required with this alternative given its location west of the forecast 2060 high erosion shoreline. If the Road North/Bridge South Alternative had been selected as the Preferred Alternative, changes to the alignment to eliminate the need for dunes could have been investigated.*

Comment: "The discussion on page 2-2, Section 2.1 of the 'No-Action Alternative' relates to Section 4.5.3.1 and the unsupported conclusion that the ability of visitors to reach the Refuge recreational resources will be adversely affected. This is a 'negative' presented in the document without a discussion of the positive aspects. As an addendum to the 'No- Action Alternative,' the Department recommends exploring the idea of an adequately planned ferry system. This could enhance a visitation experience to the Refuge even though that access may be different than historic access."

> **Response:** *The feasibility of the Oregon Inlet Bridge to be replaced by a ferry service as the sole means of access to Hatteras Island from Bodie Island is discussed in Section 2.2 of the SDEIS, SSDEIS, and FEIS. The cost and impact of a ferry service to the north end of Hatteras Island for recreational access is discussed in Section 2.5.3 of the SDEIS, SSDEIS, and FEIS. Neither was found to be a reasonable alternative.*

Comment: "Pages 2-15 and 2-116 refer to the fact that in order for NCDOT to construct a bridge or perform associated NC 12 maintenance or beach stabilization within the Refuge that is outside of its permitted easement, the Refuge Manager must find that the new bridge is compatible with the purpose of the Refuge stated in the 1938 Executive Order creating the Refuge and mission of the National Wildlife Refuge System found in the National Wildlife Refuge System Improvement Act of 1997. The Department does not necessarily agree that the Refuge Manager must do so. The compatibility issue will be dealt with under separate cover by the Refuge Manager."

> **Response:** *Position acknowledged. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is allowed by its NC 12 easement agreement, and a compatibility determination is not required. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement.*

Comment: "Page 2-74 states: 'Two primary risks were identified: potential for a storm-caused breach in the Refuge and faster than expected erosion of nourished beaches.' The Department believes that these are very real and significant risks with a high potential to occur. The SDEIS appears to assume that law, regulation and policy will allow breach closure on the Refuge now and for the life of the project. New information regarding requirements for federally listed species, current policy/new legal requirements may affect what is found to be compatible over the next 50 years."

> **Response:** *Position acknowledged.*

Comment: "Page 2-76 states: 'It is assumed that if it were decided that maintaining paved road access the full length of the Refuge is necessary, a Parallel Bridge Corridor with NC 12 Maintenance alternative likely would be selected for implementation and not the Pamlico Sound Bridge Corridor.' This statement seems out of place within a description of the Pamlico Sound Bridge Corridor, and seems to be an overemphasis since the NEPA/404 Merger Team has not specifically stated that a paved road access through the Refuge is essential, and it is not part of the project purpose. While some may assume paved road access is essential, it should not be assumed that the Refuge considers the paved road as an essential feature. It is important to understand that the highway is not necessary for the Refuge to exist and fulfill its mission and purpose. The over emphasis on access to the Refuge on pages 2-76 and 2-78, tends to discount adaptability to new access. Negative aspects of future access are presented without presenting positive aspects about different means of access to the Refuge. The text overlooks the fact that those who do not return to visit the Refuge because of changes in access may be replaced by those who prefer the new means of access, relative isolation, and improved scenery and wildlife viewing opportunities afforded by the Pamlico Sound Bridge Corridor alternatives."

> **Response:** *This statement was made in response to comments from the public that if NCDOT built the Pamlico Sound Bridge Corridor, they also would have the expense of maintaining NC 12 in the Refuge. This statement was made to point out that such a position was not valid in light of NCDOT's understanding that the Refuge does not consider a paved road in the Refuge essential. The final statement of the comment assumes that the Refuge would be willing and able to provide a means access to the Refuge that would readily serve the same number of visitors that the Refuge serves currently. The options noted by the Refuge to date and reflected in the FEIS do not indicate such a capability.*

Comment: "Page 2-78, Section 2.7 states: 'If a storm-caused breach were to occur at the southern end of the Refuge, it would need to be closed or ferry service implemented to get visitors and their vehicles to and from the Refuge.' The NPS questions whether a storm-caused breach at the southern end, or any location within, the Refuge would necessarily need to be closed to get visitors and their vehicles to and from the Refuge if the Pamlico Sound Bridge Corridor alternative is implemented. Artificially filling or closing the storm-caused breach would not be consistent with the management goals or policies of the Refuge or NPS which are oriented toward allowing the natural processes of the barrier island system to operate. The breach area would potentially provide excellent habitat for foraging and perhaps nesting birds such as the Piping Plover. And closing the breach in this case would not be necessary to maintain the transportation corridor (NC 12) between Hatteras Island and the mainland for residents or visitors. The decision to artificially close a breach or to allow the breach to close naturally, and/or to implement ferry service to provide access to the Refuge should be made based on the individual characteristics of the breach, should one occur."

Response: T*he Pamlico Sound Bridge Corridor terminates south of the Refuge. If a breach occurred at the southern end of the Refuge, the only way to reach the Refuge would be by water if the breach is not closed. A ferry would be a public means of conveying Refuge visitors across the breach to the Refuge. The FHWA and NCDOT agree that "the decision to artificially close a breach or to allow the breach to close naturally, and/or to implement ferry service to provide access to the Refuge should be made based on the individual characteristics of the breach, should one occur."*

Comment: "Pages 2-78 and 2-112 state: 'If a storm-caused breach were to occur at the southern end of the Refuge, it would need to be closed or ferry service implemented to get visitors and their vehicles to and from the Refuge.' This statement presupposes that vehicular traffic is required or allowed on the Refuge. Other access options may include pedestrian traffic. A critical point to understand is that Refuge property does not carry deed encumbrances for a public transportation corridor as does NPS property. It is likely that a legal determination would be required from the Department as to which laws, regulations and policies would apply and how to comply with them when dealing with an inlet closure."

Response: *The statement assumes only that walking or swimming across the breach would not be an option for all potential users of the Refuge.*

Comment: "Page 2-83 states that the Pamlico Sound Bridge could accommodate utility lines on the proposed bridge. Although the Parallel Bridge could also accommodate utility lines, there is a significant environmental benefit to the Pamlico Sound Bridge accommodating utility lines because of reduced disturbance within the Refuge from utility line placement, utility poles, etc."

Response: *The impact of utility pole disturbance was included in the SSDEIS in Section 4.12.7 and is in Section 4.12.5.7 of the FEIS.*

Comment: "Page 2-116 addresses permits and the compatibility determination required by the FWS. Right-of-way permits would need to be reviewed for compatibility if the alternative chosen proposes a new use, an expanded use, a renewed use or an extended existing use. The terminal groin was authorized by a 'Permit' from the FWS. The permit is not characterized as a Special Use Permit or Right-of-Way Permit/Easement. We, therefore, request that the term 'Special Use' be deleted."

Response: *This change was made in the FEIS.*

Comment: "Page 4-38 provides insufficient information regarding the full extent of project impacts. It is not clear how the acreages presented for each alternative were derived. To fully analyze impacts, acreage figures should include the current right-of-way, new right-of-way, and the area between the rights-of-way for a complete analysis of impacts to wildlife resources on the Refuge."

Response: *The numbers include the area of new right-of-way or easement. There would be no project impact between the current easement and the new easement.*

Comment: "Pages 4-43 and 4-44 refer to sand availability for closing a breach of NC 12 within the Refuge. No discussion is given on whether the ocean bar source is biologically suitable for nesting sea turtles and invertebrates found in the swash zone and beach face."

Response: *Neither of the two alternatives that utilize beach nourishment was selected as the Preferred Alternative. If one had been selected as the Preferred Alternative, NCDOT would have provided additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.6.3.4 of the FEIS pertaining to available and suitable sand sources.*

Comment: "Page 4-68 refers to disturbances to feeding and resting wintering waterfowl in Pamlico Sound. Please provide species and numbers of wintering waterfowl using this part of Pamlico Sound. Impacts to other migratory birds should not be overlooked as the purpose for establishing the Refuge was to provide habitat (refuge and breeding grounds) for migratory birds and other wildlife, not just waterfowl."

Response: *This is done in Section 3.7.6.6 of the SDEIS and the FEIS.*

Comment: "Pages 4-68 and 5-31 discuss potential impacts of the Parallel Bridge Corridor Road North/Bridge South and All Bridge alternatives to feeding and resting water birds within the ponds of the Refuge from construction activities and long term mortality from road kill. However, nothing is said about the long-term impacts from disturbances caused by constant traffic noises or the effects of the road and road maintenance on habitat quality. Bird species more sensitive to noise impacts could be displaced by an adjacent road. The increased mortality of birds, the loss of habitat such as submerged aquatic vegetation and loss of bird use of the ponds might continue to affect the ability of the Refuge to fulfill its purpose."

Response: *Additional material on noise impacts is included in Section 4.7.6.6 of the FEIS.*

Comment: "Pages 4-78 through 4-84 discuss several compensatory mitigation options. It should be noted that some of the compensatory mitigation measures described are not likely to be possible on the Refuge due to the position on the landscape. Impacts on Refuge resources will have to be mitigated on or immediately adjacent to the Refuge. Also, it should be clearly understood that mitigation cannot be used to make an otherwise incompatible proposed use compatible with the mission and purpose directives."

Response: *Position understood.*

Comment: "Pages viii and ix of the SDEIS state 'Ocean overwash is expected to continue to be a regular and increasing problem over the life of a replacement bridge.' The Department notes that a Pamlico Sound Bridge would not be affected by ocean overwash."

Response: *This is expected to be a regular and increasing problem if nothing is done. The Pamlico Sound Bridge Corridor is only one alternative that would not be affected by ocean overwash.*

Comment: "Pages xii and 4-19 state that replacing the Bonner Bridge with a 17.5-mile long bridge would increase vehicle travel distance from Rodanthe to the mainland by 2 miles and increase travel time by 2 minutes. While this may be valid, it seems to provide a more reliable travel route should NC 12 be covered by wind-blown sand, overwashed, flooded or breached by a storm north of Rodanthe. Two minutes may be a small price to pay to ensure reliable transportation. If the discussion remains in the document as presented, it seems reasonable to include a reference to the amount of time people currently spend waiting for sand and water to be removed from the highway on a frequent basis."

> **Response:** *All of the detailed study alternatives would address the problem of "the amount of time people currently spend waiting for sand and water to be removed from the highway on a frequent basis."*

Comment: "Page 2-2, section 2.1 presents a confusing description of the 'No-Action Alternative.' The alternative as described cites ferry service to a resident population capable of transporting 400 to 450 vehicles per day during the summer. In contrast, a 'between island' ferry system provides transportation for up to 3,500 vehicles per day during the summer. This is mixing resident and tourist transportation data, and it makes no sense to then propose a 'resident ferry system' capable of transporting 400 to 450 vehicles per day when the need during summer could exceed 3,500 vehicles per day for the only land-based access to the barrier islands on the northern end."

> **Response:** T*he commenter is correct that such a proposal makes no sense, which is one reason why the No-Action Alternative is not a reasonable alternative. Typically, the No-Action Alternative is a "Do-Nothing Alternative," which in this case would mean Bonner Bridge would be removed and no access would be provided to Hatteras Island. NCDOT is obligated to provide at least minimal access, thus the addition of a minimal ferry service to the No-Action Alternative. The feasibility of a full ferry alternative is examined in Section 2.2 of the SDEIS and FEIS.*

Comment: "Page 2-60 refers to coastal modeling and assumes that the terminal groin will remain in place through 2060. What happens if the terminal groin does not remain in place through 2060?"

> **Response:** *This situation is described in Section 3.6.2.3 of the SDEIS and Section 3.6.3.5 of the FEIS.*

Comment: "Page 2-86 refers to a service road for the Curved Rodanthe Terminus alternative. What are the wetlands and biotic community impacts of this service road, and are they included in the overall impacts for the alternative?"

> **Response:** *They are included in the overall impacts of the alternative.*

Comment: "Pages 2-99 and 2-100 refer to a temporary detour road for the Parallel Bridge Corridor Nourishment Alternative. The Refuge compatibility issue described earlier will apply even with a temporary detour road, as permits will be required from the Refuge. The SDElS gives insufficient information regarding the temporary detour road to fully evaluate impacts."

> **Response:** *The impacts are discussed in Chapter 4 of the SDEIS and FEIS. Chapter 2 only describes the design characteristics of the alternatives.*

Comment: "Page 2-101 states: 'The four practical methods are described as follows: This statement contradicts the preceding sentence that states '… a work bridge and top-down construction are not practical.'"

> **Response:** *All four methods are practical in some situations and not in others.*

Comment: "Page 3-7, Section 3.1.3.3, the National Park Service Plan, first paragraph: In the discussion of the NPS's Management Policies (NPS, 2001), suggest stating that the NPS Management Policies are presently undergoing review and revision. A new draft NPS Management Policies was placed in the Federal Register in October 2005 for a 90-day public review and comment period."

> **Response:** *Section 3.1.3.3 is updated for the National Park Service in the FEIS.*

Comment: "Page 3-43 refers to an environmental impact study for groin removal. The permit for the terminal groin was issued for the expressed purpose of protecting the southern terminus of the Herbert C. Bonner Bridge. One of the conditions of the permit requires removal of the terminal groin when the purpose is no longer being served. Consequently, studies are not needed for removal of the groin as there is a legally binding agreement signed by involved parties for this action. The presumption is that environmental consequences have been considered in preparation of the permit to allow the groin. However, if a proposal to leave the groin in place after the existing bridge is no longer functional should be presented, the NEPA documentation for the ensuing permit modification(s) and Compatibility Determination would be required."

> **Response:** *The environmental consequences of removing the groin were not addressed in the NEPA documentation for the groin. If USFWS officials ask the NCDOT to remove the groin following completion of the demolition and removal of Bonner Bridge, the NCDOT and representatives of the USFWS would assess the impacts of groin removal in a separate environmental study, as needed, prior to any final decision to remove the terminal groin.*

Comment: "Page 4-37 refers to land currently occupied by Bonner Bridge being reverted back to the Seashore. How much land would be reverted back?"

> **Response:** *The area reverted back to the Seashore on Bodie Island would be 6.3 acres (2.6 hectares).*

Comment: "The SDEIS does not adequately address the issues as to how the proposed construction of either bridge will effect those concessions with gross sales in excess of $3,000,000.00 annually and which includes the operation of a fleet of 49 Charter Boats, a Head Boat as well as other visitor amenities including restrooms, a boat refueling dock, a travel trailer pumping-out station, five public boat launch ramps, 60 boat trailer parking spaces and 60 automobile parking spaces, all receiving heavy use in the summer months and on all Holidays."

> **Response:** *This concern relates to the affect of the project on the Oregon Inlet Fishing Center and Marina. A discussion of this concern is included in Section 4.1.5 of the FEIS.*

Comment: "Section 4(f) of the Department of Transportation Act of 1966, as amended (49 U.S.C. 303), states that the U.S. Department of Transportation may not approve the use of land from a significant publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site unless a determination is made that: there is no feasible and prudent alternative to the use of land from the property; and the action includes all possible planning to minimize harm to the property resulting from such use. The information presented still clearly demonstrates that implementation of any of the Parallel Bridge Corridor alternatives would violate Section 4(f), because the Pamlico Sound alternatives are clearly feasible and prudent and would minimize harm to the Refuge (a Section 4(f) property)."

> **Response:** *Position noted. The Phased Approach/Rodanthe Bridge Alternative (Preferred), which was presented in the SSDEIS that was released after the receipt of this letter, is also a Section 4(f) resource avoidance alternative for the Refuge because it would remain within the existing NC 12 easement through the Refuge. FHWA has determined no constructive use of the Refuge would occur. All of the detailed study alternatives, including the Pamlico Sound Bridge Corridor alternatives, would use land from the Cape Hatteras National Seashore on Bodie Island.*

Comment: "Statements in Section 5.4 are difficult to follow. The conclusions seem to be based upon recreational access and dredging channels with some portions not being Section 4(f) property. There should be a statement to the effect that the ferry system would significantly minimize harm to the Refuge."

> **Response:** *A ferry service that would bypass the Refuge would minimize harm to the Refuge. The ferry facilities required in the Cape Hatteras National Seashore on the Bodie Island side of Oregon Inlet would increase harm to the Seashore, another Section 4(f) resource. See Section 2.2.6.*

Comment: "Page 5-41 refers to harm versus use questions being dependent upon preferences of the officials responsible for the Seashore and the Refuge. It should be acknowledged that for the Refuge Manager, these 'preferences' are mandated by law, regulation and policy. The Refuge Manager must use a best professional judgment approach based upon available science in the absence of any new compelling data when confronted with compatibility decisions."

> **Response:** *Position acknowledged.*

Comment: "Page 5-41 of the Draft Section 4(f) Evaluation states that 'From the Bodie Island perspective there are no substantive differences that would result in the conclusion that one alternative corridor minimized harm better than the other.' and in comparing the Parallel Bridge Corridor with the Pamlico Sound Bridge Corridor, that '…it could be concluded that either alternative minimizes harm, or it could be concluded that while different in type of harm, they are equal in the degree of harm.' The Department does not agree with this statement. The Draft Section 4(f) Evaluation has determined that there will be Section 4(f) effects on the Oregon Inlet Coast Guard Station and on the Refuge from reduced or altered access of visitors if the Pamlico Sound Bridge Corridor is selected. We do not believe that these effects (from reduced or altered access) are on the same level as the Parallel Bridge Corridor's 20.05 to 62.71 acres (Table 5-9) of direct physical impacts to the biotic communities of the Refuge. Nor does it consider the adverse effects to the Refuge resulting from 50 more years of intensive dune construction and/or beach stabilization associated with the Parallel Bridge Corridor alternatives. In general, it appears that the Draft Section 4(f) Evaluation attempts to put all alternatives on equal footing as to the level of Section 4(f) impacts. We do not believe this is the case. In addition, the evaluation does not adequately address the fact that the Pamlico Sound Bridge Corridor would produce beneficial effects to the Refuge in that many acres of Refuge land would be restored to its intended purpose. There are references throughout the document (beginning on page xiii) acknowledging that there will be a 'substantial intrusion into the landscape of the refuge.' This is an accurate assessment whether referencing visual impacts or fish and wildlife habitat impacts. It is not possible to continue to dissect a National Wildlife Refuge with road relocation and bridge construction projects without fragmentation of Refuge wildlife habitat, which is a direct threat to the ecological integrity of this Refuge's barrier island ecosystem, and the very purpose for the Refuge's existence."

> **Response:** *Position acknowledged. The statement referenced acknowledges the differing positions on the importance of road access expressed by the full range of stakeholders in the project area, including the public and local government officials. The statement is no longer contained in the Section 4(f) evaluation. See the current least harm analysis presented in Section 5.4.*

Comment: "Though all alternatives have some form of Section 4(f) impact, we believe the Parallel Bridge Corridor alternatives have far greater impacts in quantity and quality on lands protected by Section 4(f). Based upon Section 4(f) directives, we believe that park and refuge lands should not be used whenever there are feasible and prudent alternatives that would avoid or minimize harm to those lands. The NCDOT has clearly demonstrated that the Pamlico Sound Bridge Corridor alternatives present feasible alternatives from an engineering standpoint. This reduces the analysis to the question of prudence, which seems to be an issue of cost and visitor access. We believe that the Pamlico Sound Bridge Corridor is prudent. Access to the refuge for recreational purposes will continue regardless of alternative selected.

The Department believes that this Draft Section 4(f) Evaluation needs to be revised with particular attention being paid to the Pamlico Sound Bridge Corridor, which we believe has been demonstrated to be feasible and prudent with minimal adverse impacts, and likely positive effects to Refuge lands."

> **Response:** *Positions noted. The Phased Approach/Rodanthe Bridge Alternative (Preferred), which was presented in the SSDEIS that was released after the receipt of this letter, is also a Section 4(f) resource avoidance alternative for the Refuge because it would remain within the existing NC 12 easement through the Refuge and has been determined by FHWA not to have a constructive use of the Refuge. The Pamlico Sound Bridge Corridor is not practicable based on cost estimates and funding availability. See Section 2.15 for the reasons for selection of the Phased Approach/Rodanthe Bridge Alternative as the Preferred Alternative.*

Comment: "We believe the Pamlico Sound Bridge Corridor, overall, has substantially fewer environmental impacts. The Pamlico Sound Bridge Corridor does not physically affect the Refuge. Either of the two alternatives for the Pamlico Sound Bridge Corridor is less expensive than two of the three Parallel Bridge Corridor alternatives. The Department continues to support the Pamlico Sound Bridge Corridor and is looking forward to engaging in discussions of the two alternatives within the corridor."

> **Response:** *Position acknowledged. It also is acknowledged that the addition of the Phased Approach alternatives (including the Preferred Alternative) in the SSDEIS did not change this position.*

<u>*United States Department of the Interior-April 27, 2007 (page A-20)*</u>

(This letter includes the comments from the National Park Service, the US Fish and Wildlife Service, and the Pea Island National Wildlife Refuge.)

Comment: "There are several references to project being analyzed by the Outer Banks Task Force (OBTF) throughout the SDEIS. Because of the emphasis placed on the OBTF, the SDEIS should describe the OBTF and explain the role of that organization in the overall planning process. The goals outlined in the OBTF Memorandum of Understanding (MOU) should be presented, and each alternative, including mix and match options, should be placed into the context of level of contribution towards achieving those goals. It is acknowledged that the MOU was last renewed in 1999 and expired in 2004, but the fact that it established guiding principles for the OBTF should be clearly stated."

> **Response:** *The OBTF and its role are described in Section 2.2.5 of the SDEIS and Section 2.3 of this FEIS. The Phased Approach/Rodanthe Bridge Alternative (Preferred) will serve as a long-term approach for maintaining NC 12 between Oregon Inlet and Rodanthe, supporting the goals of the OBTF.*

Comment: "There are several references to the Constructability Workshop held on August 29-31, 2006, with regards to the Phased Approach alternatives throughout the SDEIS. The purpose of the workshop was to assess the feasibility of constructing the various bridges, and other structures within the existing right-of-way. We note that while the workshop addressed the feasibility of constructing the Phased Approach bridges, it is unclear whether or not it addressed the practicability of such construction. It is clear from the long history of maintenance activities on NC 12 that even relatively simple maintenance of the existing highway cannot be done within the existing right-of-way, much less construction of bridges, temporary roads, shoulders and ditches within that same right-of-way width. We recommend that the feasibility of constructing the various bridges, roads and other structures within the existing right-of-way, as well as maintenance of the highway, be discussed in greater detail."

> **Response:** *It was determined through bridge engineering and construction engineering evaluations that the Phased Approach (including the Preferred Alternative) is technically feasible. Technical feasibility means that design and construction of the Phased Approach physically can be performed under the constraints prescribed. Conventional construction techniques are available for heavy/highway contractors to use to build these bridges while maintaining traffic, remaining inside of the existing right-of-way, and not substantially affecting areas of SAV or wetlands, etc. The project constraints present unique complexities to the construction of the project. However, it is known that these complexities can be effectively addressed. Further explanation of construction techniques is provided in Section 2.10.2.4.*

Comment: "Page xix [of the SSDEIS] states "The potential also exists for a deep breach near the terminal groin, resulting in part from soundside erosion. It would likely need to be closed with a bridge, such as included in the two Phased Approach alternatives and the All Bridge Alternative." We note that either of the Pamlico Sound alternatives would avoid this problem altogether. Therefore, we recommend that the text be modified to reflect this point."

> **Response:** *A statement saying that the Pamlico Sound Bridge Corridor would bypass potential breach locations between Oregon Inlet and Rodanthe was added to the summary section of this FEIS.*

Comment: "Page xxiii [of the SSDEIS] states "The Phased Approach alternatives would necessitate the implementation of short-term NC 12 maintenance actions in the Canal Zone and Rodanthe 'S' Curve…hot spots (with associated impacts) that are being planned in the context of studies by the Outer Banks Task Force." The Department is very concerned that these short-term, interim measures to stabilize NC 12 could be used as justification to return to the status quo of repeatedly reacting to storm damage to NC 12 once Phase I is completed. Since the Phased Approach alternatives would be built in four phases over several years, we are concerned that after the Oregon Inlet Bridge is constructed (Phase I), the decision could be made to not proceed with Phases II, III and IV. The following statements on page 2-4 appear to be a tacit admission of such: “Although the Phased Approach alternatives are described and addressed in this Supplement as a phased alternative with specific locations and lengths for the phases…these details could be adjusted based on funding availability and the changing conditions within the project area…implementation of any individual phase could be accelerated or delayed.” Due to the high costs of this project, the Department is concerned that the Phased Approach could be used to only build the Oregon Inlet Bridge and then return to the status quo of repairing NC 12 after storms and artificially maintaining the protective dune system in the Pea Island National Wildlife Refuge. This would continue to prevent natural barrier island processes from occurring, and thus adversely affect the Refuge and the fish and wildlife resources that utilize the Refuge throughout the 28-year construction timeframe.”

> **Response:** *The intent of the statement referenced was to acknowledge the existence of the short-term NC 12 relocation studies (NCDOT TIP Project Nos. R-3116D, E/F) and that their outcome could affect the location of the NC 12 easement prior to the implementation of later phases, particularly in Rodanthe. The purpose of the short-term studies, in which Department of the Interior representatives participate as members of the merger team, is to identify short-term solutions to NC 12 maintenance. The intended purpose is not to substitute short-term solutions for long-term solutions, such as the proposed action. It should be noted that since the selection of the Preferred Alternative, planning work on these short-term studies has been suspended and none of the projects are listed in the 2009-2015 TIP.*
>
> *Additional discussion of NCDOT’s intent related to the timing of the implementation of Phases II to IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred), particularly as it relates to changing coastal conditions, is included in Section 2.10.2.5 of the FEIS. Maintaining the status quo is not FHWA’s or NCDOT’s intent.*

Comment: “We recommend that clarifying text be added to sections 7 and 9 on pages xxiv and xxv [of the SSDEIS]. The terms and conditions of the right-of-way easement specify, to a certain extent, what can and cannot be done within that right-of-way. The current easement for NC 12 grants authority to NCDOT for the specific purpose of constructing, operating and maintaining a public road through the Refuge and facilities, including parking for a ferry landing to be used in conjunction with the public road. The existing easement does not grant NCDOT the authority to any uses not described above. Consequently, replacing a road with a bridge may not be considered a minor modification to the right-of-way, even though all work may be entirely within the existing easement boundaries, and a determination must be conducted before a decision is made. If it is determined that the modification is not minor, an amendment to the easement will be required and that process will invoke Compatibility Determination requirements under the National Wildlife Refuge System Improvement Act of 1997 and its implementing regulations (50 CFR 26.41). In the Phased Approach alternatives, where it addresses construction, operation, and maintenance of NC 12 with the Refuge, we believe the proposed uses may not receive a favorable compatibility determination. We note that these concerns do not exist with the Pamlico Sound Corridor alternatives. Therefore, we recommend that the text be modified to reflect this requirement and potential outcome.”

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is allowed by its NC 12 easement agreement, and a compatibility determination is not required.*

Comment: “It is stated throughout the SDEIS that the Phased Approach alternatives would be confined to the existing NC 12 easement within the Refuge. However, page 2-10 states “…by the time a Phased Approach Alternative is designed and built, it is possible that NC 12 will be in an easement different from where it is today." These are seemingly contradictory statements. Furthermore, page 2-10 states "Since the future location of such relocation is unknown, this design and assessment of the Phased Approach alternatives assumes its bridges are built within the existing easement and that the impacts would be similar in either case." There seems to be a presumption that other NEPA documents prepared for maintenance activities and hot spot "solutions" will satisfactorily address concerns and impacts. If the intent is to relocate the existing NC 12 right-of-way on an "as needed" basis, then additional, direct, indirect and cumulative analysis of the impacts is necessary."

> **Response:** *The intent of the statement referenced was to acknowledge the existence of the short-term NC 12 relocation studies (NCDOT TIP Project Nos. R-3116D, E/F) and that their outcome could affect the location of the NC 12 easement prior to the implementation of later phases, particularly in Rodanthe. It should be noted that since the selection of the Preferred Alternative, planning work on these short-term studies has been suspended, and none of these projects are listed in the 2009-2015 TIP.*
>
> *Additional discussion of NCDOT's intent related to the timing of the implementation of Phases II to IV of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is included in Section 2.10.2.5 of the FEIS. Maintaining it on an "as needed" basis is not FHWA's or NCDOT's intent.*

Comment: "The discussion section 2.3.1.4 on page 2-20 regarding potential cost sharing for beach nourishment assumes that dredged sand is biologically suitable (e.g. for sea turtle nesting). This may not be a scientifically supported assumption. Sand that is not comparable to native beach sand with regards to physical and chemical properties, including grain size and color, cannot be placed on the Refuge beach. Allowing sand on the beach that is not suitable would be disruptive to the ecological processes in the beach face ecosystem, would degrade nesting habitat for sea turtles, and negatively impact beach invertebrates serving as a prey base for numerous migratory bird species. This is a critical point and we believe that it should be discussed in detail."

> **Response:** *The need for beach nourishment sand to be biologically suitable, whatever its source, is acknowledged in Section 2.8.2.1 of the SDEIS and Section 2.10.2.1of the FEIS. The Phased Approach/Rodanthe Bridge Alternative (Preferred) does not include beach nourishment.*

Comment: "The discussion in section 2.3.1.4 on page 2-20 seems to assume that the Corps of Engineers has, and will continue to have, funding for pipeline dredging on an annual basis. This has not been the case in the past. Also, the sand from certain areas of the Oregon Inlet navigation channel may not be suitable for placement on the Refuge beach. This is due to difference in hydraulic sorting that occurs in different segments of the inlet. The DOI's Fish and Wildlife Service has 12 years of trend analysis data which demonstrate impacts to invertebrates in the beach face. The invertebrate population declines after large sand disposal projects. Time, quantity, and spacing patterns of sand placement will affect the level of impacts to the invertebrates. Any sand placement on Refuge land should be fully coordinated with the DOI to avoid adverse impacts to our trust resources. We also recommend text be added that acknowledges Corps of Engineers' funding uncertainties and sand suitability analysis that needs to occur."

> **Response:** *This section noted a potential opportunity and not a firm intent. As stated, the use of sand from ocean bar dredging was assumed and not sand from dredging within*

the inlet. It was assumed that if sand dredged from the ocean bar were not biologically compatible, then it would not be used with the nourishment alternatives. Cost sharing arrangements could have made it more feasible for the USCOE to continue dredging on an annual basis. It was not assumed, however, that under such an arrangement that all of the sand used in nourishment would come from that single source. The Phased Approach/Rodanthe Bridge Alternative (Preferred), however, does not include a nourishment component.

Comment: "The first paragraph on page 4-4 suggests that there is some confusion with the Pea Island National Wildlife Refuge Comprehensive Conservation Plan (CCP) and a Compatibility Determination. These two documents do not have the same purpose. The CCP provides guidance for Refuge management over the next 15 years to aid the Refuge in accomplishing the mission of the National Wildlife Refuge System and for achieving the purpose for which the Refuge was established. When conducting a Compatibility Determination for a proposed use, the CCP is used as a reference document and for guidance to determine whether that use will materially interfere with or detract from the mission and purpose directives. Text should be added to make this difference clear to the reader."

Response: *The text is revised in the FEIS in Section 4.1.2.*

Comment: "Page 4-10 states "Like the All Bridge Alternative, the bridge [associated with the Phased Approach Alternatives] would present a stark contrast with the natural character of the Refuge…It would not be characteristic of the undeveloped and protected character of the Refuge that makes it rare along the eastern US seaboard in terms of views and a setting for recreation activities." We strongly agree that such a massive, elevated bridge running through almost 10 miles of the Refuge would adversely affect the character of the Refuge. We note that these concerns are not as pronounced with the Pamlico Sound Corridor alternatives. The text within this section should be modified to reflect this point."

Response: *The Pamlico Sound Bridge Alternative's lack of visual impact on the Refuge is presented in Section 4.3.2 of both the SDEIS and the FEIS.*

Comment: "Section 4.6.3 on pages 4-21 through 4-26 does not fully address the issue of scour around bridge piles. The discussion does not follow through with any meaningful analysis of the ecological impacts of scour. With bridges over land which is gradually transitioning to the ocean environment, the Phased Approach bridge impacts will occur on continuum along and across the beach through time. Impact analysis should not focus on one or two species, but should include impacts to habitat quantity and quality for listed species as well as migratory birds and other wildlife over time. To fully disclose the impacts, additional analysis should be conducted for maintenance and/or repair of bridge piles, to include the potential placement of revetment or other stabilizing structures adjacent to the piles, and their effects on fish and wildlife resources inside and outside the existing easement, as well as those piles currently on land, currently under water, and those that may be under water in the future."

Response: *Since the publication of the SSDEIS, NCDOT has conducted additional coastal research and engineering studies to address these questions. New material addressing both scour and the presence of the Phased Approach/Rodanthe Bridge Alternative (Preferred) over time is included in Section 4.6.8 of this FEIS. New material addressing design criteria for establishing pile lengths so new revetments and stabilizing structures would not be expected is included in Section 2.10.1.2 of this FEIS.*

Comment: "Section 4.7.5 on page 4-34 [of the SSDEIS] states "The two Phased Approach alternatives would have no direct impact on Refuge lands since they would be within the existing NC 12 easement," We disagree with this statement. The Phased Approach/Rodanthe Nourishment alternative would directly affect 1,500 feet of Refuge beach outside the existing NC 12 easement. Construction noise and the presence of construction equipment will directly affect wildlife on Refuge lands immediately outside the existing easement. Section 4.7.5 also does not discuss impacts associated with potential road relocations and other maintenance activities during the time leading up to each successive phase of construction. The existing text should be modified to acknowledge these effects."

> **Response:** *A discussion of the maintenance activities leading up to each phase is included in Sections 4.6.8.6 and 4.7.8 of the FEIS.*

Comment: "From the information on pages 4-35 and 4-36 [of the SSDEIS], it can be determined that all four phases would require at least 13 years of actual construction during a 28-year timeframe. This amounts to a near-perpetual construction zone within the Refuge for 28 years. Section 4.7.6.5 does not adequately address the effects of this construction disturbance to shorebirds, waterfowl and other migratory birds. Also, the section does not adequately address the permanent effects to birds and other species of having a bridge on or near the beach. At some point, as the beach erodes, the bridge will be directly over the beach. Later, the bridge will be in the ocean immediately off-shore from the beach. The SDEIS does not address what the specific effects to the birds would be. We are especially concerned with the effects to the federally threatened piping plover (*Charadrius melodus*). Text should be added to address this issue."

> **Response:** *Additional material related to natural resource impacts of the Phased Approach/Rodanthe Bridge Alternative (Preferred), including changes in those impacts over time as the shoreline erodes, is added to Section 4.7.6 of the FEIS. Additional discussion on the effects on the piping plover is added to Section 4.7.9 of the FEIS and is based on completed formal consultation on threatened and endangered species with the USFWS per the guidelines of Section 7 of the Endangered Species Act. The USFWS Biological and Conference Opinions (USFWS, 2008) document is presented in Appendix E.*

Comment: "Page 4-37 states "However, shoreline erosion could create Piping Plover habitat under the bridges as the shoreline erodes." This is a questionable statement since it is uncertain that piping plovers would utilize otherwise suitable habitat under a bridge. The text should be modified to reflect this point."

> **Response:** *This statement has been clarified in Section 4.7.9 of the FEIS.*

Comment: "The discussion on green sea turtles (*Chelonia mydas*) on page 4-38 mentions nighttime lighting, but does not describe the effects, The discussion on loggerhead sea turtles (*Caretta caretta*) on pages 4-38 and 4-39 does not mention nighttime lighting or its effects. We recommended appropriate text be added to analyze the effects of nighttime lighting to these two species."

> **Response:** *Additional discussion on the effects on sea turtles of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is added to Section 4.7.9 of the FEIS based on formal consultation on threatened and endangered species with the USFWS per the guidelines of Section 7 of the Endangered Species Act. The Biological and Conference Opinions (USFWS, 2008) document of USFWS is presented in Appendix E.*

Comment: "In the discussion on seabeach amaranth (*Amaranthus pumilus*), page 4-40 states "If the species would be affected, the location containing the species would not be used for dredged material disposal." It is unclear how NCDOT could leave a gap in its beach nourishment without compromising the structural integrity of the rest of the beach fill. Clarifying text should be added to address this point."

> **Response:** *This statement refers to the disposal of construction dredging material and not nourishment associated the nourishment alternatives. Note that the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) does not include beach nourishment.*

Comment: "The last sentence on page 4-40 implies that displaced wildlife can move to adjacent habitat with little impact. Movement and assimilations into surrounding habitat depends upon many factors such as species impacted, population density within the impacted area as well as adjacent habitat, and the quantity and quality (or suitability) of the adjacent habitat. It is inappropriate and misleading to discount impacts to wildlife by implying the affected species can simply move to adjacent habitat. The project area consists of a very narrow strand of barrier island and habitat availability is very limited, making it unlikely that wildlife displaced by project-related impacts would be able to easily locate suitable alternative habitat. The text should be modified to address this point."

> **Response:** *Comment acknowledged. This text is revised in Section 4.7.9.1 of the FEIS.*

Comment: "The discussion in section 4.12.2 on page 4-52 [of the SSDEIS] suggests that only the National Park Service and U.S. Fish and Wildlife Service consider ocean overwash desirable, but falls short of presenting an analysis regarding the necessity of ocean overwash for maintaining the barrier island system. Many coastal geologists, coastal engineers and scientists from other disciplines recognize overwash as a renewal process that is critical to maintaining the barrier island system (e.g., Pilkey et al. 1998, pp. 41-48). We believe the text should be modified to address the importance of overwash to coastal ecosystems."

> **Response:** *A discussion of the positive benefits of shoreline movement was added to Section 4.7.7 of this FEIS.*

Comment: "Page 4-53 states "The NCDOT would seek a new permit [for the terminal groin] from the Refuge to protect the new bridge." We continue to emphasize that selecting any Parallel Bridge Corridor alternative, including the Phased Approach Alternatives would not guarantee that a new permit to retain the terminal groin will be issued. The text should be modified to reflect this point."

> **Response:** *NCDOT recognizes that the selection of the Phased Approach/Rodanthe Bridge Alternative (Preferred) does not guarantee that a new permit for the terminal groin would be issued. The requested statement is added to Section 4.12.5.6 of the FEIS.*

Comment: "Section 5.0 beginning on page 5-1 paraphrases the SDEIS but adds little information and analysis with regards to how the Phased Approach affects Section 4(f) resources. We believe the evaluation discounts impacts to these resources by implying that the phased work will occur within the existing right-of-way without full consideration of the direct, indirect and cumulative effects of various mix and match options of implementing the Phased Approach over time. The net effect of the analysis is that it fails to recognize that the Phased Approach is a "status quo" approach to replacing the Bonner Bridge and maintaining NC 12 through the Refuge for as long as there is a sufficient land base for relocating the road. It appears that for 13 years out of 28, the Refuge would be in a near perpetual construction zone. The concern is that the Refuge's purpose of providing habitat for migratory birds and other wildlife could be adversely affected. Over time, the net result is a barrier island national wildlife refuge with severely degraded habitat quantity and quality for migratory birds, listed species and other wildlife. We note that these concerns do not exist with the Pamlico Sound Corridor alternatives. The text within this section should be modified to reflect this point."

> **Response:** *Section 4(f) of the Department of Transportation Act of 1966, as amended, does not apply to the portion of the Phased Approach/Rodanthe Bridge Alternative (Preferred) that passes through the Refuge because it is confined to the existing NC 12 easement and has also been determined not to have a constructive use of the Refuge. Impacts to the Refuge are addressed both in the appropriate sections in Chapter 4 of the FEIS, including additional material related to the issues raised in this comment, and Chapter 5.*

Comment: "Construction staging area will need to be identified for equipment, materials storage and a construction camp. Cape Hatteras National Seashore is willing to cooperate with NCDOT on this issue provided that the staging sites are evaluated for potential impacts as part of the NEPA planning and compliance process."

> **Response:** *NCDOT met with Seashore representatives to discuss potential staging sites. NCDOT has no current plans for a staging area on Bodie Island. If the design-build contractor does decide to pursue a staging area on Bodie Island, it would need to be approved by the NPS prior to the commencement of construction. Coordination with the NPS and obtaining necessary permits would be the responsibility of the contractor (including any mitigation measures stipulated). Any approved staging areas permitted by the NPS would be indicated on construction sequencing plans and submitted to the NCDOT and permitting agencies for review and comment (see Section 2.10.1.3 of the FEIS).*

Comment: "The DOI request that access is not disrupted, to the extent possible, to Oregon Inlet Fishing Center (a National Park Service Concession), the U.S. Coast Guard Station Oregon Inlet, Bodie Island Campground and Ramp 4 off-road vehicle access for Bodie Island Spit."

> **Response:** *Minimal or no disruption of access is anticipated for the Oregon Inlet Fishing Center and the US Coast Guard Station Oregon Inlet. Any need for briefly disrupting or altering access would be coordinated with the Seashore and management of the Oregon Inlet Fishing Center.*

United States Environmental Protection Agency-December 30, 2005 (page A-24)

Comment: "EPA's review of the Supplemental DEIS (SDEIS) has identified adverse environmental impacts for all three of the final PBC alternatives. In particular, EPA is concerned with long- term impacts on water quality and critical resources, as well as the ability of these alternatives to meet the PINWR Management Plan compatibility and Section 7 Endangered Species Act (ESA) requirements. However, EPA defers to FWS, the responsible agency for a final determination of Refuge compatibility and endangered species protection. Additional information is needed regarding specific avoidance and minimization measures to PINWR. Thus, the impacts are of sufficient magnitude and duration that the PBC alternatives are rated EO-2 "Environmental Objections - Insufficient Information". Although the PBC Nourishment alternative would seem to be more acceptable by remaining on the existing roadway alignment, the long term impacts from increased traffic, repetitive beach nourishment and sand dune replenishment and other road maintenance activities would be as detrimental to the natural resources as the new alignment alternatives."

> **Response:** *These positions are acknowledged.*

Comment: "EPA has assigned a rating of EC-2 "Environmental Concerns" to the PSBC alternatives because the 17.5 mile bridge over estuarine waters presents water quality concerns from construction and operation activities, with additional information needed on mitigation of those impacts. EPA's detailed comments on the SDEIS are enclosed with this letter.

The long-term project impacts (i.e., beyond the standard highway planning period) should be fully considered by decision makers because of the unique setting and ongoing challenges of managing the PINWR and its essential habitat for migratory waterfowl. Maintaining a reliable transportation corridor along an ever-changing coastal barrier island is a concern particularly with the vulnerability of the PBC alternatives. After considering all of the issues, a relocation of NC 12 outside of PINWR would achieve long term environmental benefits to the Refuge while providing reliable transportation access between Bodie and Hatteras Islands."

> **Response:** *These positions are acknowledged. EPA's detailed comments are addressed below.*

Comment: "EPA does not have any comments regarding NCDOT's defined purpose and need for the project: (1) to provide a new access to Hatteras Island from the North, (2) provide a viable long term replacement crossing of Oregon Inlet given its extreme natural changes in navigation channel, and (3) provide a facility that will not be endangered by shoreline dynamics long term. These purposes are specific to a project exposed to the storm prone coastline and barrier island dynamics, and should be met to ensure that the best alternative is selected."

> **Response:** *No response is needed.*

Comment: "The SDEIS indicates on Pages 2-16, 2-80 and 2-96 that the PSBC Bridge will have two 8-foot shoulders and the PBC Bridge will have two 6-foot shoulders. It is stated that the 6-foot shoulders would accommodate bicyclists and pedestrians more safely than the existing 2-foot shoulders on Bonner Bridge. While EPA supports multi-modal options for highway projects, there is no explanation in the SDEIS why the 8-foot shoulders are considered for the PSBC Bridge but not for the PBC Bridge. This will affect the costs for the various alternatives developed by NCDOT based upon the typical design for each corridor. From a safety standpoint, it would appear that 8-foot shoulders should also be considered for the PBC bridge alternatives. Cost tables in the SDEIS should be revised to reflect similar bridge designs typical sections for PSBC and PBC."

> **Response:** *Six-foot (1.8-meter) shoulders were used in the 1999 final design for the Oregon Inlet bridge in the Parallel Bridge Corridor. The cost estimates included in Section 2.3 of the SSDEIS and Section 2.12 of the FEIS assumed 8-foot (2.4-meter) shoulder widths for all bridges for the replacement bridge corridor alternatives. The final design for the Phased Approach/Rodanthe Bridge Alternative (Preferred) includes 8-foot (2.4-meter) shoulders for all bridges.*

Comment: "The SDEIS does not stress the importance of all the engineering studies and evaluations performed by NCDOT to develop the PSBC 2003 Alignment Alternatives (Page 2-41). There were efforts by NCDOT and other Merger Team agencies with substantive input from nationally recognized coastal geology experts to develop reasonable PSBC alignments. The reason for developing the PSBC alignments was to provide for an avoidance alternative for potentially severe environmental impacts to the PINWR."

> **Response:** *NCDOT acknowledges the importance of these efforts. They are sufficiently described in Sections 2.3 and 2.4 of the SDEIS and the FEIS.*

Comment: "The SDEIS identifies the challenges associated with the development of a PBC with NC 12 Maintenance on page 2-58. The main challenges are as follows: Coastal Erosion and Breach Formation, Existing NC 12 Easement, Wetlands, Refuge Management Plan and Legal Requirements, Disposition of the Terminal Groin, and Dare County's Desire to Maintain Road Access to the Entire Refuge. The SDEIS states that multiple approaches to long-term NC 12 maintenance were evaluated and that there was coordination with resource and regulatory agency representatives on the three detailed study alternatives for PBC with NC 12 Maintenance. As recently as May 23, 2005, the Merger Team met and was presented seven PBC alternatives and the PSBC alternative for detailed consideration. Appendix B contains Merger Team concurrence Forms. There is no Merger Team concurrence in Appendix B or descriptions of the three detailed study alternatives for PBC with NC 12 Maintenance, EPA concurred on the NCDOT's desire to perform additional environmental analysis on the PBC with NC 12 Maintenance alternative (in addition to PSBC)."

> **Response:** *The concurrence form referenced is that of October 2004 in Appendix B of the SDEIS and Appendix D of the FEIS. Specific alternatives were not listed in the concurrence form. The Merger Team was briefed on the final decision on specific alternatives on May 25, 2005. All Merger Team meetings are described in Sections 8.3 and 8.5 of the SDEIS, Section 8.2 of the SSDEIS, and Sections 8.3, 8.5, and 8.8.1 of this FEIS.*

Comment: "EPA has environmental objections to the NC 12 relocation to the west of the existing NC 12 easement, which includes the PBC with Road North/Bridge South and PBC with All Bridge alternatives. Both of these alternatives have severe and permanent environmental impacts to the PINWR (including compatibility with Refuge management goals, direct negative impacts to threatened and endangered species, severe impacts to wetlands, and to the Refuge as a Section 4(f) historic property). EPA also has environmental objections to the PBC with Nourishment alternative. Even though this alternative does not require any new right of way for NC 12 or the new bridge, it includes significant beach re-nourishment and new dune construction within the Refuge. As shown on Figure 2-9a, the length of beach re-nourishment and new dune construction for the PBC with Nourishment alternative would be 7 to 8 miles along the 15.2 miles of the existing corridor. Nearly all of this proposed construction and shoreline maintenance would occur within the PINWR. EPA has additional and specific comments regarding 'Nourishment' and the PBC with NC 12 Maintenance alternative challenges below."

> **Response:** *These positions are acknowledged. None of the alternatives referenced were selected as the Preferred Alternative.*

Comment: "On page 2-64 of the SDEIS, NCDOT itemizes six additional 'Representative Combination Alternatives for PBC with NC 12 Maintenance alternative segments. Table 2-8 provides a breakdown of cost, sand requirements and wetland "use" for these six additional detailed study alternatives. Wetland impacts for the three 'Relocate Road' alternatives and All Bridge alternative range between 34.3 acres and 81.0 acres. EPA considers bridging wetlands in this coastal environment a permanent adverse environmental impact to natural resources. Shading from bridges and other impacts from human activities (e.g., run-off from roadway deck drains which includes toxic contaminants from dripped motor oil and anti-freeze, brake lining dusts, etc.) alter the function and affect quality and use of those wetlands for wildlife purposes. The full direct, indirect and cumulative impacts from relocating NC 12 within the Refuge are not evaluated sufficiently in the SDEIS with regard to effects to protected species or other wildlife. For the two remaining 'Representative Combination Alternatives' in Table 2-8, including PBC with Nourishment and PBC with Nourishment North/Bridge South, the quantities of sand needed are estimated at 46,633,300 and 18,216,600 cubic yards assuming re-nourishment requirements every four years, average erosion rates, etc. EPA considers all of these PBC 'Representative Combination Alternatives' to be environmentally objectionable and do not provide an avoidance alternative to the Refuge."

> **Response:** *This table was used to assist in the selection of the detailed study alternatives. Impacts of the detailed study alternatives are presented in Chapter 4 of the SDEIS, the SSDEIS, and this FEIS.*

Comment: "The PSBC alternatives with either a Curved Rodanthe Terminus or an Intersection Rodanthe Terminus were developed for a viable, long-term solution to avoid impacts to the Refuge, minimize impacts to Section 4(f) properties, minimize permanent impacts to jurisdictional wetlands, minimize impacts to Submerged Aquatic Vegetation (SAV), and keep the long-term transportation interruptions on NC 12 (for providing goods and services between the mainland and Hatteras Island) to a minimum. EPA would still have environmental concerns with a Pamlico Sound Bridge alternative because of the contaminant runoff from the bridge deck. These water quality concerns can be adequately addressed, however. Providing reliable transportation in such a dynamic coastal barrier island setting is less difficult with the bridge over the Sound than through PINWR on Hatteras Island. The SDEIS has adequately demonstrated that the PSBC alternatives fully meet the requirements defined in the Purpose and Need Statement as the most reliable and environmentally sound solution for the replacement of Bonner Bridge. The useable life of the new bridge and the PBSC relocation of NC 12 could exceed current predictions for the 2060 design year without major rehabilitation or repair. The Project Commitments section indicates that the estimated full life of the bridge to be as much as 100 years."

> **Response:** *These positions are acknowledged. Additional material related to water quality impacts is included in Section 4.7.2 of the FEIS.*

Comment: "Drs. Fisher, Riggs and Overton and others have done detailed and intensive studies on coastal geology and shoreline erosion rates along the northeastern North Carolina coastal system since 2000. The panel of experts identified five potential breach sites (Page 3-38). However, it is not possible for these experts to predict the actual storm event which will potentially cause the breaches. These sites are vulnerable due to underlying geologic conditions, historic inlet formations, magnitude and characteristics of past storm events, stability of Oregon Inlet, etc. And while beach nourishment and new dune construction may reduce the potential for breach formation (Pg. 3-39, Dr. Robert Dean), a single storm event could remove all of the sand to nourished areas. Most of the panel members generally agreed that it may only take one severe storm event to cause another breach in one of the sites they identified. Page 2-74 of the SDEIS identifies the two primary risks: the potential for a storm-caused breach within the Refuge and faster than expected erosion of nourished beaches. There is no statistical analysis regarding the frequency or likelihood of a storm-caused event supporting the vulnerability assumptions. EPA fully agrees with the panel's breach and 'normal' erosion rate vulnerability analyses."

> **Response:** *No response is needed.*

Comment: "What is not emphasized in the SDEIS regarding breach formation or in 'normal coastal erosion models' is the potential break in NC 12, traffic disruptions for indefinite periods, safety issues for persons needing to obtain emergency services and medical care following a severe storm event, and the potential cost in millions for local and regional businesses while repairs to NC 12 are being made. Such events would impact tourist use, reliance of the permanent Hatteras Island population on mainland goods and services, emergency evacuation requirements if there was another pending storm before repairs were completed, and totally disrupt the estimated 5,400 vehicles per day (2002 Annual average daily traffic). The adverse economic impacts of the loss of NC 12 due to island breach were analyzed and presented beginning on page 4-14. While the analysis addresses a one and three month average time of NC 12 closure, it did not consider the economic impact of the six month closure defined by the expert panel. It also appears that the timeframes considered were for closing the island breach only, so additional time and money would be needed for the reconstruction of the roadway.

It should also be noted that the NC 12 roadway could be made impassible by less severe storm events than a complete breach of the island. Removing the NC 12 route from the vulnerable sections through the PINWR essentially eliminates this economic concern. Further, peripheral towns like Rodanthe serve as gateways to wilderness areas and it could realize an economic benefit from a PSBC alternative."

> **Response:** *All of the detailed study alternatives are located west of the 2060 high erosion shoreline, placed on bridges, or involve a regular schedule of beach nourishment with the expectation that the regular NC 12 maintenance that currently occurs following storm events would no longer occur once the project is complete. The one exception is the effect of breaches that might occur on alternatives that do not bridge potential breach locations. As noted in the comment, the economic impacts associated with breaches are discussed in the SDEIS and FEIS. The economic impact of a six-month closure is estimated as twice the economic impact of a three-month closure. The time allotted for breach closure includes time to replace the pavement.*

Comment: "Under the two PBC alternatives with Nourishment and New Dune Construction, EPA has environmental objections with such potential large-scale maintenance and construction activities. … These massive re-nourishment and construction activities will significantly impact both wildlife and human activities within PINWR. The SDEIS has predicted that massive maintenance and construction activities would be required every 4 years. The SDEIS does not fully address the direct and indirect and cumulative impacts to listed species from such dredging and maintenance operations. …EPA further understands that there may also be problems with not only finding consistent sand grain size, but also with the color of the sand compared to existing beach conditions. FWS has found that color can alter the heating effects and ultimately the sex characteristics in nesting sea turtles…

On Page 4-78 of the SDEIS, NCDOT indicates that they will work with environmental resource and regulatory agencies to develop plans for nourishment, dune construction, and dredged material disposal plans that would minimize harm to natural resources. While this is a general minimization statement, it does not provide detail on how minimization would actually occur considering the priority will be to immediately re-open NC 12 to traffic following a significant storm event. These accepted minimization plans become ineffective following a storm related disaster, and there are numerous emergency repair requests that follow such storm events. While these minimization plans may address normal shoreline erosion effects, they do not provide any assurance that long-term harm is not caused to listed species and wildlife from repeated emergency or interim actions. … The history of public notice emergency maintenance actions along the Outer Banks, suggests a 1-2 year frequency, not 4 years, should be assumed. There are also significant environmental impacts from sand dredging activities in a coastal environment, especially in areas designated as essential fish habitat (EFH) and other benthic communities. The SDEIS only provides generalized information on these potential impacts and does not specifically address how these negative impacts will be either avoided or minimized through the selection of one of the PBC with Nourishment alternatives."

> **Response:** *All of the detailed study alternative are located west of the 2060 high erosion shoreline, placed on bridges, or involve a regular schedule of beach nourishment with the expectation that the regular NC 12 maintenance following storm events that currently occurs would no longer occur or be minimized once the project is complete.*

Comment: "History and scientific studies along the Outer Banks indicate that breaches will form at some point in the future from a severe storm along NC 12 in PINWR. … Various coastal geology experts retained by NCDOT have generally characterized that there is a probability that a breach or multiple breaches will occur during the project design life ending in 2060, page 3-39. Thus, it is reasonable and foreseeable that daily traffic along NC 12 (with a PBC alternative requiring beach or dune nourishment) will be disrupted until emergency repairs to NC 12 can be made. Experts estimate the time and costs for each breach event ranged from 3 to 6 months (page 4-45) and from $7.28 million to $10.66 million, respectively, depending on quantity and distance to the borrow site (page 4-44)."

> **Response:** *NCDOT recognizes the probability of breach formation within the project area. Section 3.6.2.2 of the SDEIS and Section 3.6.3.2 of the FEIS address breach formation. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would bridge the predicted potential breach locations in the project area. It should be noted that the All Bridge Alternative would also have bridged these locations.*

Comment: "EPA supports the National Park Service (NPS) policy on beach re-nourishment activities along the Cape Hatteras National Seashore and other lands under Federal stewardship. NCDOT has estimated the total length of beach requiring regular nourishment at 6.3 miles. Nourishment is proposed to occur in four National Seashore locations, "likely repeated at four-year intervals" (Summary - pages v and vi). There is no specific technical analysis presented in the SDEIS which compares these estimated beach nourishment activities with other projects along the Outer Banks. In some areas along Cape Hatteras National Seashore, EPA understands that beach nourishment projects are proposed and occur on an annual or biennial basis in order to keep replacing lost sand from certain beaches (e.g., Salvo) to protect NC 12."

> **Response:** *The four-year interval, as opposed to an annual or biennial interval for nourishment, described for the alternatives involving nourishment assumed that adequate quantities of sand would be placed on the beach to permit four years of erosion before a new round of nourishment would be needed. However, the Phased Approach/Rodanthe Bridge Alternative (Preferred) does not include beach nourishment.*

Comment: "As stated in the SDEIS, any improvements to NC 12 outside of the existing 100-foot easement would require a right-of-way permit from the FWS. At past Merger meetings which EPA attended, FWS representatives from the Refuge indicated that a permit would not be issued for any improvements outside of the existing right-of-way. Given that the FWS is the Federal steward of the PINWR, EPA defers to FWS on that issue."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is confined within the existing NC 12 easement. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement.*

Comment: "Actual Section 404 jurisdictional wetlands losses for PBC alternatives range from 4.28 to 78.15 acres (Table 4-12). For the two PSBC alternatives, total jurisdictional losses are 4.84 and 4.18 acres. Avoidance and minimization to jurisdictional wetlands is preferable when there are clear alternatives that can meet the purpose and need for the project. From a Section 404 perspective, a permit can be issued to the least damaging practicable alternative so long as that alternative does not have other significant adverse environmental consequences. While the jurisdictional impacts to wetlands are relatively low for the PBC Nourishment alternative, as discussed previously, there are significant environmental and cost impacts associated with massive shoreline re-nourishment initiatives. Furthermore, as noted previously, the PBC alternatives may not address the long-term stability of the NC 12 corridor and Section 7 issues under the ESA."

> **Response:** *This position is acknowledged.*

Comment: "Table 5-8 of the SDEIS identifying the biotic community impacts on just Bodie Island within the Cape Hatteras National Seashore is unclear. Actual impacts to jurisdictional wetlands from PSBC alternatives are 0.79 acres from shading effects only. Actual jurisdictional impacts to wetlands from PBC alternatives are 0.37 acres from fill and 1.50 acres from shading effects. The table totals would appear to show a greater wetland impact from PSBC alternatives. The non-jurisdictional impacts 10 upland man-dominated areas represent the largest impact category in the table for PSBC alternatives (i.e., 2.17 acres)."

> **Response:** *This table was removed for the FEIS.*

Comment: "The wetland impacts from the two 'non-nourishment' PBC alternatives represent significant and permanent impacts to PINWR. The SDEIS does not provide a full environmental analysis as to the impacts to wildlife at the Refuge as a result of wetlands loss. There would be the direct loss of other habitat. In addition, there would also be extensive habitat fragmentation and we have noted evidence of collisions between vehicles and waterfowl. Collisions between waterfowl and passenger vehicles from raised highway facilities surrounded by waterfowl impoundments and foraging wetland areas can be severe and represent an unsafe roadway condition. Shifting the road to the west of the existing easement into these wetlands and other essential wildlife habitat areas does not provide a reasonable balance between safe transportation needs and minimizing harm to the natural environment."

> **Response:** *Wildlife impacts both in wetlands and uplands are addressed in Section 4.7.6 of the SDEIS, the SSDEIS, and the FEIS. The position indicated on the need to balance safe transportation needs with minimizing harm is acknowledged.*

Comment: "Finally, as a point of technical issue is NCDOT's categorization of "shading" being an impact to Pamlico Sound bottom. Table 4-11 indicates the PSBC (bridge) having 73.8 acres of shading impact to the Sound in water depths deeper than SAV habitat. While shading should be considered a negative impact over any vegetated areas because of the reduced light available for plant photosynthesis, scientific data should be referenced to document functional impact to the bottom of the Sound. To our knowledge, finfish traverse and utilize habitat under bridges, and the benthic epifaunal and infaunal communities are not functionally compromised by shading from bridges. These are areas of already very low light intensity below the recognized depth extent of SAV habitat."

> **Response:** *It is acknowledged that finfish traverse and utilize habitat under bridges, and the benthic epifaunal and infaunal communities are not functionally compromised by shading from bridges.*

Comment: "In summary, our primary wetland concerns are the long-term habitat and wildlife impacts of the PBC alternatives to the PINWR from direct jurisdictional wetland losses, habitat fragmentation and ongoing re-nourishment activities. Our wetland concerns with the PSBC alternatives are the direct wetland losses ranging from 4.18 to 4.84 acres and any impacts that may be due to open water shading."

> **Response:** *This concern is acknowledged. NCDOT is committed to avoiding and minimizing wetland and other habitat impacts to the extent possible.*

Comment: "Page 2-58 of the SDEIS identifies the PINWR management plan as a "challenge" to the PBC alternatives. This challenge could be the most pronounced in moving the proposed bridge replacement project forward. In 2001, the Refuge management gave a preliminary determination that the Oregon Inlet bridge in the PBC alone 'cannot be found compatible' [with their Management Plan] and a right-of-way permit cannot be issued. The SDEIS has not identified any change to the Refuge's opinion from 2001. Through the NEPA/404 Merger Process, EPA has not learned of any condition which has altered FWS's position on the PBC alternatives. It is EPA's understanding that the Refuge management cannot act on a permit until an application has been submitted and other requirements have been completed (e.g., Formal consultation under Section 7 of the ESA). It is also EPA's understanding from past Merger Team meetings that FWS representatives do not desire paved access through the Refuge and have a goal of reducing disturbances to wildlife and improving habitat conditions by returning the right-of-way and adjacent areas to natural conditions. EPA gives deference to the FWS on the long-term management goals for PINWR. Disposition of the Terminal Groin at Oregon Inlet is a similar matter to the Refuge Management Plan and the potential need for a compatibility determination by the FWS."

> **Response:** *Despite the Refuge's position, NCDOT studied the Parallel Bridge Corridor Alternatives because of the concerns over loss of Refuge access if the Pamlico Sound Bridge Corridor was constructed and because of funding concerns given the high initial cost of the Pamlico Sound Bridge Corridor. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is confined within the existing NC 12 easement for which NCDOT has a permit. Therefore, a compatibility determination is not required.*

Comment: "EPA understands Dare County's concern regarding access to the Refuge, including fishing at the north end of Hatteras Island and continued retention of the terminal groin. However, access for many National parks, forests and refuges in the U.S. are through other modes of transportation, including boats, off-road vehicles, hiking, etc. Few national wildlife refuges (NWR) in North Carolina provide paved access for the public throughout their property limits (e.g., Swanquarter NWR, Great Dismal Swamp NWR, Currituck NWR, and Pocosin Lakes NWR). There are numerous other opportunities for beach access and fishing along the Outer Banks and on Hatteras Island that are not within PINWR. Between the Village of Hatteras and the Town of Rodanthe, there are approximately 34 miles of beach access and alternative fishing areas serviced by NC 12. There are extensive beach and recreational opportunities on Bodie Island within the Cape Hatteras National Seashore available to the public. Where appropriate and consistent with the Refuge Management Plan, Dare County officials, NCDOT, FHWA and FWS should explore other opportunities for accessing and enjoying the Refuge beaches and natural trails (e.g., bicycle and hiking trails)."

> **Response:** *The economic impact assessment in Section 4.1.5.3 of the SDEIS and the FEIS takes into account visitor use of other recreation areas should direct road access to the Refuge be lost. Opportunities for providing alternate access are discussed in Section 2.3.3 of the SSDEIS and Section 2.10.1.2 of the FEIS, as well as Section 4.5.3.1 of the SDEIS and FEIS.*

Comment: "The SDEIS provides extensive discussion of the Section 4(f) property impacts to Cape Hatteras National Seashore and PINWR. The Section 4(f) evaluation, while very detailed, appears to provide an incomplete representation of the nature and severity of the impact from the PSBC alternatives to the PINWR. While the Refuge's three purposes and objectives are stated on Page 5-9, the impact evaluation focuses more on the lost opportunities for public enjoyment. The removal of traffic along existing NC 12 and from the Refuge would appear to fully meet the prime Refuge objectives: provide nesting, resting and wintering habitat for migratory birds and provide habitat and protection for endangered and threatened species. EPA disagrees with the statement of harm on Page 5-41 of the SDEIS concerning the PSBC and PBC alternatives under the Section 4(f) evaluation ("they are equal in degree of harm"). The intensity and degree of harm from the PBC alternatives are direct, permanent and negatively alter the function and management of the Refuge. The lack of paved access to the former Oregon Inlet Coast Guard Station and the potential reduction in visitors to the PINWR from paved NC 12 access can not be measured as equal in degree or intensity."

> **Response:** *The statement on page 5-41 of the SDEIS acknowledges the differing positions on the importance of road access to the Refuge expressed by the full range of stakeholders in the project area, including the public and local government officials. The Phased Approach/Rodanthe Bridge Alternative (Preferred) does not constitute a Section 4(f) use of the Refuge. See the least harm analysis in Section 5.4.*

Comment: "The PBC alternatives have less of an impact to businesses and residences than the PSBC alternatives but the impacts are low for a project of this length. There is an advantage of the PSBC Rodanthe Intersection Terminus alternative particularly by lessening relocation of Rodanthe businesses."

> **Response:** *This position is acknowledged.*

Comment: "Mitigation for road and bridge operational impacts is addressed throughout the document. Construction impacts are addressed including those of temporary access to construction and demolition areas discussed beginning on page 4-58. It is indicated that a temporary haul road would be necessary over open waters and emergent wetlands. EPA appreciates that impacts from these actions are unavoidable but that they can be minimized by available technique and technology. Temporary haul roads and bridges are differentiated in the document, but we wish to state that not all haul roads need to be on fill material. Temporary board roads could lessen impacts to wetlands. The loss of SAV is problematic because the altered physical conditions may not allow SAV to recover, and the success rate for SAV restoration is very poor. Accordingly, the loss of SAV should carry a higher mitigation ratio than the minimum 1:1 ratio mentioned for other wetlands.

It is noted that the "top down construction technique" to minimize the impact to aquatic and wetland communities was rejected in the 1993 review. While a partial top down technique is mentioned in the SDEIS to be possible for some construction, EPA requests further consideration particular1y if a PSBC alternative is selected."

> **Response:** *These positions are acknowledged, and impacts from temporary haul roads and bridges will be minimized to the extent possible. The Pamlico Sound Bridge Corridor was not selected as the Preferred Alternative.*

United States Environmental Protection Agency-April 20, 2007 (page A-29)

Comment: "…EPA has assigned a rating of EC-2 "Environmental Concerns; additional information is requested" for both of the PBC-PA alternatives because of the potential impacts to jurisdictional waters of the U.S., the long-term effects to water quality, the long-term impacts to the Refuge including the permanent impact to migratory birds, the severe visual impacts to the Cape Hatteras National Seashore, the prolonged impacts to natural resources from construction and maintenance activities, and the severe risk of constructing additional bridges (between "hotspots") along the NC 12 corridor that will be subject to ocean wave conditions. Maintaining a reliable transportation corridor along an ever-changing coastal barrier island is a concern particularly due to the vulnerability of the PBC and PBC-PA alternatives. In light of the many issues presented in the 1993 DEIS, the 2005 SDEIS and this SSDEIS, EPA recommends a re-consideration of some of the preliminary alternatives that were not studied in detail, including the rehabilitation of the existing Bonner Bridge combined with continued NC 12 maintenance activities and permanent ferry service."

> **Response:** *Regarding rehabilitation, currently a major maintenance effort (NCDOT TIP Project No. B-5014) is underway to add an estimated ten years to the life of the current bridge. To completely rehabilitate the bridge for a long-term life would require replacing every part of it, essentially building a new bridge (and requiring the structure to be closed during construction) (see Section 2.2.4 of the SDEIS and the FEIS). The capacity, environmental impact, and cost concerns associated with a ferry alternative are addressed in Section 2.2.6 of the SDEIS and this FEIS remain valid. A reassessment of the bridge rehabilitation and ferry service alternatives is not needed.*

Comment: "However, with the ongoing vulnerable coastal conditions the most viable, long-term alternative for the NC 12 corridor appears to be the relocation of the roadway off the barrier island system and into the more protected Pamlico Sound. Therefore, based on all the analyses to-date the PSBC alternatives would provide, on balance, the best long-term and reliable solution with the least overall environmental impacts."

> **Response:** *This position is acknowledged. The reasons for selecting the Phased Approach/Rodanthe Bridge Alternative as the Preferred Alternative are presented in Section 2.15 of the FEIS.*

Comment: "EPA does not have additional comments regarding NCDOT's defined purpose and need for the project: (1) to provide a new access to Hatteras Island from the North, (2) provide a viable long term replacement crossing of Oregon Inlet given its extreme natural changes in navigation channel, and (3) provide a facility that will not be endangered by shoreline dynamics long term. These purposes are specific to a project exposed to the storm prone coastline and barrier island dynamics, and should be met to ensure that the alternative is selected. With regards to the PBC-PA alternatives, EPA is not convinced that these additional alternatives can reasonably meet purpose #3 above. The periodic construction of new bridges along the existing NC 12 corridor at the 'hotspot' locations will most likely be exposed to the full intensity of storms and ocean wave conditions. EPA has attempted to find other bridges in the U.S. (and Worldwide) where permanent bridges are constructed in the wave break zone along barrier island formations. EPA has been unable to find other barrier island bridges that are similarly proposed under the PBC-PA or PBC alternatives."

> **Response:** *Position acknowledged. NCDOT also knows of no similar bridges to those with the Phased Approach alternatives (including the Preferred Alternative).*

Comment: "EPA is concerned that the transportation agencies may not be giving previously rejected alternatives an equal comparison to the current alternatives under full consideration. As the cost of the bridge replacement options currently under detailed study has increased exponentially within the last few years to more than $1 billion, the rehabilitation of the existing bridge alternative discussed on page ix of the SSDEIS should be reconsidered. EPA recognizes the potential problems with the existing Bonner Bridge including extensive corrosion of reinforcing steel, major spalling of concrete, extensive pile scour, insufficient ship impact strength, and the narrowing of the navigation span zone due to channel migration. Unfortunately, the continued operation and maintenance efforts to keep the existing bridge minimally safe are also costing millions of dollars each year. While the reasons to eliminate this preliminary alternative were valid more than a decade ago, the need for a new structure considering both the significant costs and the potentially severe environmenta1 impacts makes a re-evaluation that more meaningful. EPA as a member of the Outer Banks Task Force has seen the photographs and other documentation provided by NCDOT on the condition of the existing bridge and the substantial repair measures to keep the bridge minimally safe. EPA is not discounting the challenge of trying to rehabilitate the existing Bonner Bridge and address the issues mentioned above. However, the decision to eliminate this alternative at the feasibility stage was made more than 15 years ago without the full understanding of barrier island dynamics."

> **Response:** *Regarding rehabilitation, currently a major maintenance effort (NCDOT TIP Project No. B-5014) is underway to add an estimated ten years to the life of the current bridge***.** *To completely rehabilitate the bridge for a long-term life would require replacing every part of it, essentially building a new bridge (and requiring the structure to be closed during construction) (see Section 2.2.4 of the SDEIS and the FEIS). A reassessment of the bridge rehabilitation alternatives is not needed.*

Comment: "When the Bonner Bridge was first constructed across Oregon Inlet in 1962, the science and engineering concerning the dynamics of barrier islands was not fully known to transportation officials. EPA has been unable to find a similar structure located along a barrier island anywhere else in the U.S. or worldwide. Since the time it was initially constructed, it is has become apparent to a number of highly regarded scientists, engineers and other interested parties contracted by NCDOT and FHWA that the effects of building a bridge along a barrier island represents a substantial risk and a huge public investment. As stated in the SSDEIS, "Beach erosion, however, has increased problems with ocean overwash along NC 12 south of

Bonner Bridge. Ocean overwash is expected to continue to be a regular and increasing problem over the life of a replacement bridge. Increasing the length of the existing Bonner Bridge either through the selection of one of the PBC alternatives or PBC-PA alternatives by miles of new bridges will only increase the future risk and public investment to keep NC 12 open by additional bridging. The planning for the replacement of Bonner Bridge began just 30 years after its opening. The concept that the new bridge(s) located in a parallel corridor (regardless of the construction method or timeframe) will 'safely' last 50 or more years into the future is not realistic considering the present condition of Bonner Bridge. Thirty (30) years after the potential replacement of the 2.7 mile new Bonner Bridge, planning for its replacement will need to be made before Phase IV of PBC-PA alternative would even be completed in Post 2030. All of the PBC alternatives will continue to be subject to shoreline erosion, high winds, storm surges, erosive waves, beach overwash, inlet migrations, hurricanes and other extreme conditions."

> **Response:** *Position acknowledged. All bridges designed after October 2007 must be in accordance with FHWA's Load and Resistance Factor Design (LRFD) specification. LRFD defines design life as the "Period of time on which the statistical derivation of transient loads is based: 75 years for these Specifications." Because of the adverse conditions of the project area, corrosion protection measures beyond those called for in these specifications will be used in an effort to extend this statistical design life.*

Comment: "Similar in some respects to the Rehabilitation alternative, EPA believes that the Ferry alternative should also be reconsidered. Since 2002 when EPA became involved in the Merger process for this project the costs for the replacement bridges alternatives have doubled and in some cases tripled previous cost estimates. Notwithstanding some of the significant potential environmental and socio-economic impacts from providing a reliable ferry service between Bodie Island and Hatteras Island, North Carolina currently has one of the finest ferry services in North America. The Ferry alternative would mostly likely have a significant impact to the bay bottom environment from dredging the required navigational channel as well as some substantial impacts to wetlands. This alternative would also potentially reduce the level of service across Oregon Inlet and increase emergency evacuation time. It would also have a potential economic impact to Dare County. Nonetheless, the potential magnitude in cost increases and significant environmental impacts to PINWR from the bridge replacement alternatives makes its complete elimination from further detailed study possibly premature. NCDOT currently maintains a reliable and much longer ferry service between Swan Quarter and Ocracoke Island and Cedar Island and Ocracoke Island. An expanded, robust and reliable ferry service as well as other economic opportunities could make this alternative more attractive than a strict bridge replacement alternative. Cost estimates for operating a ferry service to the north end of Hatteras Island including regular maintenance dredging are estimated by NCDOT and FHWA at $500,000,000, which is more than $100,000,000 less expense than the PBC Road North/Bridge South alternative (Page 2-24 and Table 2-1)."

> **Response:** *The capacity, environmental impact, and cost concerns associated with a ferry alternative are addressed in Section 2.2.6 of the SDEIS and this FEIS and remain valid. A reassessment of ferry service alternatives is not needed.*

Comment: "Considering expert opinions from renowned scientists contracted by NCDOT and FHWA, any significant storm event that hits the project study area at the correct angle with a certain duration and/or intensity could cause major breaches along NC 12 at the hot spots. Not counting damaging 'Northeasters' like the recent one on April 15, there have been 46 hurricanes to hit the N.C. coast in the last 150 years (Riggs, NC Climate Change Commission, 2006). On average, that is almost one hurricane every three years. At a minimum, emergency ferry service should be considered between Bodie Island and Hatteras Island as a contingency for any of the PBC alternatives and realistic costs projected for these contingencies. The extended construction timeframes for new bridges as well as executing emergency roadway repairs for the PBC alternatives should require that very specific contingency plans be made part of this overall EIS analysis."

> **Response:** *NCDOT currently has an emergency ferry service between Hatteras Island and the mainland.*

Comment: "The PBC-PA Rodanthe Bridge alternative would utilize four phases to construct NC 12 as a bridge for the entire length of the project (i.e., Bodie Island to Rodanthe) except for 2.1 miles in the southern half of PINWR. The PBC-PA Rodanthe Nourishment alternative would be again a phased approach for construction with the exception that beach nourishment would take the place of a bridge option near Rodanthe. From Section 2.2.2.4 of the SSDEIS, it appears that the total construction time frame is estimated to be 12.5 years of active construction over the first 20 years of the phased project. These post-Phase I (Current TIP cycle, 2009-2015) phases, include approach roadways, beach nourishment activities, new access frontage roads near Rodanthe, etc. Considering responses to weather-related overwash conditions at the Rodanthe 'S' Curves Hot Spot, Sandbag Area Hot Spot, and Canal Zone Hot Spot during the proposed construction phases, PINWR would be subject to disruptions and intensive human activities for a majority of the time over the next 20 years."

> **Response:** *Potential NC 12 maintenance activities associated with storms that could occur before the implementation of each phase are discussed in Section 4.6.8.6 of this FEIS. The potential impacts on natural resources of these activities are discussed in Section 4.7 of this FEIS. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement.*

Comment: "As noted during EPA's review of the 2005 SDEIS, NCDOT and FHWA continue to propose two typical sections for the two basic corridor alternatives. For PSBC, the typical section is two 12-foot travel lanes and two 8-foot shoulders. For the PBC alternatives, including PBC-PA alternatives, the typical roadway section is two 1 2-foot travel lanes and two 8-foot shoulders. However, the typical section for the Oregon Inlet bridge for the PBC alternatives would provide two 12-foot lanes and two 6-foot shoulders. EPA is uncertain as to why there are two different designs for the replacement bridge structure and the NC 12 bridges, especially considering safety issues for bicycles and pedestrians."

> **Response:** *Six-foot (1.8-meter) shoulders were used in the 1999 final design for the Oregon Inlet bridge in the Parallel Bridge Corridor. The cost estimates included in Section 2.3 of the SSDEIS and Section 2.12 of the FEIS assumed 8-foot (2.4-meter) shoulder widths for all bridges for the replacement bridge corridor alternatives. The current design for the Phased Approach/Rodanthe Bridge Alternative (Preferred) includes 8-foot (2.4-meter) shoulders for all bridges.*

Comment: "The SSDEIS addresses the potential for a breach to occur at various locations along Hatteras Island (the 'Hot spots'), depending upon the alternative selected. It is very likely that the placement of bridge pilings out in the ocean or in the near shore area may cause significant scouring that could lead to additional breaches or much greater breaches during storm events. The PBC-PA alternatives are designed and planned for addressing the 'historic' hot spots, not their accelerated formation or the increased size of new inlets along Hatteras Island."

Response: *The potential for scour adjacent to bridge piers once portions of the Phased Approach/Rodanthe Bridge Alternative (Preferred) are in the ocean is discussed in Section 4.6.8 of the FEIS.*

Comment: "On page 5-6 of the SSDEIS, there is a discussion of impacts to PINWR. It is noted that the SSDEIS clearly identifies that the PBC-PA alternatives cause 'substantial visual intrusion' into the landscape of the Refuge, including the portions that contribute to the Refuge's National Register eligibility. This section also describes the temporary and permanent impacts to the Refuge, including construction noise from driving or jetting piles and land disturbance. There are also localized impacts to the Refuge from PBC-PA alternatives to air quality from diesel equipment exhaust, lighting impacts during nighttime construction, the relocation of utilities, etc."

Response: *The commenter's observations on the SSDEIS content are correct.*

Comment: "The SSDEIS states on page xxiii that telephone and electrical lines along existing NC 12 will likely need to be moved one or more times between now and year 2060. However, it is not clear whether these costs were included in the costs of the PBC and PBC-PA alternatives. It is important to note that it is less likely that utilities will need to be moved for the PSBC alternatives."

Response: *These costs are included in the other public costs tables, Tables 2-11 and 2-12. They are not considered a part of project costs because their relocation is associated with shoreline erosion and not the project.*

Comment: "On page vii of the SSDEIS, there is a discussion concerning the proposed 25-foot vertical clearance of the bridges associated with PBC-PA alternatives. This discussion needs to be included for all of the PBC alternatives and reflected in the costs for the different alternatives."

Response: *All project costs were revised for the SSDEIS and reflected NCDOT's understanding of current requirements.*

Comment: "Permanent jurisdictional impacts for the PBC-PA Rodanthe Bridge and PBC-PA Rodanthe Nourishment alternatives are 3.11 acres and 3.08 acres, respectively. Both alternatives include 12.45 acres of temporary impacts to jurisdictional waters of the U.S. While permanent impacts to wetlands have been substantially reduced from the PBC alternatives by proposing the PBC-PA Alternatives, the temporary impacts are greater. These 'temporary impacts' to wetlands from the PBC-PA alternatives include temporary traffic maintenance roads which may be quite long-lasting due to repeated compaction and disturbance. While technically these impacts are not permanent fill in wetlands, these temporary impacts will cause the general degradation of these high quality systems. In addition, the duration of construction impacts have also been extended over a much greater time frame, thereby, increasing the risk of other potential impacts."

Response: *As discussed in Section 2.10.2, it is expected that temporary impacts would last approximately three years, the length of the construction for each of Phases II to IV.*

Comment: "One significant environmental concern that EPA has with the PBC-PA alternatives is the potential for leakage and spillage of oil and accidental releases to waters of the U.S. The longer construction period for the PBC-PA alternatives increases the probability that a spill or release of hazardous materials will occur into jurisdictional waters from all of the heavy equipment. Considering the sensitive ecosystem of the coastal wetlands in the project study area, even a minor spill could have significant adverse effects to wildlife and recreational activities such as surfing and fishing. As a general rule, it is far less costly and difficult to clean up an oil spill in a more placid bay-sound system, than it is in an ocean or near shore condition. Spilled oil could be spread much farther and faster near the beach and wave areas. The waters in the project study area are classified as Class A Salt Waters, with a supplemental classification of High Quality Waters (SA-HWQ)."

> **Response:** *Only Phase I of the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be built over water or coastal wetlands. Phases II to IV would be built within the existing NC 12 easement while it is still on land.*

Comment: "The SSDEIS notes that the PSBC alternatives increase the amount of highway storm water runoff. However, the SSDEIS does not describe the appropriate designs and methods that can ameliorate these additional amounts. On page 4-28, the SSDEIS states that the PBC-PA alternatives could also permanently affect water quality in the near shore area, but diminishes the significance of the storm water inputs by asserting that the flushing and wave action of the ocean will dilute the pollutants. EPA does not prescribe to the use of 'dilution as an acceptable solution to water pollution. The transportation agencies should plan to treat polluted runoff from the PBC-PA alternatives in the same environmentally acceptable manner as it would for all of the other alternatives."

> **Response:** *Additional analysis of water quality impacts and mitigation has been added to Section 4.7.2 of the FEIS.*

Comment: "The SSDEIS describes wetlands and open water habitat impacts in Section 4.7.4. EPA notes that there is a great deal of emphasis on shading impacts to SAVs (Submerged Aquatic Vegetation) and open water, especially noting that the PSBC alternatives have the greatest impact. While this is an impact, it is not in the same category of complete and total impact caused by permanent fill in coastal wetlands. Because of the north-south orientation of the barrier islands, NC 12 and the different alternatives, shading may have less of an impact to aquatic resources than what is being implied in the SSDEIS. The SSDEIS does not highlight the difference in the type and severity of the impact and consistently confused impact information by listing all of the biotic community type impacts with jurisdictional impacts."

> **Response:** *Separate tables for jurisdictional impacts were provided in the SSDEIS and FEIS. Wetlands and other jurisdictional impacts are also biotic community impacts. Total biotic community impacts should be presented.*

Comment: "Furthermore, the predicted permanent wetland impacts on page 4-31 are not consistent for the PBC-PA alternatives described on page 4- 41. The discrepancy should be corrected or explained."

> **Response:** *Any inconsistencies have been corrected.*

Comment: "Tables 4-1 and 4-2 of the SSDEIS are excellent examples of how information is being confused for the reader, including total fill and pile placement impacts. Biotic communities that are 0 acres impact should be de-emphasized or removed from the tables in order to make the actual impacts for the particular alternatives clearer. Impoundments, wetland man-dominated, wetland overwash, wetland reed stand, upland reed stand, salt flat, brackish marsh and upland black needlerush impacts are a11 '0.00 acres' and could easily be removed from Table 4-1 to make it easier for the reader to discern the actual permanent impacts. The same issue applies to Table 4-2 for temporary impacts: Seven (7) out of 22 biotic community types are '0.00 acre' impacts."

> **Response:** *The commenter's opinion is noted, but it is felt that it is also important to indicate the community types that are not affected.*

Comment: "EPA does not understand why the costs presented in Table 2-1 for wetland mitigation (excluding SAVs) for the PSBC Curved Rodanthe Terminus alternative is substantially higher than the PSBC Intersection Rodanthe Terminus or the PBC-PA alternatives. NCDOT and FHWA should explain this difference and the assumptions used in developing these cost estimates. NCDOT and FHWA should begin consulting with the resource agencies concerning compensatory mitigation opportunities."

> **Response:** *The cost per acre is the same. The difference is in the area of wetland taken. The FEIS wetland mitigation section reflects coordination with resource agencies on potential mitigation sites.*

Comment: "The PSBC will not result in permanent disturbance to Significant Natural Heritage Areas (SNHA) as identified by the North Carolina Natural Heritage Program (NCNHP). All of the PBC and PBC-PA alternatives will result in permanent and temporary impacts to the Refuge that has been identified as a SNHA by NCNHP. The PBC and PBC-PA alternatives potentially impact the Green sea turtle *(Chelonia mydas*) and Piping plover (*Charadrius meloders*), and the SSDEIS states that the Section 7 biological conclusion for these two species is 'Unresolved'. EPA defers to the U.S. Fish and Wildlife Service (FWS) on formal consultation issues, proposed mitigation and the compatibility permit for the Refuge. The SSDEIS states that the FWS issued the PINWR Comprehensive Conservation Plan in September of 2006. EPA notes on page 4-37 of the SSDEIS that a potentially unsubstantiated claim is being made regarding PBC-PA alternatives and the Piping plover. The SSDEIS states, 'However, shoreline erosion could create Piping plover habitat under the bridges as the shoreline erodes'. The Piping plover nests in open beach areas in a sand depression along the high beach close to the dunes. The nests are sometimes lined with small stones or shell fragments. EPA can not find anywhere in the literature where Piping plovers would nest under a highway bridge. This statement should be corrected in the FEIS or provided with a supporting, relevant literature source. According to FWS website information on the Piping plover, there are several factors contributing to the decline of the threatened species along the Atlantic Coast, including commercial, residential and recreational development, human disturbance (often curtails breeding success), human pets such as dogs, and developments near beaches that provide food and attract predators. The PBC-PA (and PBC) alternatives would include long-term construction activities (12 out of the first 20 years) that will increase noise, air emissions of mobile source air toxics (MSATs) and other pollutants, nighttime lighting, food sources (and potentially litter) from construction crews, and other related impacts in the right of way and near potential beach nesting habitat. On page 4-37 of the SSDEIS it is stated that the only method of ensuring that Piping plover would not be negatively affected by construction of the proposed project is through monitoring efforts to evaluate changes in the distribution of suitable habitat and the responses of breeding plovers to construction and demolition activities. EPA believes that another method would include intensive surveying efforts prior to construction to identify existing and historic breeding sites and providing and strictly enforcing a substantial buffer to these areas. As further stated in the SSDEIS, the dynamic nature of the Oregon Inlet area results in a continually changing distribution of suitable habitat for plovers. Because of this dynamic environmental condition (which the species has become adapted to over time), efforts to avoid suitable habitat areas in the Refuge is actually the best method to ensuring that the species is not negatively affected. Monitoring the species after construction has begun is potentially too late to avoid or minimize potential impacts. Compared to the PSBC alternatives, the PBC-PA (and PBC) alternatives would appear to have the greatest potential impact to this threatened species."

> **Response:** *The results of formal consultation on threatened and endangered species with the USFWS, including the associated Biological Assessment, and Biological and Conference Opinions (USFWS, 2008) are presented in Section 4.7.9.1 of the FEIS. The Biological and Conference Opinions (USFWS, 2008) document prepared by USFWS is in Appendix E. The statement related to the creation of piping plover habitat under bridges is revised in the FEIS.*

Comment: "The SSDEIS states that the PBC-PA alternatives could permanently disrupt feeding and migrating birds within the near shore area once the shoreline erosion places the bridges south of Oregon Inlet in the ocean (Page 4-35). This permanent impact to migratory birds would appear to EPA to be inconsistent with PINWR's Comprehensive Conservation Plan and the Refuge's overall mission."

> **Response:** *Position acknowledged. The USFWS will be responsible for determining whether or not the Parallel Bridge Corridor alternatives are consistent with the Pea Island National Wildlife Refuge Comprehensive Conservation Plan.*

Comment: "Section 4.6.3 of the SSDEIS addresses the issues of bridges piles from the PBC-PA alternatives on scour and longshore sediment transport. There are several critical issues unresolved concerning the placement of bridge piles in the near shore area to the ocean. On page 4-21 of the SSDEIS it is stated that scour would be modeled during the final design of bridges associated with the selected alternative to ensure adequacy of foundations as it relates to scour. As stated in the SSDEIS, 'Bridge foundations designs must ensure that, even with scour, piles are buried deep enough to support the bridges. EPA believes that scour modeling for PBC-PA alternatives needs to be conducted prior to the selection of the preferred alternative. This scour modeling is necessary to ensure that the bridges can be safely supported and the depth of the piles is not 'unreasonable' or 'infeasible.' The SSDEIS also states that the presence of piles near the Canal Zone hot spot could accelerate the development of an island breach at this location during storm events. EPA believes that there are technically available laboratory scale models that could confirm this hypothesis. The SSDEIS also acknowledges that scour has been studied extensively in the laboratory but then maintains that field data is lacking (Page 4- 23). The SSDEIS then extensively describes the efforts and the excellent source of data from the U. S. Army Corps of Engineers Field Research Facility VRF) at Duck, N. C. From this detailed analysis concerning "G/D ratios" (typical distance between piles to pile diameter), there is an acknowledgement that the combined impact of multiple groups over the length of the bridge could result in a scouring effect associated with the entire structure (referring to the PBC-PA Phase II Canal Zone hot spot area). The pier modeling assumptions in this analysis indicate that a similar problem would not occur for the Phase II, III, and IV bridge locations and that scouring would be localized around the smaller diameter, individual piles. While these assumptions may be realistic for normal wave conditions, specific storm events could change the localized scour prediction and major breaches could be triggered. Regarding longshore sediment transport, the SSDEIS states that it is not possible to draw a one-to-one correlation with what has happened at the FRF's pier because of the difference in the orientation of the structure with what is being proposed for the PBC and PBC-PA alternatives (perpendicular versus parallel). It is acknowledged that a change in bathymetry could affect cross-shore transport (of sediment) during storm events. There is further recognition in the SSDEIS that the presence of structures (i.e., piles) would accelerate the development of a breach during storm events. The bridge elements in the upland areas are also expected to disrupt normal sand wind-borne transport mechanisms and reduce sediment in the backshore areas of the beach. The questions that concern EPA are not if the normal sand and sediment transport processes will be affected by the PBC and PBC-PA alternatives but to what degree and what are the likely indirect and cumulative impacts associated with these potentially drastic changes to the coastal landscape."

> **Response:** *Additional analyses of potential scour and other potential effects of the presence of the Phased Approach/Rodanthe Bridge Alternative (Preferred) in the ocean have been added to Section 4.6 of the FEIS.*

Comment: "EPA acknowledges that the transportation agencies have separated the actual bridge replacement and NC 12 costs from the 'other public costs' as was requested by a number of the Merger team agencies after the issuance of the SDEIS. Page 2-21 of the SSDEIS includes a discussion of Refuge access should one of the PSBC alternatives be selected. If there were a storm-caused breach at the southern end of the Refuge, there appears to be a perception that a ferry service would need to be implemented to get visitors and perhaps their vehicles to and from the Refuge. EPA is uncertain as to under what conditions there would be visitors at the Refuge following a storm event strong enough to cause a breach in the island."

> **Response:** *It is assumed that the breach would not be closed, and there would remain a desire to allow the public to visit the Refuge in the long-term.*

Comment: "Tables 2-1 and 2-2 of the SSDEIS provide the highway cost to 2060 in 'low' estimates and 'high' estimates for the different alternatives. It is interesting to note that the 'low' estimated costs for the PBC-PA alternatives are relatively in the same range as the PSBC alternatives (i.e., $1.1 to 1.2 billion versus $1.3 billion, respectively). EPA recognizes the 'unknown' or only partially known information and factors relating to project costs on page 2- 5 of the SSDEIS. EPA also understands the issues of the higher inflation factor for the PSBC alternatives, the change in contract type to design-build, etc., which has dramatically increased project cost estimates. EPA acknowledges that the PBC alternatives Nourishment and Road North/Bridge South continue to have the lowest total highway cost to 2060. EPA has previously stated its environmental objections to these two alternatives in its 12/30/05 letter on the SDEIS. The cost estimates for the road and bridge operation and maintenance to the year 2060 are also presented in Tables 2-1 and 2-2. EPA does not comprehend the method by which these projected costs were forecasted. The operation and maintenance costs for the PSBC alternatives are more than all of the other alternatives and greater than the actual bridge replacement costs for all of the PBC and PBC-PA alternatives. NCDOT and FHWA have projected operation and maintenance costs for the new 18-mile PSBC alternative bridges at approximately $356,000,000 to the design year at 2060. The PBC All Bridge alternative operation and maintenance cost is estimated at only $274,000,000 for a 16-mile structure. The total construction cost for all of the PSC and PBC-PA alternative new bridges (16-mile structures) are estimated between $260,000,000 and $290,000,000. EPA requests that the detailed assumptions used in developing the operation and maintenance costs be provided to the Merger Team agencies at the upcoming scheduled Concurrence Point 3 Least Environmentally Damaging Practicable Alternative (LEDPA) meeting. NCDOT and FHWA should be able to develop realistic cost estimates from other existing long bridges that are along the Outer Banks. EPA recognizes that operation and maintenance costs for a structure within the sound may be more expensive (referring to the 4th bullet comment in Section 2.3.1.3). However, EPA believes that the weather conditions and other storm events are not as severe in the Pamlico Sound as they are on the near beach alternatives and there should be less drastic repairs required for the PSBC alternatives. Also, the typical section for the PSBC alternatives include two 8-foot shoulders and should make roadway access for routine operation, inspection and maintenance activities less difficult and easier than the existing Bonner Bridge and NC 12."

> **Response:** *The requested information describing how the operations and maintenance costs were developed was provided to the Merger Team in the context of meetings associated with the selection of the LEDPA. It was noted the maintenance costs are higher on bridges than on roads on land. The Pamlico Sound Bridge Corridor alternatives include the longest length of bridges of the detailed study alternatives considered.*

Comment: "EPA has reviewed the generalized information contained in Section 2.3.4 of the SSDEIS regarding capital funding. NCDOT and FHWA identify that there may be innovative financing techniques to help fund the proposed project, including the issuance of revenue bonds against one or more long-term sources of revenue. It is cited that many states use innovative techniques to finance large projects or transportation improvement programs, including future FHWA Federal-Aid funds, State motor fuel taxes and the use of local taxes and fees and tolls. EPA is unsure how these capital funding techniques are truly innovative, as many states, including North Carolina, are already using these additional 'non-traditional' funding mechanisms. From past Merger meetings within the past year, EPA understands that the funds allocated in the NCDOT's Draft 2007-2013 Transportation Improvement Program are insufficient to fund the bridge replacement construction for any of the alternatives currently under consideration (i.e., $207,252,000 TIP FY09 versus $260,000,000 for PBC Nourishment, Road North/Bridge South, All Bridge and $294,000,000 for PBC-PA Rodanthe Bridge and Rodanthe Nourishment). EPA requests that NCDOT and FHWA provide more detailed information on capital funding issues and commitments for the LEDPA meeting."

> **Response:** *The requested information was provided to the Merger Team at the Merger Team meeting associated with the selection of the Preferred Alternative on June 20, 2007 (see Section 8.10.1.2).*

Comment: "The SSDEIS does not discuss the potential cumulative and secondary impacts from Sea Level Rise (SLR). This emerging yet documented issue needs to be evaluated fully for the different alternatives in the FEIS. There are now predictions from the N.C. Climate Change Commission concerning SLR and its impacts to the shoreline of North Carolina (A number of papers and presentations can be found through a search at http://www.ncleg.net/gasscriipts/documentsites/browsedocsites.asp?. On page xii of the SSDEIS, historic beach erosion trends were used for the development of the worst-case 2060 shoreline. However, this analysis does not appear to take into account likely future trends due to SLR. The predicted shoreline may not be at the locations that are presented in the SSDEIS. In fact, the worst case shoreline along Hatteras Island is projected by NCDOT where there may not be a shoreline present or the shoreline will have significantly shifted to the west (Riggs, NC Climate Change Commission, 2006; Page 19) due to SLR. Shoreline forecasts in the SSDEIS apparently did not consider what many scientific experts are reporting on SLR effects to the N.C. coasts. The effects of SLR may also require much more nourishment and dune construction than is discussed in the SSDEIS. The amount and estimated schedule of beach nourishment should be re- evaluated based upon SLR projections within the project study area. The magnitude, costs and duration of these beach maintenance activities may have been substantially under-estimated in the 2005 SDEIS and SSDEIS."

> **Response:** *Discussions of accelerated sea level rise are included in Sections 3.6.3.3 and 4.6.6 of the FEIS, including a peer exchange workshop on the topic conducted as a part of the analysis.*

Comment: "One of the recommendations to the N.C. Climate Change Commission in a recent report (Radar, Implications of Changing and Rising Seas for Coastal NC, 2006) was the proposal to prohibit new public and publicly licensed or permitted infrastructure in flood- prone and storm-surge-prone areas. The construction of new and extended bridges along the existing NC 12 corridor (PBC Alternatives, including PBC-PA Alternatives) would appear to be inconsistent with this technical recommendation."

> **Response:** *The proposed project replaces existing infrastructure and as such is not new.*

Comment: "There are acknowledgements in the SSDEIS that there will be other impacts from the PBC-PA alternatives, including for example the change in surfing, fishing and other beach recreational activities, the change in access to the Refuge, reduced flexibility for the USACE to move the dredged channel at Oregon Inlet as the channel migrates, and the visual impact from a raised bridge for approximately 10 miles or more within PINWR (Page 4-1 0). EPA was unable to find an analysis or discussion within the SSDEIS that addressed the increased safety concerns for vehicle-avian species collisions. Gulls and other seashore birds often use elevated structures for floating on prevailing air currents. Some of these birds would also be attracted to the elevated roadway from litter and uneaten food. The near shore wind currents can be very strong and highly variable and the potential frequency of collisions is more likely with the PBC-PA alternatives than with the PSBC alternatives."

> **Response:** *Additional discussion of the potential for traffic and bird collisions has been added to Section 4.7.6.6 of the FEIS.*

Comment: "EPA recognizes that a new section on MSATs has been included in Section 4.9.2 of the SSDEIS. EPA has previously stated its concerns about the use of a qualitative type assessment being offered under FHWA's interim guidance. There is some project specific information contained in the SSDEIS, including the estimate that potential MSAT emissions will be 17 percent higher for the PSBC alternatives because of its longer length. This potential increase, however, would appear to be essentially negligible as it relates to human health impacts as there are no near roadway receptors or sensitive populations located in Pamlico Sound.

The analysis does not address the potential near-road exposures of fishermen and other users of the Refuge from existing and future MSAT pollutants for the PBC and PBC-PA alternatives. Also, the context of most MSAT research is intended to examine the potential impacts to the human environment, and not to wildlife. Since the project is almost entirely within the Cape Hatteras National Seashore and PINWR, the transportation agencies should further explore this issue with the FWS, the North Carolina Wildlife Resource Commission and other university experts regarding any impacts of toxic compounds and other air pollutants from the project on native wildlife populations."

> **Response:** *The MSAT assessment did not find that any of the alternatives would result in substantial MSAT-related impacts.*

<u>*Other*</u>

The United States Department of Agriculture-Natural Resources Conservation Service also sent letters on March 8, 2007 and April 4, 2007, but did not have comments.

8.12.2.2 State

North Carolina Department of Environment and Natural Resources-January 23, 2006 (page A-37)

Comment: "The Pamlico Sound Bridge Corridor would be a new alignment bridge within the Pamlico Sound and is approximately 17.5 miles. Construction of this bridge would require about 8 miles of dredging. This raises issues with water quality in reference to turbidity associated with construction and possible direct impacts to SAVs. We found the environmental document lacked information on SAV impacts due to incomplete surveys and incomplete details associated with the 8 miles of dredging. In 1994, the department favored using top-down construction in wetland and SAV areas. This type of construction technique provides a means of minimizing environmental impacts especially in relation to the Pamlico Sound Bridge Corridor. While the Pamlico Sound Bridge Corridor has been identified as costing more than the Parallel Bridge, the Pamlico Sound Bridge would bypass the Pea Island National Wildlife Refuge, avoid expensive long term beach nourishment and be a more reliable source of transportation for a longer length of time."

> **Response:** *The SDEIS and SSDEIS relied on available sources of information on SAV locations. The Pamlico Sound Bridge Corridor was placed at depths in Pamlico Sound that reduced the likelihood for SAV impacts. Cost estimates for the Pamlico Sound Bridge Corridor alternatives assumed the use of work bridges rather than dredging in likely SAV areas. Detailed SAV surveys would have been conducted to identify SAV locations more specifically had the Pamlico Sound Bridge Corridor been selected as the Preferred Alternative.*

Comment: "The Parallel Bridge Corridor alternative with beach nourishment would use the existing NC 12 through the Pea Island National Wildlife Refuge. This alternative is approximately 12.5 miles and would require continued protection of NC 12 between Oregon Inlet and Rodanthe through beach stabilization. The Parallel Bridge Corridor with nourishment has its own unique impacts due to moving barrier islands. As noted in the SDEIS, this proposal would impact wetlands and coastal wetlands. The Parallel Bridge Corridor with nourishment could affect natural ecological conditions within the Refuge and beach organisms in both the short and long term. With this said, the SDEIS notes that this alternative will cause minimal secondary and cumulative impacts due to the fact that the replacement bridge corridor alternatives would not alter area development. Considering the effects of construction on the Refuge, fish and wildlife habitat and long term maintenance and repair of NC 12, the department does not agree that secondary and cumulative impacts will be minimal and finds the SDEIS inadequate in this manner."

> **Response:** *Section 4.7 of this FEIS includes an expanded discussion of the direct natural resource impacts associated with the Phased Approach/Rodanthe Bridge Alternative (Preferred) over the extended time frame of construction. NCDOT and FHWA consider all impacts associated with the proposed action, including construction, to be direct impacts and not indirect and cumulative impacts. A discussion of the impacts of NC 12 maintenance prior to the implementation of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is added to Section 4.7. All of the detailed study alternatives are located west of the 2060 high erosion shoreline, placed on bridges, or involve a regular schedule of beach nourishment with the expectation that the regular NC 12 maintenance associated with shoreline erosion that currently occurs following storm events would no longer occur once the project is complete.*

Comment: "We concur that access to the island should be maintained in a safe, efficient manner that will not be subject to shoreline movement. The environmental document should adequately recognize the long-term impacts of replacing the Bonner Bridge and provide appropriate documentation that all environmental impacts have been considered and analyzed. In identifying the inconsistencies, the department feels the SDEIS falls short of being an efficient decision-making document. Examining secondary and cumulative impacts are also essential. The department finds misleading statements throughout the document. For example, the department does not agree that bridge alternatives are equal in the degree of impacts. We do not agree that the Department of Transportation has fully evaluated the long-term environmental impacts of keeping NC 12 intact at its current location due to beach erosion and the uncertainty of coastal storms. Nourishment would occur in four locations and could be repeated at four-year intervals until 2060? Under these circumstances will compatible sand be available to nourish NC 12 until 2060? The SDEIS noted there may be adequate and compatible sources in the area but details were not available. Did the Department of Transportation consider inflation cost for sand replacement?

Based on the attached comments and the desire to move this project forward it is recommended that agency comments be adequately addressed in the FEIS. It is also imperative that the U.S. Department of Transportation determines if they will approve the use of 4(f) lands and the compatibility determination needs to be resolved by the U.S. Fish & Wildlife Service in order to determine the best possible alternative. In bringing these various issues to the surface, the department cannot specifically support any alternative at this time."

> **Response:** *A nourishment alternative was not selected as the Preferred Alternative. If it had been selected as the Preferred Alternative, additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.10.2.1 of the FEIS pertaining to available and suitable sand sources would have been identified. The costs for all alternatives are in current-year (2006) dollars, as is customary in these studies; however, the cost estimates for all activities through 2060 have been included. The Phased Approach/Rodanthe Bridge Alternative (Preferred) remains within the existing NC 12 easement, and will not have a constructive use of the Refuge. As such, Section 4(f) does not apply to this alternative except on Bodie Island where it would use land from the Seashore. Also, since the Phased Approach/Rodanthe Bridge Alternative (Preferred) remains within the NC 12 easement within the Refuge, a compatibility determination is not required.*

North Carolina Department of Environment and Natural Resources-April 12, 2007 (page A-39)

Comment: "The Phased Approach/Rodanthe Bridge A1ternative consists of four phases with a construction timeframe of 12.5 years. The phased approach raises both short and long term environmental concerns. Of particular interest is the potential to cause permanent damage to the natural ecological conditions within the refuge and surrounding areas. The department continues to raise issues about erosion impacts, sediment, impacts to wetlands and coastal wetlands and sand sources for nourishment. In addition, more specific concerns and informational weaknesses are identified in the attached comments from our resource agencies."

> **Response:** *This position is acknowledged. The specific comments are addressed below for the various divisions of the North Carolina Department of Environment and Natural Resources.*

North Carolina Department of Environment and Natural Resources-Division of Coastal Management-January 20, 2006 (page A-39)

Comment: "It appears as though the Parallel Bridge Corridor with Road North/Bridge South alternative and the Parallel Bridge Corridor with All Bridge alternative are the least preferred alternatives due to significant impacts to Coastal Area Management Act (CAMA) Coastal Wetlands. We therefore recommend that these two alternatives be dropped from further consideration."

> **Response:** *Chapter 2 of this FEIS presents a historical discussion of the alternatives development process, which began in 1990. Section 2.6 of this FEIS examines the Parallel Bridge Corridor with NC 12 Maintenance alternatives and discusses the reasons for the elimination of specific alternatives and the reasons for retaining three alternatives for detailed evaluation in the SDEIS. These two alternatives, however, were not selected as the Preferred Alternative for the project.*

Comment: "This project will impact the following CAMA Areas of Environmental Concern: Estuarine Waters; Coastal Wetlands; Estuarine Shorelines; Public Trust Areas; Ocean Erodible Area; High Hazard Flood Area; Inlet Hazard Area; and Unvegetated Beach Area. Therefore, this project will require a CAMA major permit. A formal DCM review of the project to determine consistency with the state's Coastal Management Program cannot occur until a CAMA major permit application is received. At that time, the CAMA major permit application will be circulated to the network of state agencies that comprise North Carolina's Coastal Management Program. The statutes, rules and policies of each of these agencies must be considered during the review of the CAMA permit application. The consideration and incorporation by NCDOT of the comments contained within this letter should help to expedite the CAMA major permit application review process. However, due to the complexity of the project and the extent of environmental impacts that are proposed, NCDOT is urged to submit the CAMA major permit application for this project to DCM a minimum of one year prior to the anticipated construction let date.

During the CAMA major permit application review process, DCM may have additional comments after examining the more detailed environmental information that will be provided with the permit application. DCM may also place conditions on any CAMA permit that is issued to minimize environmental impacts. The information provided in this letter shall not preclude DCM from requesting additional information throughout the CAMA major permit application review process, and following normal permitting procedures."

> **Response:** *NCDOT will submit the CAMA permit application as early as possible given the urgency to replace Bonner Bridge.*

Comment: "All of the alternatives appear to be consistent with/not in conflict with the Dare County 1994 Land Use Plan approved by the Office of Coastal Resource Management (OCRM) on 4/30/99 and the Dare County 2003 Land Use Plan certified by the Coastal Resources Commission (CRC) on 7/24/03."

> **Response:** *This position is acknowledged. No response is needed.*

Comment: "Wetland exchange (converting one wetland type to another wetland type of higher functional value) is mentioned as a potential mitigation option if sufficient onsite mitigation is not available. This is not an acceptable form of wetland mitigation. The type of wetland that exists at a given site is tied to the particular hydrologic properties of the site. Also, while one type of wetland may perform some functions more than another type of wetland, it is not really possible to compare the overall wetland function of different wetland types, as different types of wetlands inherently perform different functions. Wetland enhancement credit should be reserved for instances where degraded wetland functions are restored, not for conversion of wetlands from one type to another. If sufficient onsite mitigation is not available, additional mitigation should be found off-site. Off-site mitigation should consider the Outer Banks area to ensure that the restored wetlands replace the impacted resources. Given the intense development pressure on the Outer Banks, preservation may be a reasonable off-site mitigation option for 404 wetlands. Preservation is not an acceptable form of mitigation for CAMA Coastal Wetlands.

Without a detailed mitigation plan, it is difficult to comment on the adequacy of the proposed mitigation. Based on the descriptions provided in the SDEIS, the existing bridge approach and ferry access road, ditched wetlands on Bodie Island, and removal of Bodie Island dike trail all seem to be reasonable mitigation options. Eradication of the *Phragmites* stands in the Pea Island National Wildlife Refuge for wetland enhancement credit is a promising option, but there remains the issue of who will maintain the site over time to ensure that *Phragmites* does not become re-established. However, NCDOT should be required to establish a long-term maintenance fund to treat the *Phragmites* if it does become re-established.

If NCDOT decides to use the Ecosystem Enhancement Program to satisfy part or all of the mitigation requirements, strong coordination with appropriate resource agencies is strongly encouraged to ensure that the mitigation efforts adequately offset losses."

> **Response:** *During the permitting phase of the project, Concurrence Points 4B (30 percent hydraulics review) and 4C (permit drawings review) of the NEPA/Section 404 merger process, NCDOT will investigate on-site mitigation opportunities throughout the area. NCDOT will coordinate with the NC Department of Environment and Natural Resources' Ecosystem Enhancement Program (NCDENR-EEP) for off-site stream and wetland mitigation where on-site mitigation is not practicable.*

Comment: "DCM is very concerned about public trust usage of the lands and waters within Pea Island National Wildlife Refuge. If either of the Pamlico Sound Bridge Corridor alternatives is selected as the LEDPA, then NCDOT and the United States Fish and Wildlife Service (USFWS) should develop an acceptable plan for maintaining public access to the lands and waters within Pea Island National Wildlife Refuge."

> **Response:** *Neither Pamlico Sound Bridge Corridor alternative was selected as the Preferred Alternative. The Phased Approach/Rodanthe Bridge Alternative (Preferred), when completed, will allow for two points of access inside the Refuge. Since construction of the project would be phased, USFWS would have an opportunity to carefully consider and implement additional access opportunities.*

Comment: "DCM is also concerned about potential impacts to public trust usage in the Pamlico Sound if either of the Pamlico Sound bridge corridors is selected as the LEDPA. If either of the Pamlico Sound Bridge Corridor alternatives is selected as the LEDPA, then the design of the Pamlico Sound Bridge causeway should be modified to create some sections that are higher than 10 feet above mean high water level. This is necessary to allow for passage of traditional vessels (commercial and recreational) that cannot navigate under the planned 10- foot vertical clearance above mean high water level. The number, frequency and dimensions of these navigational passageways should be decided by the NEPA 404 project team during the avoidance and minimization discussion if either of the Pamlico Sound Bridge Corridor alternatives is selected as the LEDPA."

> **Response:** *Neither of the Pamlico Sound Bridge Corridor alternatives was selected as the Preferred Alternative. The Pamlico Sound Bridge Corridor would have included a navigation zone that is longer than existing Bonner Bridge's navigation zone. The navigation zone for the Pamlico Sound Bridge Corridor would be 1,600 to 2,000 feet (488 to 610 meters) long. In that zone, the minimum navigation opening would be 200 feet (61 meters) horizontally and 75 feet (23 meters) vertically. If this alternative had been selected as the Preferred Alternative, NCDOT would have revisited the proposed bridge height in the non-navigation areas based on this comment.*

Comment: "The two Pamlico Sound Bridge alternatives have a limited amount of direct wetland impacts, with most impacts occurring to wetlands that are already man-dominated. It is not apparent that any indirect impacts to wetlands would occur as a result of construction of the bridge through the Pamlico Sound Bridge Corridor. Of the two alternatives, the Intersection Rodanthe Terminus is preferable because it has fewer overall wetland impacts, but the difference between the two alternatives is relatively small.

DCM is especially concerned about the 8 miles of dredging that is proposed for construction of the Pamlico Sound Bridge Corridor. Detailed information assessing the dredging impacts to shallow water habitats, shellfish beds, sub-aquatic vegetation (SAV) habitat and other estuarine resources was not provided in the document. There was also limited discussion on where the extremely large amount of excavated material would be placed and any potential impacts to estuarine or ocean resources which could occur from its disposal."

> **Response:** *Neither of Pamlico Sound Bridge Corridor Alternatives was selected as the Preferred Alternative. Additional information on aquatic impacts is included in an Essential Fish Habitat Assessment (CZR, Incorporated, 2008). Potential sites for the disposal of excavated material are discussed in Section 4.13.5 of the SDEIS and the FEIS. The nondiscretionary measures outlined in the Biological and Conference Opinions (USFWS, 2008) for the Phased Approach/Rodanthe Bridge Alternative (Preferred) related to piping plovers specify that "all dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission." The NCDOT is committed to implementing this measure.*

Comment: "Beach nourishment may also be a viable alternative. However, the viability of the Parallel Bridge Corridor with Beach Nourishment alternative is limited by available beach compatible sand that is in reasonable proximity to the project study area. The viability of this alternative is also limited by the potential for significant adverse impacts to ocean resources. While the document mentioned that there may be adequate and compatible sand sources close by, there has been no detailed investigation provided. Therefore, DCM must question the practicability of this alternative without the assurance that adequate amounts of beach compatible sand resources will be available to sustain the 50-year life of this project. Sand availability could be even more limited when considering that many municipalities along the oceanfront sections of Dare County are also actively pursuing beach nourishment projects of their own."

> **Response:** *The Nourishment Alternative was not selected as the Preferred Alternative. If it had been selected as the Preferred Alternative, additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.10.2.1 of the FEIS pertaining to available and suitable sand sources would have been sought.*

Comment: "In addition, beach nourishment projects can have significant negative impacts on the flora and fauna of the coastal ecosystem. For example:

1) If the renourishment cycles are too close together temporally and/or spatially, flora and fauna may not be able to adequately repopulate the nourished areas between nourishment events. This can lead to a "sterile" beach that is impoverished of its typical biodiversity;

2) If the sand resource is not compatible with the native beach material in grain size and/or color, sea turtles may not have suitable nesting habitat, the proportion of male vs. female sea turtle hatchlings may be altered, and shorebirds may not be able to find adequate amounts of invertebrates for food; and

3) Although a single beach nourishment project may not have a significant adverse effect on the beach ecosystem, there may be a significant adverse effect when cumulative and secondary impacts of other beach nourishment projects in the vicinity are considered."

> **Response:** *A nourishment alternative was not selected as the Preferred Alternative. The four-year nourishment cycle defined in Section 2.8.2.1 of the SDEIS and Section 2.10.2.1 of the FEIS was selected taking into consideration the first point. The need for biologically compatible sand was assumed. If a nourishment alternative had been selected as the Preferred Alternative, additional detail on its characteristics would have been developed, including gathering additional data on the availability of biologically compatible sand.*

Comment: "The amount of wetlands that would be impacted by the Parallel Bridge Corridor with Beach Nourishment alternative would be similar to the two Pamlico Sound Bridge Corridor alternatives. By maintaining NC Highway 12 at its current location, this alternative would not come into direct conflict with the high quality wetland resources contained within the Pea Island National Wildlife Refuge. If the Parallel Bridge Corridor with Beach Nourishment alternative is selected as the LEDPA, then the NEPA/404 project team will need to find a way to substantially avoid and minimize the impacts of beach nourishment."

> **Response:** *Comment acknowledged. A nourishment alternative was not selected as the Preferred Alternative.*

North Carolina Department of Environment and Natural Resources-Division of Coastal Management-April 11, 2007 (page A-41)

Comment: "A formal DCM review of the project to determine consistency with the state's Coastal Management Program cannot occur until a CAMA major permit application is received. At that time, the CAMA major permit application will be circulated to the network of state agencies that comprise North Carolina's Coastal Management Program. The statutes, rules and policies of each of these agencies must be considered during the review of the CAMA permit application. The consideration and incorporation by the N.C. Department of Transportation (NCDOT) of the comments contained within this letter should help to expedite the CAMA major permit application review process. However, due to the complexity of the project and the extent of environmental impacts that are proposed, NCDOT is urged to submit the CAMA major permit application for this project to DCM a minimum of one year prior to the anticipated construction let date.

During the CAMA major permit application review process, DCM may have additional comments after examining the more detailed environmental information that will be provided with the permit application. DCM may also place conditions on any CAMA permit that is issued to minimize environmental impacts. The comments provided in this letter shall not preclude DCM from questing additional information throughout the CAMA major permit application review process, and following normal permitting procedures."

> **Response:** *Comment acknowledged. NCDOT will submit the CAMA permit application as early as possible given the urgency to replace Bonner Bridge.*

Comment: "All of the alternatives being studied for TIP No. B-2500 will impact CAMA Areas of Environmental Concern (AECs). Therefore, any alternative that is selected as the LEDPA will require a CAMA major permit. It is possible that the location of such a massive, permanent structure like the Bonner Bridge and NC Highway 12 within the Outer Banks coastal ecosystem could prevent any of the alternatives being studied for TIP No. B-2500 from complying completely with the rules of the N.C. Coastal Resources Commission (CRC). Therefore, it is possible that DCM will need to deny a CAMA permit application for any of the alternatives for procedural reasons. DCM will work closely with the NEPA/404 Project Team to ensure that whatever alternative is selected as the LEDPA complies with the rules of the CRC to the maximum extent practicable. DCM's concurrence with the selection of a LEDPA will indicate that DCM will support that alternative if the CAMA permit must be denied, and the permit application needs to go before the CRC for a variance. …"

> **Response:** *Position and need to comply with CAMA process are acknowledged, including if needed the process of seeking a variance. Note that the Phased Approach/Rodanthe Bridge Alternative (Preferred) does not include beach nourishment.*

Comment: "Based upon the information provided within the 2007 Supplement, the Parallel Bridge Corridor Phased Approach/Rodanthe Bridge and Parallel Bridge Corridor Phased Approach/Rodanthe Nourishment Alternatives both are consistent with/not in conflict with the Dare County 1994 Land Use Plan approved by the Office of Coastal Resource Management (OCRM) on 4/30/99 and the Dare County 2003 Land Use Plan certified by the CRC on 7/24/03."

> **Response:** *This position is acknowledged. No response is needed.*

Comment: "DCM is very concerned about public trust usage of the lands and waters within the project area. Public trust usage such as navigation and recreation within Pamlico Sound, Oregon Inlet and the Atlantic Ocean, fishing opportunities at Oregon Inlet and access to the lands and waters within Pea Island National Wildlife Refuge will be important considerations when selecting a LEDPA. As much as possible, public trust usage should be accommodated in the alternative designs before a LEDPA is selected."

> **Response:** *This concern is acknowledged. Impacts to recreation opportunities in the Pamlico Sound, Oregon Inlet, and the Atlantic Ocean are addressed in Sections 4.5.3.2 and 4.5.4 of the SDEIS, Sections 4.5.3.2, 4.5.3.3, and 4.5.4 of the SSDEIS, and this FEIS.*

Comment: "The 2007 Supplement and 2005 SDEIS do not provide a concise summary and comparison of all temporary and permanent impacts to biotic communities between all of the alternatives under consideration in a format that allows the reviewer to readily make comparisons between the alternatives. The package of information that is provided to the NEPA/404 Project Team prior to the LEDPA meeting should include a concise summary and comparison of all temporary and permanent impacts to biotic communities between all of the alternatives under consideration, including but not necessarily limited to fill, pile placement, excavation and shading. This should include construction impacts; including impacts to the beach nourishment borrow site(s) and dredging disposal sites."

> **Response:** *Tables 4-9 and 4-10 of the SDEIS and Table 4-1 of the SSDEIS, which summarize impacts to biotic communities, are combined in the FEIS.*

Comment: "Developing suitable compensatory mitigation for the impacts to wetlands and waters of the State, including SAV, will likely be a challenging undertaking for the mitigation provider. Close coordination between the mitigation provider and NCDOT, DCM, the N.C. Division of Water Quality (DWQ), the N.C. Division of Marine Fisheries (DMF), the N.C. Wildlife Resources Commission (WRC), the U.S. Army Corps of Engineers (USACE), the U.S. Environmental Protection Agency (EPA) and other interested state and federal agencies is strongly encouraged."

> **Response:** *NCDOT will coordinate with the above referenced agencies regarding compensatory mitigation within the context of Concurrence Points 4B (30 percent hydraulics review) and 4C (permit drawings review) of the NEPA/Section 404 merger process.*

Comment: "Like the Parallel Bridge Corridor Nourishment Alternative, the viability of the Parallel Bridge Corridor Phased Approach Rodanthe Nourishment Alternative is limited by available beach compatible sand that is in reasonable proximity to the project study area. The viability of both alternatives is also limited by the potential for significant adverse impacts to ocean resources. The 2007 Supplement does not demonstrate that there are adequate and compatible sand sources close by to accomplish the proposed nourishment for the Parallel Bridge Corridor Phased Approach/Rodanthe Nourishment Alternative every 4 years for the 50-year life of this project."

> **Response:** *As was assumed for the Nourishment Alternative, additional surveys for suitable nourishment sand would have been conducted had this alternative been selected as the Preferred Alternative. A nourishment alternative was not selected as the Preferred Alternative.*

Comment: "On Page 2-10, the 2007 Supplement states that: "The estimated amount of sand needed for the Phased Approach/Rodanthe Nourishment Alternative if nourishment begins in 2007 is 2.3 million cubic yards for the first cycle of nourishment, and 1.5 million cubic yards every four years throughout the life of the project (through 2060)." DCM does not understand with the current project timeline how nourishment would begin in 2007. This should be further explained by NCDOT."

> **Response:** *An initial cycle of nourishment was incorporated because of the severity of shoreline erosion within Rodanthe. However, interim measures, including sandbag placement and dune reconstruction, completed by NCDOT (with the cooperation of the Refuge) have negated the need for this first cycle of nourishment. The reference to nourishment beginning in 2007 is removed from the FEIS.*

Comment: "DCM is concerned that the successful implementation of the Parallel Bridge Corridor Phased Approach/Rodanthe Bridge and Parallel Bridge Corridor Phased Approach/Rodanthe Nourishment Alternatives may be too dependent upon the estimated position of the ocean shoreline through the year 2060. Short-term erosion events should be considered when looking at the worst-case scenario shorelines in addition to long-term erosion rates."

> **Response:** *The high erosion rate used to define the Phased Approach alternatives (including the Preferred Alternative) is the best available information upon which to predict today the timing of the implementation of the various phases and is the same rate used to define the other Parallel Bridge Alternatives. Additional information related to shoreline monitoring and adapting the timing of the NC 12 phases to actual conditions as the shoreline evolves are presented in Section 2.10.2.5 of this FEIS.*

Comment: "A permanent bridge that is constructed in a location that is projected to be in the ocean during the bridge's lifespan will be exposed to significant wave energy. While this design may be technically feasible, it does not appear to be practicable."

> **Response:** *Technical feasibility means that design and construction of the Phased Approach (including the Preferred Alternative) physically can be performed under the constraints prescribed. Conventional construction techniques are available for heavy/highway contractors to use to build these bridges while maintaining traffic, remaining inside of the existing right-of-way, and not substantially affecting areas of SAV or wetlands, etc. The project constraints present unique complexities to the construction of the project. However, it is known that these complexities can be effectively addressed. Further explanation of construction techniques is provided in Section 2.10.2.4.*

Comment: "Prior to selecting a LEDPA, DCM would like to know how the bridges for all of the alternatives under consideration will be disposed of when they have reached the end of their service life. Prior to selecting a LEDPA, DCM would also like to know the estimated life spans for the bridges of all of the alternatives under consideration. The bridge life spans, and possibly the future disposition plans, may have a strong impact on the long-term cost effectiveness of the alternatives under consideration."

> **Response:** *The design life assumed in the SDEIS and SSDEIS was 50 years, although bridge structure components of the alternatives could potentially last longer than 50 years. A discussion of the disposal of the proposed bridge when it has reached the end of its service life is presented in Section 2.11.3 of this FEIS.*

Comment: "DCM looks forward to working with the NEPA/404 Project Team to select a LEDPA for this critically important transportation project as soon as possible. NCDOT is strongly encouraged to coordinate closely with all of the NEPA/404 Project Team members in advance of the NEPA/404 Project Team LEDPA meeting to ensure that all of the information that is needed to select a LEDPA is available prior to the meeting."

> **Response:** *NCDOT provided information needed to select a LEDPA prior to the associated NEPA/Section 404 Merger Team meetings. The three LEDPA-related Merger Team Meetings are described in Sections 8.10.1.1, 8.10.1.2, and 8.10.1.3.*

Comment: "As stated in the 1/20/06 DCM letter, it appears as though the Parallel Bridge Corridor with Road North/Bridge South Alternative and the Parallel Bridge Corridor with All Bridge Alternative are the least preferred alternatives due to significant impacts to the CAMA Coastal Wetlands AEC. We therefore continue to recommend that these two alternatives be dropped from further consideration so that the additional time and effort needed to prepare for the LEDPA meeting can be focused on the remaining alternatives under consideration."

> **Response:** *The Parallel Bridge Corridor with Road North/Bridge South and the Parallel Bridge Corridor with All Bridge alternatives were not selected as the Preferred Alternative.*

Comment: "When the NEPA/404 Project Team selects a LEDPA, the participants should be reasonably sure that the design features necessary to successfully implement all of the alternatives under consideration have been incorporated into each of the alternative designs to the same level of detail. Design features that should be incorporated into the alternative designs prior to selection of a LEDPA, if this can be accomplished in a timely manner, include, but are not necessarily limited to: (1) vertical clearance of bridges; (2) implementation of AASHTO/FHWA Joint Wave Task Force interim guidance for quantifying wave forces on bridges, structural design approaches for wave forces, and deployment of countermeasures for existing bridges; (3) bridge foundation assumptions; (4) implementation of mechanisms identified by the physical modeling of the hydraulics of the Oregon Inlet area for mitigating the risk of erosion and inlet formation; and (5) construction methodologies. If this information is not available prior to the scheduled NEPA/404 Project Team LEDPA meeting, then the NEPA/404 Project Team should make an informed decision whether to wait until more information is available, or whether to proceed with the selection of a LEDPA with the best available information at the time."

> **Response:** *Design features presented in the SDEIS and the SSDEIS, supplemented by responses to questions asked by the NEPA/Section 404 Merger Team during their meetings to discuss the LEDPA were adequate to select the LEDPA. The three LEDPA-related Merger Team Meetings are described in Sections 8.10.1.1, 8.10.1.2, and 8.10.1.3.*

Comment: "As stated in the 1/20/06 DCM letter, the transportation link that the Herbert C. Bonner Bridge provides between Hatteras Island and Bodie Island is a critical component in the safety of the residents and visitors of Hatteras Island and Ocracoke Island, and the economic vitality of the Outer Banks. Given the importance of this transportation link and the advancing age of the existing Bonner Bridge, DCM continues to urge DOT to move expeditiously towards the development of a final project design that satisfies the transportation needs of the residents and visitors of Bodie, Hatteras and Ocracoke Island, while also ensuring that coastal resources are adequately protected."

> **Response:** *NCDOT will continue to move expeditiously towards the development of a final project design that satisfies the transportation needs of the residents and visitors of Bodie, Hatteras and Ocracoke Island, while also ensuring the coastal resources are adequately protected.*

North Carolina Department of Environment and Natural Resources-Division of Marine Fisheries-January 13, 2006 (page A-44)

Comment: "The major factors in determining the range of bridge alternatives which can be considered for this project are dependent on a Compatibility Determination under the National Wildlife Refuge System Improvement Act of 1997. The SDEIS states, "The USFWS compatibility determination will be presented in the Final EIS." Potential delays in obtaining a decision concerning compatibility may lead to project delays."

Response: *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is confined within the existing NC 12 easement for which NCDOT has a permit, so a compatibility determination is not required. The Phased Approach is consistent with the original purpose of the permanent easement.*

Comment: "The Pamlico Bridge corridor contains a proposed bridge that would be approximately 17.5 miles long, with approaches, a total length of approximately 18 miles. About 8 miles of dredging would be needed for construction of this bridge. Waters with depths less than 6 ft would need to be dredged to 8 ft. The SDEIS indicates that dredging would be restricted to shallow portions of alignment near Rodanthe and Bodie Island. Another section indicates that a work bridge on the Bodie Island side would be constructed over marsh and SAV areas. In previous meetings and documents, resource agencies were told that barges could be utilized in waters with a depth of 6 ft. or more. Thus, the Pamlico Sound Bridge alignment is proposed outside the SAV areas, which are in depths less than 6 ft. Approximately one mile of the area near Rodanthe contains SAVs and a work bridge is proposed in this area. A current SAV survey map is greatly needed with the proposed alignment overlaid to truly assess impacts. Existing water depths must be supplied along the proposed alignment to determine areas that will require dredging. An important question is that if a 6 ft. depth is adequate for the barges, why is there proposed dredging to an 8 ft. depth?"

Response: *The SDEIS and SSDEIS relied on available sources of information on SAV locations. The Pamlico Sound Bridge Corridor was placed at depths in Pamlico Sound that reduced the likelihood of SAV impacts. Detailed SAV surveys would have been conducted to identify SAV locations more specifically had the Pamlico Sound Bridge Corridor been selected as the Preferred Alternative. The proposed dredging to an 8 foot depth is needed to reduce the frequency of re-dredging as the channel naturally fills in.*

Comment: "The proposed vertical clearance outside the navigation system (75 ft) is only 10 ft. This height would result in a hazard to navigation for boats passing under the bridge. We recommend a greater clearance above the normal water level for the entire bridge outside the main navigation areas near Oregon Inlet or at least periodically along the bridge length, including near the southern terminus at Rodanthe."

Response: *This comment is referring to the Pamlico Sound Bridge Corridor Alternative. This alternative was not selected as the Preferred Alternative. If this alternative had been selected as the Preferred Alternative, NCDOT would have revisited the proposed bridge height in the non-navigation areas based on this comment.*

Comment: "The document indicates that spoil from dredging would be placed in an in-water borrow sites. Where exactly are these located? What surveys have been conducted to determine the least damaging locations for these sites?"

Response: *Section 4.13.5 of both the SDEIS and the FEIS discusses potential waste disposal sites. Final decisions on waste disposal sites will be done during the permitting phase. The nondiscretionary measures outlined in the Biological and Conference Opinions (USFWS, 2008) for the Phased Approach/Rodanthe Bridge Alternative (Preferred) related to piping plovers specify that "all dredge spoil excavated for construction barge access must be used to augment either existing dredge-material* *islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission." The NCDOT is committed to implementing this measure.*

Comment: "The Pamlico Sound Bridge Corridor will be west of Oregon Inlet, resulting in less sand movement. This would probably reduce the amount of dredging required."

Response: *As noted in Section 4.6.4 of the SDEIS and the FEIS, "A replacement bridge within either of the replacement bridge corridors would make navigation channel dredging operations easier to undertake and could reduce the frequency and size of dredging operations from what is required today."*

Comment: "The [Pamlico Sound Bridge] corridor depending on the termini, would permanently affect 10.8-12.8 acres of biotic communities, yet it would result only in the loss of 0.01 acres of coastal wetlands. Please explain this great difference between permanent effects and actual loss."

Response: *Section 4.7.3 of the FEIS discusses the impacts on the biotic communities. Within the construction limits of the Pamlico Sound Bridge Corridor alternatives, there are several types of biotic communities (habitat), which are detailed in Table 4-10. In total, the Pamlico Sound Bridge Corridor depending on the termini, would permanently affect a total of 10.8 to 12.8 acres (4.4 to 5.2 hectares) of habitat. Of these total acreages only 0.01 acre (less than 0.01 hectare) is coastal wetlands, which include smooth cordgrass and wetland black needlerush communities.*

Comment: "The Parallel Bridge would be located west of the existing bridge and be approximately 2.7 miles in length. A vertical clearance of 75 ft. throughout the structure length would exist. In one section of the document a dredged channel is indicated behind Bodie Island that would be 120 ft wide with a depth of 10 ft. The channel would likely require continuous dredging with material placed in an in-water disposal site (Would this be a new long-term site?) or used for beach nourishment, if appropriate. In another area of the document a haul road is indicated. To the north of Hatteras Island an area approximately 2000 ft long is proposed for dredging, including approximately 5.5 acres. Current SAV coverage and water depths should be provided for the area with the alignment overlaid for agencies' review."

Response: *During construction, the channel would likely require continuous dredging with material placed in an in-water disposal. Dredge disposal would only be needed during construction. NCDOT surveys in 2007 indicate that about 25 percent of the open water area affected behind Bodie Island includes SAVs. No SAVs are in Oregon Inlet or in the area where the replacement bridge would approach Hatteras Island.*

Comment: "The Parallel Bridge, with Road North/Bridge South would result in the loss or impact of 78.2 acres of wetlands, with 11.8 acres being coastal wetlands. The All Bridge alternative would fill 12.3 acres of wetlands, of which, 2.2 acres are coastal wetlands. These two alternatives would result in 1.4 acres of SAVs being filled, this agency would not support either of these alternatives due to the loss/impact to wetlands and SAVs."

Response: *The Parallel Bridge Corridor with Road North/Bridge South and All Bridge alternatives were not selected as the Preferred Alternative.*

Comment: "The Parallel Bridge with the Nourishment would impact a total of 4.3 acres of wetlands and coastal wetlands account for 0.3 acres of the total. Beach nourishment every four years would result in re-occurring impacts to the near shore biotic community, including numerous species of economically important fishes and their prey. Are adequate borrow sites now available for 50 or more years of nourishment? Exactly where are the sites located? Several sites offshore have been identified as borrow sites for other projects. Adequate analysis of sand compatibility must occur, with results presented for agencies' review."

> **Response:** *The Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative. The best available information pertaining to the analysis of sand compatibility was used in the SDEIS and the SSDEIS. Had an alternative involving nourishment been selected, surveys would have been done to confirm suitable sand availability before finalizing a selection.*

Comment: "A comprehensive table with Pamlico Sound and Parallel Bridge alternatives needs to be included in the document to assess impacts and costs."

> **Response:** *Although the impacts and costs for the Pamlico Sound and Parallel Bridge Alternatives are not in tabular form, the impacts and costs are summarized for all alternatives in Section 6 of the Summary of the SDEIS, SSDEIS, and the FEIS.*

Comment: "The Division of Marine Fisheries has indicated in previous comments on this project that some type of fishing access must be maintained at the north end of Hatteras Island to provide anglers with the reasonable opportunities to fish local waters for sport fishing, including parking comparable to that which currently exists. This is an extremely important area utilized by recreational fishermen on a year round basis. The EIS will not be adequate unless this issue is satisfactorily addressed."

> **Response:** *NCDOT will examine opportunities for continued recreational access during the final planning and design of the Phased Approach/Rodanthe Bridge Alternative (Preferred) (see Section 2.10.1.2 of the FEIS).*

Comment: "The DMF has previously indicated that the Bonner Bridge demolition materials could be used for artificial reef material. The Division requests that suitable (uncontaminated) material be made available to the agency for artificial reef material as a condition of the contract for the Bonner Bridge demolition. Costs for loading, transport and offloading on the designated reef site should also be included in the contract."

> **Response:** *Suitable material can be provided for artificial reef material. The NCDOT will work with the Division of Marine Fisheries to accommodate this desire during demolition planning.*

Comment: "The SDEIS mentions that a partial top down construction technique is possible for some construction. This agency suggests that serious consideration be given to this technique to minimize the impacts to aquatic and wetlands habitats, particularly with the Pamlico Sound Bridge Corridor."

> **Response:** *A partial top down construction technique is not possible with the Oregon Inlet Bridge component of the Phased Approach/Rodanthe Bridge Alternative (Preferred) because of the size of the components and the length of bridge spans (see Section 2.8.1.3*

of the SDEIS and Section 2.10.1 of the FEIS). The NC 12 maintenance component will be built on land, not over water, with limited wetland impacts.

North Carolina Department of Environment and Natural Resources-Division of Marine Fisheries-March 20, 2007 (page A-46)

Comment: "As the Division indicated in previous comments (January 13, 2006), all of the alternatives have environmental issues/consequences. Issues and concerns expressed by the Division in the January 13, 2006 memo would also apply to these alternatives."

Response: *This was assumed in answering comments in the 2006 letter.*

North Carolina Department of Environment and Natural Resources-Division of Water Quality-January 18, 2006 (page A-47)

Comment: "It is unclear what the source will be for the sand required for beach nourishment under the Parallel Bridge - Nourishment Alternative. Not only is the quantity of sand in question but also the quality of sand. Fine particles from non-suitable sand can change the physical habitat of the beach face and swash zones and choke out the invertebrate population. To some extent, this has already occurred in the Refuge due to beach renourishment using sand dredged from the Oregon Inlet.

The SDEIS states that sand dredged from the Oregon Inlet could be used to nourish the beaches of the Refuge. Dredging from the Oregon Inlet is not a reliable sand source. The quality of the dredged sand from the inlet may change and may not be suitable for nourishment of the Refuge beaches over the life of the project. Using unsuitable sand would be detrimental to the Refuge due to the negative impacts on the invertebrate population which is the primary food source of the migratory bird population within the Refuge. In addition, US Fish and Wildlife would not allow sand that does not meet the Refuge standards to be deposited on the Refuge beaches. To that end, the uncertainty of the potential water quality impacts associated with dredging operations for additional sand sources should be considered. Please provide additional information that details the locations of sand sources for beach nourishment."

Response: *An alternative involving nourishment was not selected as the Preferred Alternative. The best available information pertaining to the analysis of sand compatibility was used in the SDEIS and the SSDEIS. It was assumed that sand used in nourishment had to be biologically compatible otherwise it could not be used for nourishment alternatives. Had the Parallel Bridge with Nourishment Alternative been selected, surveys would have been done to confirm compatible sand availability before finalizing a selection of an alternative. In the discussion referenced in the comment regarding use of sand from Oregon Inlet, Section 2.8.2.1 of the SDEIS and Section 2.10.2 of the FEIS discuss the use of sand from the Corps of Engineers ocean bar dredging and not from its dredging of the inlet. It was assumed that if sand dredged from the ocean bar were not biologically compatible, then it would not be used with the nourishment alternatives.*

Comment: "Barrier Islands are dynamic ecosystems as clearly shown in the SDEIS in Figures 3-4 and B-l(a-g). Considering this fact, DWQ has some concerns about the potential impacts to water quality with an alternative that will require intensive maintenance either through nourishment or road relocation. Alternatives that include road sections along similar or parallel alignments would continually face the challenges of beach nourishment, protection and stabilization, as well as the added costs of repairs and clearing due to overwash during storm events. Over the last 16 years, DOT has spent approximately $32 million dollars in maintenance to this section of NC 12 due to overwash and erosion from hurricanes and major storms. This does not include maintenance costs for clean up from minor storms."

> **Response:** *All alternatives were developed as long term solutions, and as such continued intensive maintenance of NC 12 would not be needed. Maintenance of NC 12 would continue with the Phased Approach/Rodanthe Bridge Alternative (Preferred) until all phases are completed. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement.*

Comment: "It is unclear from the Section 4(f) discussion in Section 5.0 how no direct adverse impacts would occur as a result of the Parallel Bridge - Nourishment alternative. It is our understanding, that any fill outside the existing right-of-way could result in an adverse impact, and Section 5.2.2, page 5-23 states that new right-of-way would be required for the Nourishment alternative. Please clarify the section 4(f) discussion to address this apparent inconsistency."

> **Response:** *An alternative involving nourishment was not selected as the Preferred Alternative. Nourishment would use land from the Refuge (a Section 4(f) resource). The summary statement referenced on page 5-23 of the SDEIS, should have noted the placement of sand outside of the right-of-way, which is discussed later in the section.*

Comment: "USFWS issued a permit to DOT to construct a groin at the north end of Hatteras Island to secure the bridge approach for the Bonner Bridge. This permit was issued strictly for the current bridge alignment. If the bridge approach is moved to a different location, then a new permit would need to be issued for any bridge approach located within the Refuge boundaries. It is unclear whether USFWS would issue a permit for a new alignment within the Refuge boundaries."

> **Response:** *The design of the Phased Approach/Rodanthe Bridge Alternative (Preferred) requires the groin to remain in place. NCDOT will seek a permit to maintain the groin if requested by USFWS. FHWA and NCDOT recognizes that the selection of the Phased Approach/Rodanthe Bridge Alternative (Preferred) does not guarantee that a new permit for the terminal groin would be issued.*

Comment: "Tables 4-11 and 4-12 are confusing. Impact comparisons should simply be shown as the "Shading" and "Fill and Pile" impacts for SAVs and wetlands. Although the breakout of the different wetland types is useful information, for the purposes of alternative comparison the impacts should be provided in an additional table that displays in a less complex format the impacts to wetlands and SAVs."

> **Response:** *Tables 4-23 and 4-24 were revised in the FEIS based on this suggestion.*

Comment: "The SDEIS states that dredging may be required to maintain a work channel of 8 feet in depth for work barges. It is the understanding of DWQ that the typical depth needed for work barge operation is six feet. Why is an additional 2 feet of depth required for this project? Please clarify this issue."

> **Response:** *The proposed extra depth is needed to reduce the frequency of re-dredging as the channel naturally fills in during project construction.*

Comment: "As shown in the table below, the Parallel Bridge - All Bridge alternative and the Parallel Bridge - Road North/Bridge South alternative have the most fill and pile impacts of the alternatives. The impacts associated with the All Bridge alternative would be almost three times the amount of impacts associated with the two Pamlico Sound alternatives and the Parallel Bridge - Nourishment alternative. The impacts associated with the Road North/Bridge South alternative would be over 17 times the amount of impacts associated with the two Pamlico Sound alternatives and the Parallel Bridge - Nourishment alternative. Based on these impacts, DWQ believes issuance of a 401 Water Quality Certification for the Parallel Bridge - All Bridge and the Parallel Bridge - Road North/Bridge South alternatives would be extremely problematic, at best, and likely unpermittable, at worst."

Alternative	Fill and Pile Impacts
Parallel – All Bridge	12.33 acres
Parallel – Road N/Bridge S	78.15 acres

> **Response:** *The Parallel Bridge Corridor with All Bridge and the Parallel Bridge Corridor with Road North/Bridge South alternatives were not selected as the Preferred Alternative.*

Comment: "It is not clear how the "shading" impacts of wetlands for the project were calculated. Please provide clarification on how the shading impacts were determined. Specifically, please provide the shading impacts as those associated with direct construction and those associated with the long term effects of the bridge."

> **Response:** *Shading is the area of the bridge deck and is a long-term effect of the bridges. In general, the bridge deck for alternatives is approximately 40 feet (12.2 meters) wide.*

Comment: "The discounted cash-flow method used to present future costs in present day values needs to be described in greater detail. It is unclear why this assessment is being presented. DWQ cannot recall ever having seen this assessment presented in any other DOT projects. Moreover, the manner in which the numbers were calculated needs to be described in greater detail."

> **Response:** *Discounting is described in Section 2.6.3.3 of the SDEIS and Section 2.12 in the FEIS under "cost." The discounted cost, although important to know, did not prove to be a contributing factor to the selection of the Preferred Alternative.*

Comment: "In accordance with the Environmental Management Commission's Rules {15A NCAC 2H.O506(b)(6)}, mitigation will be required for impacts of greater than 150 linear feet to any single perennial stream or greater than one acre of wetlands. In the event that mitigation is required, the mitigation plan should be designed to replace appropriate lost functions and values. In accordance with the Environmental Management Commission's Rules {15A NCAC 2H.0506 (h)(3)}, the NC Ecosystem Enhancement Program may be available for use as stream and wetland mitigation. A discussion of potential mitigations strategies should be included in the SDEIS."

> **Response:** *Potential mitigation strategies are discussed in Section 4.7.8.3 of the SDEIS and Section 4.7.10.3 of the FEIS.*

Comment: "The 401 Water Quality Certification applications will need to specifically address the proposed methods for storm water management. More specifically, it is suggested that storm water not be permitted to discharge directly into streams or surface waters.

For all bridges on the project, bridge deck drains should not discharge directly into the stream. Storm water should be directed across the bridge and pre-treated through site-appropriate means (grassed swales, pre-formed scour holes, vegetated buffers, etc.) before entering the stream. Please refer to NCDOT Best Management Practices for the Protection of Surface Waters."

> **Response:** *Additional material related to water quality impacts and on the approaches to handling storm water on the bridges is included in Section 4.7.2 of the FEIS. NCDOT's Best Management Practices for the Protection of Surface Waters will be implemented.*

Comment: "If foundation test borings are necessary; it should be noted in the document. Geotechnical work is approved under General 401 Certification Number 3027/Nationwide Permit No. 6 for Survey Activities."

> **Response:** *Test borings are needed and appropriate permits will be obtained.*

Comment: "Sediment and erosion control measures should not be placed in wetlands."

> **Response:** *The position is acknowledged, and it is not NCDOT's intent to place sediment and erosion control measures in wetlands. All activities will be consistent with NCDOT's current sediment and erosion control guidelines.*

Comment: "Borrow/waste areas should avoid wetlands to the maximum extent practicable. Impacts to wetlands in borrow/waste areas could precipitate compensatory mitigation."

> **Response:** *The position is acknowledged and agreed upon per NCDOT's standard operating procedures.*

North Carolina Department of Environment and Natural Resources-Division of Water Quality-April 11, 2007 (page A-48)

Comment: "Section 2.2.2.2 of the referenced document discusses refuge access by one-lane ramps. It is unclear from the discussion whether the ramps would be constructed within the existing right-of-way or if additional right-of-way would be required. Please indicate if the proposed ramps would fit within the existing right-of-way and if not, whether the US Fish and Wildlife Service has approved additional right-of-way."

> **Response:** *The proposed ramps, located on the north end of Hatteras Island, would fit within the existing NC 12 easement.*

Comment: "It is unclear from the discussions in the SSDEIS if a bridge in the surf zone has long-term feasibility. Please provide additional information regarding examples of bridges constructed in the surf zone and the long-term effects of the wave action on the bridge as well as the effects of the bridge on the natural resources in the surf zone."

> **Response:** *There are no known examples of bridges constructed in the surf zone. Additional discussion of the impacts of the bridge when in the surf zone is added to*

Section 4.7 of the FEIS. Section 2.10.1.2 of the FEIS also discusses how the effects of increased wave activity will be taken into account during final design.

Comment: "On page 2-18, the document indicates a 14.9 percent increase in costs identified in the original DEIS. In addition, it identified a 15 percent increase in anticipated costs due to design-build construction being used for the project. Later on the same page, the document indicates that there was an additional 18.7 percent increase (in addition to the extra anticipated costs for design-build). Please clarify the discrepancy."

> **Response:** *These are two different factors as described in Section 2.3.1.2 of the SSDEIS and Section 2.12.1 of the FEIS. The 15 percent is includes 5 percent for design and 10 percent to reflect contractor risk. The 14.9 percent covers inflation from the current time to the estimated mid-point of construction to account for design-build contractor inflation risk. Adding an inflation factor in this way is the design-build cost estimate equivalent of assuming current year (2006) dollars when estimating the cost of a conventional contract delivery project.*

Comment: "As previously discussed, the document identifies an extra 15 percent increase in costs to all the bridge alternatives due to using the design-build construction practices. While the arguments that design-build will cost more due to the fact that DOT will be paying consultants to design the road and that contractors will build in a 10 percent increase in the profit margins to offset risk associated with the project seems reasonable, it is diametrically opposed to every other DOT (and NC Turnpike) project where we have been told that design-build will save both time and money. Please explain this apparent discrepancy."

> **Response:** *The percents added reflect recent experience with the design-build process and standard procedures now used in estimating the cost of design-build projects.*

Comment: "As previously discussed on page 2-18, the document assumes a 5 percent annual increase in costs for the project. While DWQ agrees that a recent worldwide cyclical boom in commodities has resulted in a significant increase in construction costs recently, it seems unreasonable to assume that trend will continue indefinitely. Review of information provided at the US Federal Reserve Bank's website indicates that average overall inflation for the entire economy has averaged 2.6 percent over the past 5 years. In addition, the data indicates that inflation has averaged less than 5 percent every year since 1991. The existing long range projections for inflation that the US Federal Reserve Bank projects for the next 3 years averages between 2-3 percent. Based on this information, it seems reasonable an annual inflation factor of 2-3 percent is more appropriate."

> **Response:** *Five percent is an appropriate assumption of what a design build contractor would presume to cover the risk of inflation. Note that in recent years the inflation of the cost of bridge construction has exceeded the overall national rate of inflation. Since the inflation rate is applied to all alternatives, a different inflation rate would not change the relative differences between the alternatives. A lower inflation rate would not change the affordability of the alternatives.*

Comment: "On page 2-19, the document indicates that previous costs estimates had used an estimated bridge construction cost of $55 per square foot in the SDEIS in 2005. The document then indicates that present estimates use a construction cost of $130-$140 for conventional construction costs, and $210-$220 per square foot for segmented construction costs. The document indicates that the previous estimates using $55 per square foot would be possible because of economies of scale that could be captured. However, the document fails to discuss what economies specifically were anticipated and why they were no longer valid. Please provide this additional information. It is our understanding that present DOT cost estimates use an amount ranging from $100- $115 per square foot. That would seem to be approximately consistent with the lowest cost estimates used in the document, but not as much with the higher estimates. We recognize that the $100-$115 estimate is a simple rule of thumb that is not applicable for all projects. However, a discussion on the site-specific issues that are causing the estimates for this project to be higher than for other projects throughout the state would be beneficial."

> **Response:** *Section 2.3.1.2 of the SSDEIS and Section 2.12.1 of the FEIS summarize in full the changes to the cost assumptions made between the SDEIS and the SSDEIS. The new costs prepared by NCDOT were verified by an independent consultant with bridge construction experience, as well as the FHWA. In the context of the selection of the LEDPA, members of the NEPA/Section 404 Merger Team, including those of the Division of Water Quality, were provided notebooks containing all the cost estimates and their underlying assumptions. NCDOT staff discussed the cost estimates with the Merger Team; the members indicated that their questions related to the cost estimates were satisfactorily resolved.*

Comment: "The document presents a range of cost estimates for this project. However, we are not aware of any other DOT project that used a range of potential costs for analysis in an EIS. Moreover, the reasons given for presenting a range of costs (rather than a single estimate) were very broad and vague in their presentation, and are common uncertainties present in many, if not all, other DOT projects. Project cost is a very important factor that we examine while performing our assessment of impact avoidance and minimization. By presenting a set of alternatives with a very wide range of potential costs, the document creates necessary ambiguity when comparisons among alternatives are performed. Please describe in greater detail the site-specific issues that are creating the apparent ambiguity in developing more specific costs for this project, present a single cost estimate for each alternative as has been done in other projects."

> **Response:** *The range of costs reflects uncertainties associated with this unique project and the dynamic nature of the project area environment, as listed in Section 2.3.1.1 of the SSDEIS and Section 2.12.1 of the FEIS.*

Comment: "On page 2- 19, the document indicates that alternatives that require an expenditure of money over time (i.e., phased alternatives and nourishment alternatives) more closely align benefits derived by the public and the expenditure of the costs for infrastructure. It continues to conclude that alternatives with lower discounted costs can be viewed as providing a better return on investment than those with higher discounted costs. This conclusion is not accurate. While alternatives with lower discounted costs may represent a lower cost as measured in present day dollars, it does not necessarily represent increased value or return on investment. While DWQ understands that discounting costs to present day values is necessary to provide a fair comparison among alternatives that have expenditures occurring over different time frames, the conclusion that lower discounted costs represents better return on investment may be inaccurate. If it is assumed that benefits derived per dollar are less in the future than they are today (due to inflation), then the best rate of return on investment might be projects with higher discounted costs. DWQ recommends that the statement be removed and allow the costs as presented to stand on their own merit."

Response: *The statement that the alternatives with lower discounted costs can be viewed as providing a better return is correct; the 5 percent discount rate accounts for inflation.*

Comment: "The environmental document should provide a detailed and itemized presentation of the proposed impacts to wetlands and streams with corresponding mapping. If mitigation is necessary as required by 15A NCAC 2H.O508(h), it is preferable to present a conceptual (if not finalized) mitigation plan with the environmental documentation. Appropriate mitigation plans will be required prior to issuance of a 401 Water Quality Certification."

Response: *The material described will be developed within the context of the customary NEPA/Section 404 merger process, including Concurrence Point 4A (avoidance and minimization), and Concurrence Points 4B and 4C (permit drawings review).*

Comment: "Environmental assessment alternatives should consider design criteria that reduce the impacts to streams and wetlands from storm water runoff. These alternatives should include road designs that allow for treatment of the storm water runoff through best management practices as detailed in the most recant version of NC DWQ Stormwater Best Management Practices, such as grassed swales, buffer areas, preformed scour holes, retention basins, etc."

Response: *Additional material related to water quality impacts and on approaches to handling storm water on the bridges is included in Section 4.7.2 of the FEIS. NCDOT's Best Management Practices for the Protection of Surface Waters would be incorporated into the design.*

Comment: "After the selection of the preferred alternative and prior to an issuance of the 401 Water Quality Certification, the NCDOT is respectfully reminded that they will need to demonstrate the avoidance and minimization of impacts to wetlands (and streams) to the maximum extent practical. In accordance with the Environmental Management Commission's Rules (15A NCAC 2H.OSOS (h)), mitigation will be required for impacts of greater than 1 acre to wetlands. In the event that mitigation is required, the mitigation plan should be designed to replace appropriate lost functions and values. The NC Ecosystem Enhancement Program may be available for use as wetland mitigation.

In accordance with the Environmental Management Commission's Rules (1 SA NCAC 2H.O506(h)), mitigation will be required for impacts of greater than 150 linear feet to any single perennial stream. In the event that mitigation is required, the mitigation plan should be designed to the appropriate lost functions and values. The NC Ecosystem Enhancement Program may be available for use as stream mitigation."

Response: *The activities described will occur within the context of the customary NEPA/Section 404 merger process, including Concurrence Point 4A (avoidance and minimization), and Concurrence Points 4B and 4C (permit drawings review). There are no streams in the project area.*

Comment: "Future documentation, including the 401 Water Quality Certification Application, should continue to include an itemized listing of the proposed wetland and stream impacts with corresponding mapping."

Response: *The position is acknowledged. Future documentation developed within the context of Concurrence Points 4A, 4B, and 4C, including the 401 Water Quality*

Certification Application, will continue to include an itemized listing of the proposed wetland and stream impacts with corresponding mapping.

Comment: "DWQ is very concerned with sediment and erosion impacts that could result from this project. NC DOT should address these concerns by describing the potential impacts that may occur to the aquatic environments and any mitigating factors that would reduce the impacts."

> **Response:** *Sediment and erosion control is addressed in Section 4.13.7 of the SDEIS and the FEIS. All construction activities will be consistent with NCDOT's current sedimentation and erosion control standards.*

Comment: "An analysis of cumulative and secondary impacts anticipated as a result of this project is required. The type and detail of analysis should conform to the NC Division of Water Quality Policy on the assessment of secondary and cumulative impacts dated April 10, 2004."

> **Response:** *An analysis of the indirect and cumulative impacts is included in the SDEIS, SSDEIS, and this FEIS in Section 4.12.5. The analysis conforms to Division of Water Quality requirements when it documents why induced development is not expected.*

Comment: "NCDOT is respectfully reminded that all impacts, including but not limited to, bridging, fill, excavation and clearing, to jurisdictional wetlands, streams, and riparian buffers need to be included in the final impact calculations. These impacts, in addition to any construction impacts temporary or otherwise, also need to be included as part of the 401 Water Quality Certification Application.

1. Sediment and erosion control measures should not be placed in wetlands or streams.

2. Borrow/waste areas should avoid wetlands to the maximum extent practical. Impacts to wetlands in borrow/waste areas will need to be presented in the 401 Water Quality Certification and could precipitate compensatory mitigation.

3. The 401 Water Quality Certification applications will need to specifically address the proposed methods for stormwater management. More specifically, stormwater should not be permitted to discharge directly into streams or surface waters.

4. Based on the information presented in the document, the magnitude of impacts to wetlands and streams may require an Individual Permit application to the Corps of Engineers and corresponding 401 Water Quality Certification. Please be advised that a 401 Water Quality Certification requires satisfactory protection of water quality to ensure that water quality standards are met and no wetland or stream uses are lost. Final permit authorization will require the submittal of a formal application by the NCDOT and written concurrence from the NCDWQ. Please be aware that any approval will be contingent on appropriate avoidance and minimization of wetland and stream impacts to the maximum extent practical the development of an acceptable stormwater management plan, and the inclusion of appropriate mitigation plans where appropriate.

5. If concrete is used during construction, a dry work area should be maintained to prevent direct contact between curing concrete and stream water. Water that inadvertently contacts uncured concrete should not be discharged to surface waters due to the potential for elevated pH and possible aquatic life and fish kills.

6. If temporary access roads or detours are constructed, the site shall be graded to its preconstruction contours and elevations. Disturbed areas should be seeded or mulched to stabilize the soil and appropriate native woody species should be planted. When using temporary structures the area should be cleared but not grubbed. Clearing the area with chain saws, mowers, bush-hogs, or other mechanized equipment and leaving the stumps and root mat intact of lows the area to re-vegetate naturally and minimizes soil disturbance.

7. If foundation test borings are necessary; it should be noted in the document. Geotechnical work is approved under General 401 Certification Number 3494Nationwide Permit No. 6 for Survey Activities.

8. Sediment and erosion control measures sufficient to protect water resources must be implemented and maintained in accordance with the most recent version of North Carolina Sediment and Erosion Control Planning and Design Manual and the most recent version of NCS000250.

9. All work in or adjacent to stream waters should be conducted in a dry work area. Approved BMP measures from the most current version of NCDOT Construction and Maintenance Activities manual such as sandbags, rock beams, cofferdams and other diversion structures should be used to prevent excavation in flowing water.

10. While the use of National Wetland Inventory (NWI) maps, NC Coastal Region Evaluation of Wetland Significance (NC-CREWS) maps and soil survey maps are useful tools, their inherent inaccuracies require that qualified personnel perform onsite wetland delineations prior to permit approval.

11. Heavy equipment should be operated from the bank rather than in stream channels in order to minimize sedimentation and reduce the likelihood of introducing other pollutants into streams. This equipment should be inspected daily and maintained to prevent contamination of surface waters from leaking fuels, lubricants, hydraulic fluids, or other toxic materials.

12. Riprap should not be placed in the active thalweg channel or placed in the streambed in a manner that precludes aquatic life passage. Bioengineering boulders or structures should be properly designed, sized and installed.

13. Riparian vegetation (native trees and shrubs) should be preserved to the maximum extent possible, Riparian vegetation must be reestablished within the construction limits of the project by the end of the growing season following completion of construction."

> **Response:** *These procedures apply to all NCDOT projects and will be followed within the context of the NEPA/Section 404 merger process, the Section 404 permit application process, and in developing and enforcing the terms and conditions for the design-build contractor. The SDEIS, SSDEIS, and FEIS wetland impact calculations are based on delineated wetlands.*

North Carolina Department of Environment and Natural Resources-Natural Heritage Program-January 12, 2006 (page A-51)

Comment: "The Natural Heritage Program has numerous locations of rare species and significant natural areas in the vicinity of the project. Most of Pea Island National Wildlife Refuge, with the exception of the three man-made impoundments, is a Registered Natural

Heritage Area. The refuge is Nationally significant because of its great importance to wintering and migrating waterbirds. In addition, the beaches are used by nesting loggerhead sea turtles (*Caretta caretta*), a Federally Threatened species. The Federally Threatened piping plover (*Charadrius melodus*) breeds sporadically at both the southern tip of Bodie Island (National Park Service) and the northern tip of Pea Island; it also occurs in migration and occasionally in winter at these sand flats. At least 15 other rare animals, two rare plants, and several colonial waterbird nesting sites have been recorded on the refuge (see enclosed material [pages A-52 and A-53 of this FEIS])."

> **Response:** *Comment noted. Discussions of threatened and endangered species are included in the SDEIS and the FEIS in Sections 3.7.7 and 4.7.9. The Biological and Conference Opinions (USFWS, 2008) document of USFWS is presented in Appendix E.*

Comment: "Several islands inside Oregon Inlet are used for nesting by various colonial waterbirds. Because these islands are constantly shifting and being eroded, the birds also constantly move from year to year. NC DOT should coordinate with the NC Wildlife Resources Commission about the most recent locations and population sizes of the nesting waterbirds inside the inlet. It appears unlikely that these islands and waterbird colonies would be impacted by the Pamlico Sound Bridge Corridor, though NCDOT should make certain that the alignment does not pass over islands where birds have recently nested. Impacts to natural heritage resources, unless to colonial waterbird nesting islands, appear to be minimal with the Pamlico Sound Bridge Corridor alternative. According to Figure 3-6, the proposed alignment of the route appears to almost completely "by-pass" Submerged Aquatic Vegetation. The southern terminus of the Bridge would be in the town of Rodanthe. The northern terminus would be on Bodie Island close to the current northern terminus of the Bonner Bridge and is not likely to impact significant natural resources. In addition, the terminal groin at the tip of Pea Island would no longer serve a need to stabilize the inlet, and might well be removed. This would allow for more natural sand movement and natural inlet movement, thus providing better habitat at the tip of the refuge for nesting turtles and plovers."

> **Response:** *Comment noted. The Pamlico Sound Bridge Corridor alternative was not selected as the Preferred Alternative.*

Comment: "On the other hand, the Parallel Bridge Corridor poses a number of Natural Heritage concerns. The new bridge location by itself is not a concern, as it would parallel the existing bridge, which is to be removed with either alternative. However, wetland impacts will be much greater with the majority of the Parallel Bridge Corridor alternatives. The All Bridge Alternative would cross over at least two of the impoundments, which are used by thousands of birds for foraging. All of the Parallel Bridge Corridor alternatives would require some impacts to the dune system, and one or two would require massive amounts of dune creation and dredge material deposition onto the beaches, all of which negatively impact invertebrate usage of the beaches and might negatively impact nesting by sea turtles. Thus, these Parallel Bridge Corridor alternatives will impact the Registered Natural Heritage Area to some degree."

> **Response:** *None of the alternatives in the SDEIS were selected as the Preferred Alternative. The Phased Approach/Rodanthe Bridge Alternative (Preferred) has lower wetland impacts, no dune creation, and would use Refuge lands within the existing NC 12 easement.*

Comment: "If the Pamlico Sound Bridge Corridor is selected as the preferred alternative, the U.S. Fish and Wildlife Service would be responsible for maintenance of the "old NC 12" through the refuge. The DEIS states on Page 4-39 that "some type of access to the Refuge would be maintained by the USFWS and NPS for recreational users". At this time it is not possible, nor is it feasible, to predict potential negative impacts to the impoundments and to the natural communities such as the salt flats, marshes, and grasslands if the maintenance of "old NC 12" is shifted from NCDOT to USFWS and NPS. However, because of the constantly shifting nature of the barrier islands to the west, sand and salt water have frequently been carried into the freshwater impoundments, and the "buffer" to the east between the Atlantic Ocean and the impoundments becomes narrower each year. Negative impacts to these important sites, though man-made, will be inevitable under either the Pamlico Sound Bridge Corridor or the Parallel Bridge Corridor."

> **Response:** *The impact on the impoundments resulting from allowing beach erosion to occur is considered an acceptable outcome by the National Park Service and the USFWS, as discussed in Sections 4.1.2.3 and 4.1.2.4 of the SDEIS and the FEIS.*

Comment: "In summary, the Natural Heritage Program believes that the Pamlico Sound Bridge Corridor will cause less impact to significant natural resources and to the Pea Island NWR Registered Natural Heritage Area than will the various Parallel Bridge Corridor alternatives."

> **Response:** *This position is acknowledged. No response is needed.*

North Carolina Department of Environment and Natural Resources-Natural Heritage Program-March 26, 2007 (page A-54)

Comment: "The Supplement to the 2005 Supplement notes that the Pamlico Sound Bridge Corridor "would not result in permanent disturbance to Significant Natural Heritage Areas (SNHA) identified by the North Carolina Natural Heritage Program (NCNHP)" (page xx). We would also note that this natural area is also included on the Registry of Natural Heritage Areas under the Nature Preserves Act."

> **Response:** *This classification for the Refuge is described in Section 3.7.5 of the SDEIS and the FEIS.*

Comment: "Page xx states that "The construction of the Parallel Bridge Corridor would result in permanent and temporary disturbance to the Refuge, identified as a SNHA by the NCNHP, with all of the Parallel Bridge Corridor alternatives." Note again that the natural habitats at Pea Island National Wildlife Refuge are Registered Heritage Areas. The SDEIS says that there will be a 10-mile long bridge thru the refuge, at 30 feet above ground. It would be a visual blight (Section 4.3.2). The SDEIS does not make it clear if NC 12 would pass over the impoundments or run along the eastern edges."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is confined within the existing NC 12 easement for which NCDOT has a permit. It does not pass over the impoundments. The NC 12 easement runs along the eastern edges of the impoundments.*

Comment: "Page xxii, it states "The Pamlico Sound Bridge Corridor would support the desire of officials responsible for the Refuge and the Seashore to not stabilize the Outer Banks artificially, but rather to let natural processes take their course." Similarly, from a purely ecological habitat perspective, the Natural Heritage Program favors the Pamlico Sound Bridge Corridor."

> **Response:** *The commenter's position is acknowledged. The reasons why the Pamlico Sound Bridge Corridor was not found to be the LEDPA are in Section 2.15 of the FEIS.*

North Carolina Wildlife Resources Commission-January 17, 2006 (page A-54)

Comment: "For the purpose of this evaluation both the Road North/Bridge South and the All Bridge alternatives will be incorporated into the same analysis due to similarities in impacts. Direct impacts associated with these alternatives consist of 90.3 acres of impact to the refuge with 78.2 acres of wetland impact for the Road North/Bridge South alternative and 89.6 acres of refuge impacts with 12.3 acres of wetland impacts for the All Bridge alternative. These are substantial permanent impacts to a federally owned natural area. Pea Island National Wildlife Refuge is utilized by waterfowl, wading birds and shore birds such as terns, black skimmers, Wilson's plover, American oystercatcher and the federally listed Piping plover. Although the All Bridge alternative does reduce the wetland impacts associated with relocating the road west of the existing location, disturbance from construction activities coupled with shading impacts over wetlands will change current vegetation characteristics and habitat suitability. Furthermore these are direct impacts to a 4(f) resource; further consideration of this alternative would be inconsistent with past NCDOT projects."

> **Response:** *Chapter 2 of this FEIS presents a historical discussion of the alternatives development process, which began in 1990. Section 2.6 of this FEIS examines the Parallel Bridge Corridor with NC 12 Maintenance alternatives and discusses the reasons for the elimination of specific alternatives and the reasons for retaining three alternatives for detailed evaluation in the SDEIS. These two alternatives, however, were not selected as the Preferred Alternative for the project.*

Comment: "The third parallel bridge corridor alternative involves retaining NC 12 on its current alignment while utilizing approximately 6.3 miles of beach and dune nourishment. The estimated amount of sand needed to nourish the four areas identified approximately every four years is in excess of 46.6 million cubic yards of compatible sand. The document revealed that retention of NC 12 in its current location even with the extensive beach nourishment would continue to leave the roadway susceptible to overwash and potential breach depending on storm intensity and frequency. As stated in section 1.2 of the SDEIS, one purpose of this project is to, "Provide a replacement crossing that will not be endangered by shoreline movement through year 2050." Therefore, this alternative does not appear to meet the purpose and need. Additionally, Barrier island overwash provides important nesting and foraging habitat for shorebirds including the federally threatened Piping plover. The current requirement to maintain NC 12 eliminates this essential habitat. When the roadway is breached or over washed, sand is scraped off the roadway and incorporated into a berm to protect the road; the important overwash/sand flat habitat is perpetually lost impacting waterbirds that depend upon it for foraging and nesting."

> **Response:** *The Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "Beach and dune nourishment has frequently been utilized by NCDOT as a means to protect NC 12. Nourishment does not allow for the natural migration of sand on the Barrier Islands. As listed in the SDEIS section 3.1.3.3 under the National Park Service Plan, "realizing the problems that the managed dune system caused the estuaries…The government no longer attempts to stabilize the Outer Banks artificially but lets natural processes take their course. In its 1991 *Draft Revised Statement for Management*, the NPS affirmed a policy of managing the Seashore in ways "that support the natural processes of barrier island dynamics…" (NPS, 1991)."

NCWRC supports allowing the natural processes to return to the barrier islands. It is these processes which create and maintain habitat for wading and shore birds. Beach nourishment projects have shown adverse impacts to the invertebrate forge base shore birds and wading birds depend upon. These impacts can be both short and/or long term depending on the characteristics of the sand used for the project. Even if impacts are short term, with an expected re-nourishment rate of 4 years, short term impacts will be repeated, therefore continually degrading habitat Pea Island National Wildlife Refuge and Cape Hatteras National Seashore was established to protect. Section 2.6.3.4 states: "Any nourishment program will need to consider the effect of sand placement on beach and near shore invertebrate populations and their recovery." This analysis will need to be completed prior to further consideration of this alternative."

> **Response:** *This alternative was not selected as the Preferred Alternative. The Phased Approach/Rodanthe Bridge Alternative (Preferred) does not include nourishment.*

Comment: "During review of the SDEIS we noted limited information on the availability of compatible sand. Environmental impacts notwithstanding, there are several issues that need to be addressed prior to continuing any consideration of this alternative. NCDOT 's cumulative sand needs for the Outer Banks should be considered. NCDOT currently has proposed alternatives for R-3116a-b which would utilize an anticipated one million plus cubic yards of sand. The SDEIS identifies probable sand source locations including Oregon Inlet dredging and offshore sites, however the document states the need for Oregon Inlet dredging will be reduced with all alternative therefore decreasing the available sand. There is no information concerning the compatibility of sand sources identified in the document. Further consideration of the nourishment alternative will require extensive compatibility analysis to determine the viability of these sand sources.

Dredging activities in conjunction with the mechanical positioning of sand to nourish the beach and build the associated dune structures are additional environmental concerns with this alternative. Commitments from NCDOT disallow the use of a hopper dredge for bridge construction; however this commitment has not been made for collection of material for nourishment. Dredging and dune reconstruction activities can impact sea turtles and shorebirds. Nesting periods for shorebirds and sea turtles generally cover a time period from April 1 through November 15; any recommended nourishment activity during this time frame could impact these species."

> **Response:** *This alternative was not selected as the Preferred Alternative. If it had been selected as the Preferred Alternative, additional information beyond that presented in Section 2.8.2.1 of the SDEIS and Section 2.10.2.1 of the FEIS pertaining to available and suitable sand sources would have been sought.*

Comment: "Historically the [Parallel Bridge Corridor with Nourishment] alternative has been the most expensive alternative at a projected cost of $644,050,000 compared to the Pamlico Sound Bridge alternative costing $424,890,000. Table 2-9 [in SDEIS] outlines the use of a cost discounting model used to adjust the projected cost of the nourishment alternative to $344,800,000 now less than the Pamlico Sound bridge alternative. According to 2.6.3.3 cost discounting is based in theory upon a benefit versus cost type of analysis. The analysis shows that most alternatives only have a slight reduction in cost while the nourishment alternative is reduced by almost 50% since the benefits of beach nourishment are spread out over the life of the project. However, it is unclear how a benefit-cost analysis can be conducted on an item as unpredictable as the life span of beach nourishment. Recently, NC 12 had extensive areas of beach and dune nourishment that were lost in as little as one week. It was also not clear if the rate of inflation was included in this cost estimate, since the nourishment alternative will carry cost 50 years beyond initial completion."

> **Response:** *The best available information pertaining to predicting the rate of and the amount of sand needed for long-term nourishment was used in the SDEIS and the SSDEIS. Inflation is taken into account in the discount rate. The Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative.*

Comment: "The fourth corridor represents the Pamlico Sound bridge alternatives which are composed of a 17.5 mile bridge with alternatives varying only in terminus options in Rodanthe. This alternative focused on removing NC 12 from areas with high erosion rates between Rodanthe and the Northern tip of Hatteras Island and avoiding impacts to the refuge. The current western alignment of the bridge was designed to minimize impacts to submerged aquatic vegetation (SAV) by locating the bridge in waters deeper than 6 feet. Some SAV impacts were unavoidable where the structure nears shore and ties back into existing NC 12. Although similar in direct impacts to SAV with the nourishment alternative at 0.31 acres versus 0.20 acres, shading impacts are the greatest of all alternatives estimated at 9.20-8.90 acres. SAV impacts can be avoided and minimized during construction of this alternative by utilizing work bridges in areas of existing SAV. Based on current estimates, approximate 8 miles of dredging may be required for barge access during construction with the intention of allowing barge operations in waters 8 feet in depth. The location of the proposed dredging is unclear; however the document states no dredging required for the construction of this alternative will occur in areas containing SAV."

> **Response:** *Dredging would be required in locations where Pamlico Sound is less than 6 feet (1.8 meters) deep to allow barge access. The proposed areas are shown in Figure 2-11 of the SDEIS and the FEIS. If this alternative had been selected as the Preferred Alternative a detailed bathymetry of the sound in the area of the corridor would have been developed to refine dredging requirements. SAV surveys would have been conducted.*

Comment: "Water quality issues are a concern with this alternative [Pamlico Sound Corridor] due to storm water runoff associated with a bridge of this length over SA waters, and temporary turbidity associated with construction. The application of Best Management Practices and Design Standards in Sensitive Watersheds are expected to minimize the impacts to water quality, however it is unlikely these impacts can be avoided."

> **Response:** *Additional material related to water quality impacts is included in Section 4.7.2 of the FEIS. Impacts associated with construction are discussed in Sections 4.13.6 and 4.13.7 of the SDEIS and the FEIS. NCDOT's Best Management Practices for the Protection of Surface Waters would be implemented for any of the alternatives.*

Comment: "On the northern tip of Hatteras Island, the terminal groin was permitted to protect the southern terminus of Bonner Bridge. If the Pamlico Sound Bridge alternative is selected, it is likely the terminal groin will no longer serve that purpose and therefore will be removed as a condition of the '404' permit. This structure currently anchors the southern shore of the inlet. Removal of this groin will permit the inlet to migrate south, thus eroding the northern tip of Hatteras Island. The removal of the groin will return the natural processes of inlet migration to the island restoring natural wading and shorebird habitat. However, terminal groin removal will likely threaten the National Register-listed former Oregon Inlet US Coast Guard Station."

> **Response:** *The removal of the groin is a condition of a USFWS permit. The current design of the Phased Approach/Rodanthe Bridge Alternative (Preferred) requires the groin to remain in place. NCDOT will seek a permit if requested by USFWS.*

Comment: "The NCWRC has conducted a thorough review of the SDEIS for the replacement of Herbert C. Bonner Bridge and the associated improvements addressing a long term solution for seashore encroachment on NC 12. Environmental impacts associated with the parallel bridge alternatives are unacceptable. Both the Road North Bridge South alternative and the All Bridge alternative represent unacceptable impacts to fish and wildlife resources and their habitat. Additional information related to amounts of compatible sand is needed for consideration of the nourishment alternative. However, beach and dune nourishment of this magnitude will impact invertebrates important as forage for shorebirds and waterbirds in addition to sea turtle nesting habitat. With a frequency no longer than 4 years these impacts can be expected for the life of the project. Nourishment does not allow for natural process to develop the habitat needed to enhance waterbird and sea turtle populations on the barrier islands. The Pamlico Sound Bridge was developed to avoid the impacts associated with the parallel bridge alignment alternatives. After evaluating all alternatives, the NCWRC believes the Pamlico Sound Bridge corridor to be the Least Environmentally Damaging Practicable Alternative."

> **Response:** *None of the Parallel Bridge Corridor alternatives assessed in the SDEIS and listed above were selected as the Preferred Alternative. The reasons why the Pamlico Sound Bridge Corridor was not found to be the LEDPA are in Section 2.15 of the FEIS.*

North Carolina Wildlife Resources Commission-March 26, 2007 (page A-57)

Comment: "Throughout our involvement with this project we have consistently maintained the need to select an alternative that will allow the natural processes to return to the barrier islands. The creation and preservation of habitat utilized by wading and shore birds in addition to sea turtle nesting habitat depend on this natural succession. The supplemental document promotes the phased approach alternatives as an alternative that will allow barrier island processes to take place by elevating the roadway and permitting the shoreline to process inland while "passing" underneath the bridge structure. Essentially elevating NC 12 will allow the shoreline to naturally evolve and progress inland, however the habitat created will be severely impacted by the presence of the bridge structure."

> **Response:** *The design of the Phased Approach/Rodanthe Bridge Alternative (Preferred) does allow for natural processes to occur. Additional material related to natural resource impacts of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is added to Section 4.7 of the FEIS.*

Comment: "Coastal waterbird habitat such as overwash zones, inlets, and sand flats created in the vicinity of the phased approach bridges will not provide appropriate habitat while in close proximity to the bridge structures. Coastal waterbirds require sandy areas with unobstructed views for predator detection; elevated structures not only provide an obstruction but also a location for predation birds such as crows, raptors and grackles to perch near waterbird habitat. Once the final phase has been completed, this condition will exist for approximately 10 miles to the southern termini of the project."

> **Response:** *The location where such a statement was made (in relation to piping plovers) has been clarified in the FEIS (Section 4.7.9) to note that while potential habitat would be created, its use would be effected by the bridge structure. The distance where the*

Phased Approach/Rodanthe Bridge Alternative (Preferred) would be over the beach is presented in Table 4-23 for five different years through 2060. The longest length of bridge over the beach indicated is 3.3 miles (5.3 kilometers).

Comment: "In addition the structure will impact the ability of sea turtle habitat to properly function. As mentioned in the document sea turtle nesting is both light sensitive and temperature sensitive. Structures that produce a shadow on the beach can alter sea turtle nest incubation temperatures (Mrosovsky et al. 1195. Thermal effects of condominiums on a turtle beach in Florida. Biological Conservation 74:151-156). Sea turtles exhibit temperature dependent sex determination, reduced temperatures associated with shading could alter sex ratios to a degree that may affect population growth over time. Furthermore any elevated structure located in the vicinity of sea turtle nesting habitat will need to be designed to eliminate artificial lighting such as street lights or head lights from reaching the beach or nesting areas. Artificial lights near the nesting areas can disorient hatchlings."

Response: *For the Phased Approach/Rodanthe Bridge Alternative (Preferred), FHWA has completed formal consultation with the US Fish and Wildlife Service under the requirements of Section 7 of the Endangered Species Act of 1973, as amended. Its findings, including those for sea turtles, are presented in Section 4.7.9 of the FEIS and a Biological Assessment (FHWA and NCDOT, 2008) as well as the Biological and Conference Opinions (USFWS, 2008) document of USFWS (see Appendix E). Light and temperature sensitivity are discussed.*

Comment: "Construction impacts related to the phased approach alternatives include: nighttime construction zone lighting, temporary construction impacts, disruption of waterbird utilization of Pea Island National Wildlife Refuge and disruption of sea shore habitat use. In contrast to other alternatives there are cumulative impacts associated with the phased construction. Section 2.2.2.4 shows the total construction time frame is estimated to be 12.5 years of construction over approximately the first 20 years. This presents a significant scale of construction over an extended time frame. Impacts associated with the cumulative effects of prolonged construction were not adequately discussed in the supplement; NCDOT should provide this information prior to selecting an alternative. Once an alternative is selected, recommended environmental commitments designed to reduce impacts to these species including a shorebird and sea turtle nesting area construction moratorium from April 1 to November 15 should be developed."

Response: *FEIS Section 4.7 notes the direct natural resource impacts associated with the Phased Approach/Rodanthe Bridge Alternative (Preferred) over the extended time frame of construction. NCDOT and FHWA consider these impacts to be direct impacts, not indirect and cumulative impacts, since they are directly associated with the proposed action. Construction activities will need to occur between April 1 and November 15. Mitigation for potential impacts to the piping plover and sea turtles was an outcome of formal consultation with the US Fish and Wildlife Service under the requirements of Section 7 of the Endangered Species Act of 1973, as amended, as discussed in Section 4.7.9 of the FEIS, a Biological Assessment (FHWA and NCDOT, 2008), and the Biological and Conference Opinions (USFWS, 2008) document of USFWS (see Appendix E). Section 4.7.6.5 of the SDEIS, the SSDEIS, and the FEIS discusses impacts to Oregon Inlet birds.*

Other

Letters were received from the North Carolina Department of Administration (January 30, 2006 on page A-36 and April 16, 2007 on page A-36) that transmitted other state comment letters only. A comment letter was received from the NC Department of Cultural Resources (March 19, 2007 on page A-37) that had no comments.

8.12.2.3 Regional and Local

County of Dare-December 7, 2005 (page A-58)

Comment: "As you are aware, the replacement of the current Bonner Bridge is critical, it is our understanding that the stability rating of the existing bridge is four on a scale of one hundred. As the only land transportation route to Hatteras Island and as the main route to Ocracoke Island, the Bonner Bridge is vital to the residents of Hatteras Island and Ocracoke Island and to the economies of Dare and Hyde counties.

The Dare County Board of Commissioners supports the "short bridge" alternative for a number of reasons. This alternative will allow the replacement of the existing bridge sooner which is imperative: to Hatteras Island and Dare County. This alternative will also save the tax payers significant amounts of money which will allow other important road projects in the area to proceed.

The short bridge alternative will guarantee full public access to Pea Island and will preserve safe and efficient hurricane evacuation routes. This alternative is sensitive to the environment in that it requires less dredging and therefore minimal construction impacts to the Pamlico Sound and its submerged aquatic vegetation and shellfish habitat.

Finally, the short bridge alternatives will enhance the stability of Oregon Inlet by allowing the retention of the Terminal Groin which stabilizes Northern Pea Island and Inlet Channel. This stabilization will reduce the channel dredging requirements and have fewer impacts on the Pamlico Sound than other alternatives. The construction of the short bridge will further maintain full public access to-the state-owned historic Oregon Inlet Coast Guard Station.

For these reasons, and others, the Dare County Board of Commissioners reiterates its support for the 2.7 mile parallel bridge alternative and again, encourages DOT to continue to work diligently to make the Bonner Bridge replacement a reality in the very near future."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative was selected as the Preferred Alternative and includes the "short bridge" desired by the commenter.*

Town of Nags Head-April 2, 2007 (page A-59)

Comment: "The Town of Nags Head Board of Commissioners at their January 4, 2006 Regular meeting approved the attached resolution urging the North Carolina Department of Transportation and the U.S. Fish and Wildlife Division, U.S. Department of the Interior, to replace the aging Herbert C. Bonner Bridge over the Oregon Inlet with a parallel bridge immediately."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative was selected as the Preferred Alternative and includes the "parallel bridge" desired by the commenter.*

8.12.3 Non-Governmental Organization Comments and Responses

This section responds to written comments on the SDEIS and the SSDEIS submitted by non-governmental organizations (NGOs). The comments in the sections that follow consist of quotes from the correspondence received. Each substantive comment requiring a response is listed below. The original correspondence is presented in Appendix B.

8.12.3.1 Audubon North Carolina-April 13, 2007 (page B-240)

Comment: "The Phased Approaches Will Not Provide Reliable Transportation. The Supplement states that the Phased Approach/Rodanthe Bridge alternative would bridge all five potential breach locations and the Phased Approach/Rodanthe Nourishment Alternative would bridge all locations except for part of the southernmost potential breach location, which just happens to be the one "most likely to suffer a breach before 2060" (Supplement at 2-12). However, construction of the four phases is "based on their need from the perspective of the condition of Bonner Bridge, potential breach locations (see Figure 2-1), and the location of future forecast beach erosion" (Supplement at 2-12 to 2-13). The predictions underlying the four phase approach could be very different from what actually occurs in the future. If a large storm or a series of smaller storms were to strike the Outer Banks before the four phases were completed, the paved road transportation link in the non-bridged area could be severed. The Phased Approaches are an expensive, massive gamble that could end up being a bridge to nowhere.

In addition, we remain concerned about the transportation reliability of a bridge that is in the high energy environment of the Atlantic Ocean. In contrast to the Pamlico Sound Bridge Corridor, which will be in the lower energy environment of the Pamlico Sound, the Phased Approaches eventually will be in the Atlantic Ocean. While the Supplement includes a discussion of design features relating to piling height and width (Supplement at 2-10), NCDOT also notes that "[i]n light of Hurricane Katrina in 2005, an AASHTO/FHWA Joint Wave Task Force is developing interim guidance for quantifying wave forces on bridges, structural design approaches for wave forces, and deployment of countermeasures for existing bridges" (Supplement at 2-12). Audubon Staff have observed a bridge on I-10 that was destroyed by a recent hurricane, and that bridge was located in a bay off of the Gulf of Mexico, not out in the Atlantic Ocean. We are unaware of any bridge that is located in such a dynamic and high energy environment for such a long distance. We request that NCDOT include in the FEIS a discussion of similar bridges located in ocean locations with comparable wave energy; the reliability of such bridges; and the construction and maintenance costs associated with such bridges. Furthermore, do the projected costs associated with the Phased Approaches anticipate the higher design standards of the Wave Task Force?"

> **Response:** *NCDOT recognizes that the shoreline could evolve differently than the assumptions used in developing the Phased Approach/Rodanthe Bridge Alternative (Preferred). A monitoring program and process for deciding when to implement each phase as the shoreline evolves is presented in Section 2.10.2.5 of the FEIS. The I-10 bridge damaged in Hurricane Katrina was built at an elevation below the storm surge. Its replacement is being built above the anticipated storm surge and storm wave heights. NCDOT sought to identify similar bridges to NC 12 maintenance bridge component of the Phased Approach/Rodanthe Bridge Alternative (Preferred). None were identified. The projected costs associated with the Phased Approach alternatives (including the Preferred Alternative) anticipate the higher design standards of the Wave Task Force. Two senior employees of NCDOT serve on the task force.*

Comment: "The Phased Approach bridges would have a 40-foot roadway width and have a minimum 25-foot vertical clearance between the bottoms of the superstructure (spans) and mean high water (Supplement at 2-10). The bridges would be built "within the NCDOT's existing 100-foot easement within the Refuge" (Supplement at 2-3). While initially on land, the bridges "associated with the Phased Approach ultimately would move to the shoreline and then offshore in the Atlantic Ocean as the shoreline erodes underneath the bridges" Supplement at 4-18.

NCDOT acknowledges that the Phased Approach Alternatives would "reduce beach access" and "eliminate" the ability to surf in an area once the pilings are in the ocean (Supplement 4-18). In addition, the Supplement states that hiking and other beach activities "could take place" when the bridge is over the beach, though not in the "undisturbed natural setting in which they now occur" (Supplement at 4-18).

While the Supplement does mention certain recreational impacts, Audubon is very concerned that the document downplays the significant adverse impacts of having a bridge on the beach or just offshore. A bridge in the intertidal or near shore area would not only make surfing hazardous, but also make similar activities such as swimming or ocean kayaking extremely hazardous and would eliminate windsurfing or kite boarding in those areas where the bridge is in the water or the intertidal area. In addition, bird watching, a favored activity of thousands of our members and visitors to Pea Island, would be curtailed in beach areas where the bridge is in the ocean, as it would no longer be possible to have an unobstructed view of the ocean area to search for pelagic or other species. A massive bridge in the ocean would not be a minor inconvenience; rather, it would be a significant, long-term degradation of the recreational values of the refuge."

> **Response:** *The additional recreational activities noted in this comment were added to Section 4.5.3 of the FEIS.*

Comment: "The Supplement remains unclear regarding NCDOT 's position as to what extent natural forces will be allowed to operate on the coastline. In certain areas, there is a suggestion that such forces will be allowed to operate. For instance, NCDOT notes that the "existing dunes along the oceanside would not be re-built (i.e., they would be allowed to erode naturally). Not-rebuilding the dunes would support Refuge and Seashore Policies to let natural processes take their course" (Supplement at 2-26). Yet, presumably, in the sections of the Phased Approach that are still based on a road that is on the ground, NCDOT will maintain the artificial dune until the bridge section phase in that area is constructed? To do otherwise would expose the road to an increased risk of being covered with sand or severed.

> **Response:** *The expected impact of NC 12 maintenance activities that would occur prior to the implementation of each phase with the Phased Approach/Rodanthe Bridge Alternative (Preferred) is added to Section 4.6.8.6 of the FEIS. A monitoring program and process for deciding when to implement each phase as the shoreline evolves is presented in Section 2.10.2.5 of the FEIS. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement.*

Comment: "The Supplement also is unclear as to what action will be taken if an inlet opens up on the refuge. Certain sections of the document suggest that an inlet will be allowed to remain open. For example, NCDOT notes that the 'word 'breach' is used rather than the word 'inlet' because if a breach were to occur, it would likely close eventually (though not necessarily immediately) and likely would not become a long- term phenomenon like Oregon Inlet" (Supplement at 3-4). Yet, there continues to be the discussion of closing an inlet (Supplement at 4-6, noting that it "could take 3 -6 months to close a breach").

Response: *Although a breach could fill in naturally, it is likely that the breach would be closed or temporarily bridged because there would be an immediate need to reopen the road. The timing and nature of a breach cannot be precisely predicted. Given this factor, the phasing scheme for the Phased Approach/Rodanthe Bridge Alternative (Preferred) assumes that four of the five potential breach locations are bridged during Phase II, including the area at Rodanthe where a breach is most likely to occur. It is NCDOT's intent to place a high priority on the implementation of Phase II as soon as it is practicable. The fifth location (former New Inlet area) would be bridged during Phase III.*

Comment: The Supplement's failure to fully address the positive geological and biological impacts of ocean overwash and inlet formation, migration, and closure is a serious deficiency. Audubon previously addressed this issue in detail in our comment letter on the SDEIS (Attachment A). In the Supplement, NCDOT just repeats brief statements at several locations about Refuge and Seashore Policies, without providing any real detail about those policies or the extensive scientific and policy review that went into formulating those processes. As a result, the Supplement not only fails to disclose the positive environmental impacts of the Refuge and Seashore policies, but also fails to disclose how road maintenance activities that are inconsistent with those policies will result in adverse environmental impacts, as required by the National Environmental Policy Act.

Response: *A discussion of the positive geomorphological and natural resource benefits of allowing the natural movement of the shoreline to take place is added as Section 4.7.7 of the FEIS.*

Comment: In drafting the FEIS, NCDOT should clearly indicate when an inlet or "breach" will be allowed to remain open and when it will be closed. And, as required by NEPA, the full direct, indirect, and cumulative environmental impacts of closing an inlet should be disclosed. Likewise, the FEIS should clarify exactly when and how artificial dunes will be maintained. As required by NEPA, NCDOT should disclose the full direct, indirect, and cumulative environmental impacts of maintaining an artificial dune system."

Response: S*ee the response above to the comments of this letter related to breaches. A description of anticipated NC 12 maintenance activities, including dune maintenance, prior to the implementation of each phase of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is added to Section 4.6.8.6. Natural resource impacts of those activities are addressed in Section 4.7.8.*

Comment: "The Supplement's discussion of the direct and indirect impacts of the alternatives on "Oregon Inlet Birds" (4-35 - 4-36) and on the Piping Plover (4-37) is inadequate. Audubon previously addressed these concerns in detail in our prior comment letter, and it is disturbing that these important issues still have not been addressed properly.

The Supplement states that construction activities for the Pamlico Sound Bridge Corridor "would affect less than 1 acre (0.4 hectare) of potential nesting or foraging habitat…" (4-37). The Supplement fails to acknowledge the extensive benefits from the hundreds of acres of nesting, feeding, and resting habitats that would be created naturally if the road were removed from the refuge and natural overwash patterns were restored. These newly created areas would be prime habitat for not only the Piping Plover, but other beach nesting birds.

The Supplement states that "[s]ince construction of the two Phased Approaches would take place within the existing NCDOT easement, disturbance to potential nesting or foraging habitat in the project area would be minimal. However, shoreline erosion could create Piping Plover habitat under the bridges as the shoreline erodes" (4-3 7). This statement fails to address the direct and indirect adverse impacts of having a road and associated road maintenance activities throughout the Refuge on the Piping Plover. Once the bridge is a sufficient distance offshore, it will not be an issue, but until that time, the considerable adverse impacts outlined in our previous letter will remain. Moreover, we are aware of no existing location where there is Piping Plover "habitat under the bridges…" (4-3 7). We request NCDOT provide examples of Piping Plovers nesting or otherwise using habitat under similar bridges, or withdraw the statement. And, in the event there is such close proximity of use, the FEIS should address whether a bridge being located near habitat could result in vehicles striking birds, which would be "take" as defined by the Endangered Species Act.

The Supplement also notes that "[beach nourishment along the shoreline within the Parallel Bridge Corridor with Nourishment Alternative and the Phased Approach/Rodanthe Nourishment Alternative, could potentially encourage future nesting species" (4-37). For that statement to be accurate the profile and substrate of the created beach would have to be compatible with nesting habitat; in addition, disturbance and predation would have to be managed properly. The Supplement does not provide adequate information to support the claim. Indeed, the document fails to address a more likely result: that the "nourished" beach will not be suitable for nesting, due to the steep profile, lack of feeding habitat, and planting of dune grasses.

Audubon requests that the discussion about "Oregon Inlet Birds" (4-35) be revised to address these same issues."

> **Response:** *A discussion of the positive natural resource benefits of allowing the natural movement of the shoreline to take place is added to Section 4.7.7 of the FEIS. For the Phased Approach/Rodanthe Bridge Alternative (Preferred), FHWA has completed formal consultation with the US Fish and Wildlife Service under the requirements of Section 7 of the Endangered Species Act of 1973, as amended. Its findings, including those for the piping plover, are presented in Section 4.7.9 of the FEIS. Regarding the statement on page 4-37 of the SSDEIS, only the possibility is raised and reasons why it is difficult to draw absolute conclusions are noted. The commenter notes additional reasons. Additional material related to natural resource impacts of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is added to Section 4.7 of the FEIS.*

Comment: "The Supplement's Breach Analysis notes that at the potential inlet location at "Site 5," which is to the south of the existing terminal groin, "erosion on the estuarine (sound) side of the terminal groin has been observed. The maximum shoreline erosion to date is 275 feet (83.8 meters) and substantial shoreline change extends approximately 1,000 feet (304.8 meters) south of the rock revetment" (Supplement at 3- 6). While the Supplement does include a discussion of a '"breach" forming at this location and how it may affect the Phased Approach Alternatives (4-20- 4-2 I), Audubon is concerned that the Supplement fails to address a foreseeable, and perhaps even more likely, response: after continuing erosion brings the western shoreline closer to the road (or bridge, depending on which phase has been reached), NCDOT declares an "emergency," avoids following normal environmental review requirements, and extends the west end of the revetment 1,000 feet or more to the south to stabilize the shoreline. This response is foreseeable, given the actions that occurred in the past, specifically, the closure of Isabel Inlet and the response to the accelerated erosion that prompted the construction of the existing terminal groin in the Refuge. Unless the NCDOT will guarantee as an irrevocable permit condition that the revetment will not be extended, the FEIS should include a discussion of the environmental impacts and economic costs of extending the terminal groin."

> **Response:** *NCDOT does not anticipate the need to extend the terminal groin (revetment). As noted in the description of the Phased Approach/Rodanthe Bridge Alternative (Preferred) in Section 2.2.2.1 of the SSDEIS and in Section 2.10.2.5 of the FEIS: "The NC 12 bridges between the northern end of Hatteras Island and the southern end of the Canal Zone Hot Spot were assumed to have a more substantial foundation than the remainder of the NC 12 bridges to the south in order to accommodate a potential breach that could be deeper than breaches that might occur elsewhere in the Refuge." New discussion addressing design criteria for establishing pile lengths that prevent the need for extended or new revetments and stabilizing structures is included in Section 2.10.1.2 of the FEIS.*

Comment: "NCDOT notes that although "the NC 12 Maintenance alternatives are described and addressed in the SDEIS and this Supplement as five separate alternatives, their components could be mixed and matched geographically along the length of NC 12 to create other variations" (Supplement at vi). Thus, "different combinations of the components of the alternatives also are possible" Supplement at 2-4.

Audubon strongly objects to this "mix and match" approach, as it raises serious concerns regarding compliance with the mandates of the National Environmental Policy Act. Depending on which alternative is chosen, there are a range of direct and indirect environmental impacts. Failing to disclose what may be implemented deprives the public of information regarding the impacts of that alternative and prevents the public from having an opportunity to submit comments."

> **Response:** *A "mix and match" alternative or an alternate combination of the components of one or more alternatives was not selected as the Preferred Alternative.*

Comment: "NCDOT notes that the "full life of the proposed bridge [is] estimated to be as much as 100 years" (Supplement at xxvii). Yet, the Supplement only estimates costs "through 2060" (Supplement at 2-15). This abbreviated analysis period seriously skews the cost/benefit analysis for any options which involve beach replenishment in a way that biases the analysis against the Pamlico Sound Bridge Corridor. In addition, with the higher wave energy and thus, presumably greater maintenance costs of maintaining a bridge in the ocean, the shorter analysis period also may affect the accuracy of the cost figures for both Phased Approach Alternatives.

Audubon also is amazed that with the passing of just two years, construction costs for the Pamlico Sound Bridge have gone from $55-60 per square foot to $130 - $220 per square foot, depending on which construction technique is used. Such a dramatic inconsistency raises concerns regarding the objectivity of the analysis. Additional supporting documentation regarding the cost analysis should be included in the FEIS, including a comparison to the latest cost information regarding the Mid-Currituck Bridge proposal."

> **Response:** *The design life assumed in the SDEIS and SSDEIS was 50 years. The bridge structure components of the alternatives could potentially last longer than 50 years and perhaps up to 100 years. Fifty years, however, is the design life typically assumed in bridge planning by NCDOT. Additional support documentation related to the costs included in the SSDEIS is included in Section 2.12 of the FEIS and was presented to the Merger Team (see Section 8.10.1.2). The DEIS for the Mid-Currituck Bridge project*

(NC Turnpike Authority Project) is not complete or released for public review, so, comparable cost estimates are not available. It is presumed that the factors considered in developing Bonner Bridge replacement cost estimates will be considered in developing the Mid-Currituck Bridge cost estimates.

Comment: "The Supplement notes that newly appointed Secretary of the Interior Dirk Kempthorne wrote Senator Richard Burr a letter stating that '"the best way to proceed would be to separate the replacement of the Bonner Bridge, a project whose delay could constitute a clear and present safety issue for all concerned, from the more difficult and less urgent issues of the realignment of the road." Appendix A-2. With no supporting analysis, the letter also opines that the bridge would be "compatible" with the refuge if it is constructed within the same alignment or with minor changes to the current alignment."

The Secretary's letter is filled with numerous legal and factual inaccuracies (e.g., the bridge being an "imminent threat to public safety") that suggest the NCDOT should exercise extreme caution when considering its authority. Likewise, the suggestion that the bridge can be segmented from the remainder of the roadway through the refuge not only undermines fundamental tenants of the National Environmental Policy Act analysis, but also displays a distressing lack of knowledge regarding existing, serious transportation challenges though the remainder of the refuge. The Secretary's letter represents arbitrary and capricious agency actions, as it reverses – without any reasoned analysis – many years of consistently expressed concerns by the USFWS regarding the adverse environmental impacts associated with the short bridge alternatives and the incompatibility of these alternatives with laws governing Pea Island National Wildlife Refuge. Whatever political calculus may have been behind the Secretary's letter, NCDOT has an independent duty to consider and disclose the full direct and indirect impacts of the proposal in the FEIS."

Response: *The SDEIS, SSDEIS, and FEIS do not evaluate the Oregon Inlet bridge separately from the long-term maintenance of NC 12. The Phased Approach/Rodanthe Bridge Alternative (Preferred) incorporates both an Oregon Inlet bridge and additional bridges that would provide for the long-term maintenance of NC 12.*

8.12.3.2 Cape Hatteras Electric Cooperative-December 7, 2005 (page B-243)

Comment: "The Pamlico Sound Corridor and the subsequent loss of the existing transportation facilities will impose operating and financial burdens on the Cooperative that exceed the Cooperative's ability to respond effectively without the cooperation and financial involvement of parties beyond its present customers. The cooperative does not seek to influence the choice of corridors, provided assistance is found to mitigate the extreme financial burden the long bridge will impose."

Response: *Comment acknowledged. The costs of utility relocation were included in the overall public cost estimate, which can be found in Section 2.3.3 of the SSDEIS and Section 2.12.3 of the FEIS. The Pamlico Sound Bridge Corridor ("long bridge") Alternative was not selected as the Preferred Alternative.*

Comment: "…For the Parallel Bridge Corridor, CHEC recognizes that replacement of the present bridge cable will be required. The cost to CHEC to install cables on the new bridge for the parallel bridge option would be approximately $2.4 million. While this cost greatly exceeds typical CHEC electric system projects, the cooperative has long expected the requirement. Minimal changes would be necessary to the remainder of CHEC facilities within the Bridge

Replacement area for this option. The Cooperative's overhead power line would remain accessible via the remaining sections of NC 12 through the Pea Island Wildlife Refuge. Dune and road maintenance would continue to provide protection for the overhead portion of the power line. Continued maintenance of the Oregon Inlet protective groin would provide protection for the underground to overhead riser structure at the south end of the bridge."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative, a Parallel Bridge Corridor Alternative, was selected as the Preferred Alternative.*

Comment: "For the Pamlico Sound Corridor Option, significant modification to the present transmission power line configuration would be necessary. As NCDOT abandons the present NC 12 route through the Pea Island Refuge, the critical nature of the present route would end, as would the maintenance and restoration priority of the present roadway. Should the present roadway be removed, damaged by storms or covered by drifting sand, CHEC would lose ready access to the present power line route. Washouts of the Pea Island portion of NC 12 would likely not be repaired in any timely fashion, if at all. This condition could leave the Cooperative with no location to replace its overhead facilities, resulting in extended loss of power for Hatteras and Ocracoke Island residents and visitors.

Removal of the present Oregon Inlet protective groin would create additional problems for CHEC maintaining electric service to the islands along the present route, as the riser structure at the south end of the present bridge location would be in an unstable location if the present bridge cable were replaced with an affordable relatively short submarine cable installation under Oregon Inlet."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative was selected as the Preferred Alternative and would allow shoreline migration on Hatteras Island to continue. Power lines would thus need to be moved as the shoreline eroded. This impact is acknowledged in Section 4.12.7 of the SSDEIS and the FEIS. The costs of utility relocation associated with each alternative are noted in Section 2.3.3 of the SSDEIS and Section 2.12.3 of the FEIS.*

Comment: "Reduced maintenance or abandonment of the present corridor dictates that CHEC [Cape Hatteras Electric Cooperative] investigate more stable and viable options for its transmission line routing to replace the present route.

In response to the proposed 17 mile bridge option, CHEC undertook a study of several power line relocation options during 2004. The study yielded the following options and costs:

1. Overhead transmission line located along the side of the bridge and supported by the bridge structure: (Not estimated. NCDOT personnel indicated they would not allow consideration of this as an option).

2. Overhead transmission line supported on independent foundations adjacent to the (Pamlico Sound Corridor) bridge - $25,510,000.

3. Submarine cables alongside the bridge - $27,582,000.

4. Cables in conduit hung under the bridge deck - $44,482,000…"

"…The Cooperative also in 2004 conducted a study of the impact of the options on electric rates. The impact of absorbing a project of the cost of any of the options associated with the Pamlico Sound Corridor discussed above is enormous. The total plant investment of the cooperative in facilities as of October 2005 is $34.6 million. Even the lowest cost option available nearly doubles the present plant investment of the Cooperative. The impact of increasing plant investment by a $25,600,000 project would require an increase in retail electric rates of over 26 percent.…"

"In order to provide relief for the Cooperative should the Pamlico Sound Corridor bridge replacement option be selected by the NCDOT, CHEC requests that NCDOT take the following actions:

A. Incorporate the proposed electric system modifications, environmental impacts and costs within the final draft of the Supplemental EIS so that concurrent approval of the necessary environmental actions will take place at minimal cost to the Cooperative.

B. Include the CHEC portion of the overall cost of the necessary electric system modifications in the bridge replacement funding process for the Pamlico Sound Bridge Corridor option.

C. In the case of the overhead adjacent line (option 2.), include the necessary pilings, pier caps and anchor bolt embedment for the overhead power line in the bid documents and contract for the bridge.

Cape Hatteras Electric Cooperative agrees that the replacement for the Herbert C. Bonner Bridge over Oregon Inlet is necessary. The choice of stated bridge replacement options varies greatly in the impact that will occur on the mission of Cape Hatteras Electric Cooperative in providing reliable, reasonably priced electric service. The cost and impact of the various Corridor options on the Cooperative should be considered and provided for by NCDOT in the planning, option selection, design and funding process for the bridge replacement."

> **Response:** *The Pamlico Sound Bridge Corridor ("17-mile bridge option") Alternative was not selected as the Preferred Alternative. The costs of utility relocation associated with each alternative are noted in Section 2.3.3 of the SSDEIS and Section 2.12.3 of the FEIS and were examined as part of the LEDPA decision.*

8.12.3.3 Cape Hatteras Electric Cooperative-May 8, 2007 (page B-246)

Comment: "…The bridge replacement option that is finally chosen by the NC Department of Transportation could have a major impact on electric rates on Hatteras Island. The Cooperative as an organization has not taken an official position on which bridge options should be chosen, but management emphasized that it is important that customers understand the impact that the choice will have on operating costs of the Cooperative.

In the case of the "parallel" (or short) bridge, replacing the existing electric facilities with a set of cables located on the new bridge, similar to what is on the present bridge, is estimated to cost CHEC as much as $12 million. This expenditure is projected to result in a possible rate impact to CHEC consumers of 12 percent, or about a 1.3 cent per KWH increase from 11.2 cents in 2011 to 12.5 cents per KWH in 2014, when the replacement bridge is expected to be completed.

If the "Pamlico Sound" (or 18-mile long) Bridge option is selected by NCDOT, the cost for CHEC to replace the existing cables is estimated to be as much as $53.6 million. The long bridge option is now estimated to result in a rate increase of approximately 42 percent, or about a 4.7 cent per KWH increase from 11.2 cents per KWH in 2011 to 15.9 cents in 2014. The actual cost replacement of the bridge itself will likely be shared at least by all the taxpayers in the state. Only the electric customers on Hatteras Island will pay the full cost of the power cable replacement. While loan funds may be available to CHEC to pay the cost of the replacement cables, the loan will have to be repaid with interest.

If the long bridge option becomes a reality, Cape Hatteras Electric Cooperative will seek grant funds to pay for the added expense, but expects a low probability that such funds will be available. There is presently no known source of grant funds available for this purpose. The rate increases cited are calculated only based on the impact of the bridge cable replacement and not any increases in wholesale power costs or other changes in the Cooperative's cost of doing business."

> **Response:** *These concerns are acknowledged. The Pamlico Sound Bridge Corridor or "Long Bridge" was not selected as the Preferred Alternative.*

8.12.3.4 Coastal Wildlife Refuge Society-November 9, 2005 (page B-246)

Comment: "Our board of directors supports the alternative to build a 17 mile, $419 million, bridge bypassing Oregon Inlet and the Pea Island National Wildlife Refuge as the preferred alternative. We believe that a short, less costly bridge proposed by some local interests is a very short-sighted solution which will ultimately prove to be exorbitantly more costly and life threatening.

The existing Highway 12 roadbed continues to experience substantial overwash from even minor northeasterly storms resulting in frequent closings. The high rate of ocean front erosion along Highway 12 will ultimately require the relocation of the entire right of way significantly westward which will place the highway directly through marshland and will, even to a casual observer, need to be placed on a bridge or raised causeway structure. Such relocation, if it could ever be permitted, will be extremely expensive and destroy important sensitive habitat, resulting in significant adverse impact on the wildlife in the refuge, especially to migrating waterfowl.

Always a concern on the Outer Banks, the hurricane season finds a large number of tourists on Hatteras and Ocracoke Islands. These tourists, along with permanent residents and seasonal workers, can only be evacuated over Highway 12. It is highly probable that the strong northeast storms ahead of the actual hurricane making landfall creates a distinct probability that Highway 12 will be washed out before evacuation can take place. Many people will be stranded south of the only evacuation route. Therefore, we see the "long bridge" as the best safety measure for human life and it will ultimately prove to be the less expensive, while at the same time preserving valuable habitat for wildlife.

We urge you consider these concerns in the final decision on the location of the proposed replacement Oregon Inlet Bridge."

> **Response:** *Comment acknowledged. The reasons why the Pamlico Sound Bridge Corridor was not found to be the LEDPA are discussed in Section 2.15 of the FEIS. The Phased Approach/Rodanthe Bridge Alternative (Preferred) would place the portions of NC 12 threatened by shoreline erosion on a "raised causeway structure" in the existing easement. The associated impacts to the Refuge are discussed in Chapter 4 of the SSDEIS and the FEIS.*

8.12.3.5 Environmental Defense-December 8, 2005 (page B-247)

Comment: "The SDEIS states (p. 1-5, 1-6) that the purposes of the proposed project are to:

- Provide a new means of access from Bodie Island to Hatteras Island for its residents, businesses, services, and tourists prior to the end of the Bonner Bridge's service life;
- Provide a replacement crossing that takes into account natural channel migration expected through year 2050 and provides the flexibility to let the channel move;
- Provide a replacement crossing that will not be endangered by shoreline movement through year 2050.

The NC Department of Transportation is also a partner in the Outer Banks Task Force (OBTF), whose goals are to:

- Preserve the natural barrier island system;
- Minimize impacts to Hatteras and Ocracoke islands;
- Maintain access to and on the islands so that the transportation system is safe, efficient and has minimal impact on the environment."

Only the Pamlico Sound option meets all of the goals stated above, while all of the Parallel Bridge options would require significant alteration of the barrier island system through either beach nourishment or filling of soundside habitats. None of the Parallel Bridge options would guarantee a replacement crossing that will not be endangered by shoreline movement. Furthermore, in the event of an emergency evacuation (e.g., hurricane evacuation) of Hatteras Island, the Pamlico Sound Bridge clearly provides the safest, most reliable transportation option. The design characteristics would allow ample room for two lanes of traffic to move off the island, as well as allow for emergency vehicle access (p. 2-82, 83). The Parallel Bridge with Nourishment alternative would not provide this level of reliability and safety."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) would not include beach nourishment or filling sound-side habitats. The portions of NC 12 affected by shoreline erosion through 2060, as well as potential island breach areas in the project area, would be bridged. Note that of the Parallel Bridge Corridor alternatives considered, none placed fill in sound-side habitats, and only the Parallel Bridge Corridor with Nourishment and Parallel Bridge Corridor with Phased Approach/Rodanthe Nourishment would involve beach nourishment.*

Comment: "The SDEIS also acknowledges the highly variable maximum erosion rates at the different "hot spots" (p. 1-5) and the fact that both a storm-induced breach as well as increased erosion rates in general pose a significant risk to the Parallel Bridge alternatives (p. 2-74). These are quite realistic and likely risks that would increase both costs and environmental impacts. Moreover, the SDEIS states that the coastal modeling that was performed did not include cross-shore and long-shore changes in transport that could occur should a breach be allowed to remain open. This creates the question of how this would impact the Parallel Bridge "Road North/Bridge South" and "All Bridge" alternatives with regard to design characteristics that could withstand such change."

Response: *Neither the Road North/Bridge South nor the All Bridge alternatives were selected as the Preferred Alternative. From the perspective of the Phased Approach/Rodanthe Bridge Alternative (Preferred), in the event of a breach that is allowed to stay open, the model used to predict the high erosion scenario would not be expected to predict shoreline change in the vicinity of the new inlet. It is well documented that shorelines in the vicinity of an inlet often exhibit both greater shoreline change rates (either erosion or accretion) and a greater variance with respect to time than shoreline segments at some distance from an inlet. The alongshore distance of impact of the inlet can be as much as 0.5 to 1.0 mile (0.8 to 1.6 kilometers) on either side of the inlet. The shoreline adjacent to the new inlet will adjust in response to the configuration of the new inlet, the hydrodynamics of the new two (or more) inlet system, the underlying geology, and the sediment supply.*

The impact of a breach on the Phased Approach/Rodanthe Bridge Alternative (Preferred) design would be one of location as opposed to structural integrity. Bridges across potential breach areas would be designed to withstand the hydrodynamic forces and resulting scour that breach exposure would create. The location issue involves determination of which areas would need to be bridged and in what sequence. Four of the five potential breach locations would be bridged in Phase II. The fifth is proposed for bridging in Phase III. Additional studies on the extent of potential breach locations would be conducted prior to building each phase to help ensure that their endpoints take into account the outer edges of potential breach areas. Modeling of the hydrodynamics and shoreline response of the barrier with two or more inlets (assuming likely inlet locations) could prove useful insights to future behavior. The plan to monitor future shoreline position, as well as the evolving geomorphology of the island, and to adaptively respond to future change is a strength of the implementation planning approach.

Comment: "Finally, the draft Section 4(f) evaluation states that "it could be concluded that either alternative [Pamlico Sound Bridge or Parallel Bridge] minimizes harm, or it could be concluded that while different in the type of harm, they are equal in the degree of harm." We firmly believe that in no way can it be concluded that any of the Parallel Bridge options are ''equal" to the Pamlico Sound bridge options in the degree of harm posed, or that they "minimize" the harm posed. Rather the Parallel Bridge options all pose significantly greater harm in one aspect or another, whether that is harm to natural resources or risks to safe and reliable transit."

Response: *The statement on page 5-41 of the Draft Section 4(f) Evaluation in the SDEIS acknowledges the differing positions on the importance of road access to the Refuge expressed by the full range of stakeholders in the project area, including the public and local government officials.*

Comment: "Table 2-9, which details the construction and maintenance costs of each of the Parallel Bridge and Pamlico Sound Bridge options to the year 2060 is faulty in that it should be projected for an additional 50 years. The SDEIS states that either of the bridge options and their components would conceivably have a lifespan of 100 years (p. 3-39, 3-43). Given the controversy surrounding the costs of the Pamlico Sound Bridge as compared to the Dare County preferred option of a Parallel Bridge with Nourishment, the potential costs of nourishment should be projected on a timeframe that is comparable to the life expectancy of the bridge components. The public has a right to know the maximum costs that would be incurred."

Response: *The design life assumed for alternatives in the SDEIS and SSDEIS was 50 years, although the bridge structure components of the alternatives could potentially last longer than 50 years and perhaps up to 100 years. Fifty years, however, is the design life typically assumed in bridge planning by NCDOT.*

Comment: "In addition, Dare County officials have indicated their concern that anything except a Parallel Bridge option could substantially impact the local economy due to changes in access to PINWR. However, the SDEIS indicates that the Pamlico Sound option would not have a significant economic effect, as evidenced by the statement that lost visitor expenditures would be approximately 10% of current expenditures (p. 4-11), while losses to Dare County in tax receipts would constitute only 2.5% of the total. It should also be noted that the potential economic losses due to a storm-induced breach of NC12 with the Parallel Bridge with Nourishment alternative range from $5.7million to 146.7million. These figures alone provide support for the Pamlico Sound bridge alternatives from a strictly economic sense. Therefore, the safe and reliable transit provided by the Pamlico Sound alternatives would certainly offset the loss of 2.5% of the Dare County tax receipts."

Response: *The commenter's observations are noted. No response is required.*

Comment: "As noted in the SDEIS, the NC Division of Marine Fisheries (DMF) and Marine Fisheries Commission (MFC), as well as the South Atlantic Fishery Management Council (SAFMC) and Mid-Atlantic Fishery Management Council (MAFMC) manage fishery resources within the project area. Both the NC Marine Fisheries Commission and the SAFMC have habitat protection policies regarding, the use of beach fill and impacts to fish and fish habitats (attached). Section 4.7.6 acknowledges the potential adverse indirect impacts to fisheries of the Parallel Bridge with Nourishment alternative, mostly due to turbidity and impacts to benthic food resources. It also briefly states (p. 4-67) the risks associated with frequent dredging (every four years or less) and beach fill to benthic invertebrates. Given the tremendous importance of recreational and commercial fisheries to the project area, and the feasible alternative of the Pamlico Sound bridge alternative, the risks to state and federal fishery resources by the Parallel Bridge alternatives are not warranted.

Furthermore, the MFC also has a policy regarding the protection of Submerged Aquatic Vegetation (attached), which is a key nursery and foraging habitat for many recreationally and commercially important finfish and shellfish species. It should be noted that SAV is also one of the six major fish habitats identified in the state's Coastal Habitat Protection Plan (CHPP), the goal of which is to ensure long-term enhancement of coastal fisheries associated with each habitat. The development of the CHPP was a mandate of the 1997 NC Fisheries Reform Act, and is the first comprehensive ecosystem-based management plan on the Atlantic seaboard. A unique feature of the CHPP is that the Coastal Resources, Marine Fisheries and Environmental Management Commissions are to adopt and implement the plan. Adoption occurred in December 2004 and implementation plans are currently underway. A comprehensive set of management recommendations for the protection and enhancement of the six habitats identified is included in the CHPP and can be found at http://www.ncdmf.net/habitat/index.html. Only the Pamlico Sound bridge alternatives meet the goals and recommendations of the CHPP."

Response: *Position acknowledged.*

Comment: "Section 4.12 (Indirect and Cumulative Impacts) is sorely lacking in that it makes no mention of the cumulative and long-term effects to natural resources posed by the Parallel Bridge with Nourishment alternative. To our knowledge, no long-term or cumulative impacts studies exist to document the effects of repeated beach nourishment, both from a sand placement perspective and a dredging perspective. The potential long-term impacts of nourishment activities are only briefly mentioned in Section 4.7.6. The proposed project has a minimum expected lifetime of 50 years, yet no monitoring program is proposed, should the Parallel Bridge with Nourishment alternative be chosen. Given the significant potential impacts of this alternative to fish, benthic invertebrates and shorebirds, a draft monitoring plan (pre- and post-construction) should be included in the SDEIS. Although recovery may be evident within 1-3 years of sand dredging or emplacement, many benthic invertebrate populations have seasonal and interannual variability that will not be captured by a three year study. Proponents of beach fill often cite an Army Corps of Engineers seven year study of New Jersey's Sandy Hook to Barnegat Inlet nourishment project as evidence of no long-term impacts. In the context of a 50-year project, seven years is by no means "long-term". An example of a potential pre-project monitoring plan that is currently underway is that for the Dare County Beaches - Bodie Island (North) project."

> **Response:** *The long-term effects, including natural resource impacts, of the nourishment alternatives are considered as direct impacts because they are associated with the project, which includes all rounds of nourishment dredging. An alternative involving nourishment dredging was not selected as the Preferred Alternative.*

Comment: "A concern of all interested in the Bonner Bridge replacement project is the potential impact of stormwater runoff, particularly from the Pamlico Sound bridge alternatives. Very little mention of stormwater impacts is made in the SDEIS, other than that NC DOT would examine possible best management practices to control stormwater (p. 2-82). Opponents of the Pamlico Sound Bridge claim that the stormwater runoff from a 17-mile long bridge would be a significant source of pollution. However, most stormwater runoff in urban areas collects pollution from sources such as herbicides, pesticides and fertilizers which arc placed on land adjacent to roads. Environmental Defense requests that a comparative stormwater analysis be performed to answer the following questions: What contaminants are currently in the stormwater runoff along the portion of NC12 in the study area? What impact does the number of vehicles parked along NC12 during peak tourist season have on stormwater (e.g., dripping oil, coolant, other fluids)? What does the current level of maintenance and repair of NC12 contribute to the contaminants in stormwater? What types of stormwater collection systems have been used in other long bridge construction projects? Public Access Environmental Defense firmly supports continued public access to PINWR. Visitor surveys indicate that 60% of current visitors would continue to visit the refuge, even if access is no longer by means of a paved road. The U.S. Fish and Wildlife Service (FWS) has committed to providing continued public access to PINWR, and Environmental Defense requests that the FWS establish a working group to determine the most feasible means of maintaining such access. It should be noted that North Carolina has other remote coastal recreational areas (Cape Lookout National Seashore, Hammocks Beach State Park, etc,) that are accessed by means other than a paved road, and which have high levels of visitation during the tourist season."

> **Response:** *Additional material related to water quality impacts for all detailed study alternatives and approaches to handling storm water on the bridges is included in Section 4.7.2 of the FEIS. The USFWS has indicated that they would prepare a future access plan if the Pamlico Sound Bridge Corridor was selected. The Preferred Alternative, however, provides access to the Refuge both at the northern end of the Refuge and via a 2.1-mile (3.4-kilometer) section of existing roadway.*

Comment: "In sum, it must be stated that there exists no perfect solution to the issue of safe, reliable transit over Oregon Inlet and the future of NC12 on Hatteras Island. None of the alternatives presented meets all needs with regard to safety, reliability, economic feasibility, public access and avoidance of environmental impacts. However, when all factors are balanced, and the requirements of both NEPA and Section 4(f) of the Department of Transportation Act are considered, the Pamlico Sound Bridge alternatives present the best solution to all of these issues, save access, which the USFWS has committed to address. For these reasons, Environmental Defense supports the Pamlico Sound bridge replacement corridor and requests that a working group be."

> **Response:** *The position of the commenter is noted. The Phased Approach/Rodanthe Bridge Alternative (Preferred), which was presented in the SSDEIS that was released after the receipt of this letter, also avoids impacting the Refuge from a Section 4(f) perspective because it would remain within the existing NC 12 easement through the Refuge. The FHWA also has determined that no constructive use would occur to the Refuge by the Preferred Alternative. As indicated in Section 2.10.2.5, NCDOT would not perform storm-related NC 12 maintenance work outside the existing easement in the Phase III, IV, and no action areas on NC 12.*

8.12.3.6 Environmental Defense-April 17, 2007 (page B-256)

Comment: "The Supplement states Phase II, III, and IV would be constructed post-2013, post 2020 and post-2030 respectively (with the exception of the beach fill included in the Rodanthe Nourishment alternative); it also states that construction would occur in locations where a breach is likely or where the distance between the active shoreline and NC 12 is predicted to be less than the buffer distance of 230 feet by one of the above dates. However, oceanfront erosion does not always occur at a steady, long-term erosion rate. On the Outer Banks, erosion is far more likely to occur in a punctuated fashion as a result of hurricanes and nor'easters. These erosion-inducing events could easily result in the active shoreline being within the 230 foot buffer distance to NC 12 sooner than predicted, i.e., before 2013, 2020, or 2030. If such a situation were to occur, would NCDOT proceed with phased bridge construction in the affected area as stated in the Supplement or would other measures (i.e., beach fill) be used to increase the buffer width between NC 12 and the active shoreline to 230 feet? Furthermore, would beach fill continue to be used until the 2013, 2020, or 2030 dates are reached?

Page 2-4 of the Supplement states "…if a storm related breach were to occur, or if shoreline erosion accelerated or decelerated in a particular location, implementation of any individual phase could be accelerated or delayed." However, a set of specific decision-making criteria regarding exactly when and under what conditions construction of the bridges in Phases II-IV would occur needs to be established. In the absence of such criteria, actual construction under the Phased Approach alternatives could be delayed indefinitely resulting in a de-facto Parallel Bridge w/Nourishment alternative. As detailed in our 12/8/05 comments on the SDEIS, Environmental Defense strongly objects to the Parallel Bridge w/Nourishment alternative as it results in unacceptable cumulative and long-term impacts to natural resources and fails to meet the needs of providing safe and reliable transportation."

> **Response:** *A monitoring program and process for deciding when to implement each phase as the shoreline evolves is presented in Section 2.10.2.5 of the FEIS. The implementation of any phase also is dependent upon adequate funding. The Parallel Bridge Corridor with Nourishment Alternative was not selected as the Preferred Alternative, nor is "de-facto" nourishment proposed.*

Comment: "Page xxvii ('Project Commitments') the Supplement states that the life expectancy of a replacement bridge is estimated to be as long as 100 years. Environmental Defense strongly believes that a true accounting of the costs associated with the various alternatives should be calculated on a timeframe comparable to the life expectancy of the bridge, rather than the artificial project endpoint of 2060. We made a similar statement in our comments on the SDEIS. Given that substantial public funds will be used for construction, the public should be informed of the maximum costs that could be incurred. Should NCDOT determine that use of additional beach fill is necessary in a scenario such as that described in the paragraphs above, those costs need to be factored into the Phased Approaches. Finally, we request additional information regarding the cause for the apparent non-linear increases in per-square foot construction costs between the SDEIS and this Supplement."

> **Response:** *The design life assumed in the SDEIS and SSDEIS was 50 years, which is the typical design life NCDOT assumes for bridge projects. This is also why 2060 was selected as the project endpoint. The bridge structure components of the alternatives, however, could potentially last longer than 50 years and perhaps up to 100 years. Beach fill is not a component of the Phased Approach/Rodanthe Bridge Alternative (Preferred). Section 2.3.1.2 of the SSDEIS and Section 2.12.1.2 of the FEIS identify the reasons for the increases in costs between the SDEIS and the SSDEIS.*

Comment: "While the direct wetland impact from the phased alternatives has been evaluated to be relatively small, in part due to potential natural wetland infill from sand movement within Pea Island National Wildlife Refuge (PINWR), the total temporary and permanent biotic impacts (which include wetland impacts) from construction of either of the phased approaches are not insignificant (48.5 acres temporary biotic impact, Supplement, p.4-30). While much of the impact might be "temporary", the magnitude of that effect on the biota and general ecology of the Refuge can be exacerbated by the timing of such "temporary" impacts. The Supplement does not adequately evaluate this.

> **Response:** *Both the permanent and temporary wetland impacts associated with the Phased Approach/Rodanthe Bridge Alternative (Preferred) would be mitigated under the requirements of Section 404 of the Clean Water Act.*

Comment: "Additionally, the phased alternatives present a likely adverse impact to federally endangered populations of both piping plover (Supplement, p.4-37) and green sea turtle (Supplement, p.4-38). We disagree with the biological conclusion in the Supplement of "Unresolved" for both of these species. While shoreline erosion may indeed create piping plover habitat under future bridges (Supplement, p.4-38), the lack of conclusive information regarding disturbance impacts from vehicle noise warrants a precautionary approach, and therefore a conclusion that the Phased Approach alternatives are likely to adversely affect the species. A similar precautionary approach and conclusion is warranted for the green sea turtle as well, given the certain impacts of bridge piles on nesting habitat quality as well as potential construction impacts. Finally, the Supplement erroneously concludes that the Phased Approach would not likely adversely affect loggerhead sea turtles, based on observations from 2003 and 2004 (Supplement to SDEIS, p. 4-39). The area should be re-evaluated before making such conclusions. The certain and potential impacts described for green sea turtles above also apply for this species."

> **Response:** *For the Phased Approach/Rodanthe Bridge Alternative (Preferred), FHWA and NCDOT has completed formal consultation with the US Fish and Wildlife Service*

under the requirements of Section 7 of the Endangered Species Act of 1973, as amended. Its findings are presented in Section 4.7.9 of the FEIS.

Comment: "The eventual result of the Phased Approaches alternatives will be several bridges in the ocean. While the immediate impacts of construction from Phases II-IV are unlikely to directly impact nearshore fish species and habitats, the long-term and cumulative impacts to these resources—as well as nearshore benthic communities—as erosion moves the bridges into the ocean is not considered in Section 4.12 of the Supplement. Given the discussion in Section 4.6.3 of the Supplement regarding the impact of scour from the Phased Approach alternatives on the local bathymetry and wave climate, and potentially longshore sediment transport, this is a significant omission. These are all characteristics which impact benthic community structure, and potentially resident fish species. While changes may be gradual in nature, this does not mean that they will be insignificant. Alteration of habitat structure for fauna at the base of the food chain can have cascading ecological impacts that should be acknowledged, particularly given the importance of fishing and tourism activities (e.g., birding) on the local economy. In order to adequately evaluate the Phased Alternatives an accounting of these cumulative and long-term impacts is necessary."

Response: *In response to this comment, FEIS Section 4.7.3.2 includes a discussion of changes in the relationship of the Phased Approach/Rodanthe Bridge Alternative (Preferred) with the shoreline and its biotic communities. NCDOT and FHWA consider these impacts to be direct impacts, not indirect and cumulative impacts, since they are directly associated with the proposed action.*

Comment: "As discussed in section Sections 4.3.2 and 5.2.2 of the Supplement, the Phased Approach alternatives represent a substantial visual impact to the Refuge, and indeed, would permanently alter the undeveloped and protected character of the Refuge which makes it a unique national treasure. Furthermore, the Phased Approach alternatives provide the most restrictive access of any of the Parallel Bridge Corridor alternatives (Supplement, p. 4-5, 4-6, 5-8). Environmental Defense strongly supports continued access to the Refuge and points out, as we did in our comments on the SDEIS, that access to other public trust areas in the state is maintained without a paved road such as NC 12. Finally, the limited public access provided by the Phased Approach alternatives would not only adversely affect Refuge resources, but would also severely impact recreational activities such as fishing, hiking, birding and particularly surfing. These impacts alone make the Phased Approach alternative incompatible with the purpose and mission of the Refuge."

Response: *These concerns are acknowledged. The Phased Approach/Rodanthe Bridge Alternative (Preferred), however, is the LEDPA for the reasons presented in Section 2.15 of the FEIS. As with the Pamlico Sound Bridge Corridor, the USFWS could provide additional access without the use of a paved road with the Phased Approach/Rodanthe Bridge Alternative (Preferred).*

Comment: "The Phased Approach alternatives do not appear to provide a safe and reliable means of transportation, which is of paramount importance. Overwash and flooding will continue to be an issue with these alternatives. Additionally, the eventual location of bridges in the ocean that are 25 feet above mean high water will not provide safe transit during the frequent storm events which impact Hatteras Island. The Pamlico Sound alternative will provide significantly safer transit during storm events, as it would be in the lee of the island with less direct exposure to storm winds and at a lower elevation of 10 feet above mean high water. The Long Bridge Operations and Safety Study Report (Parsons Brinckerhoff Quade & Douglass, June

2006) indicated that crash rates on North Carolina long bridges tended to be low and in fact were lower than crash rates observed on statewide two and four lane roads. In addition, the crash rates for long North Carolina bridges corresponded closely with the crash rates calculated for the Chesapeake Bay Bridge Tunnel, which consists of a 15.5 mile long bridge and 2.1 mile long tunnel. Based on the data we maintain that the Pamlico Sound Bridge alternative will provide the safest and most reliable transportation to and from Hatteras Island.

As stated in our previous comments on the SDEIS, none of the alternatives presented meets all needs regarding safety, reliability, economic feasibility, public access an avoidance of environmental impacts. Based on the information contained in the Supplement, Environmental Defense maintains that the Pamlico Sound Bridge alternative still presents the best solution when all of the factors above are considered and balanced."

> **Response:** *These positions are acknowledged. The findings of the Long Bridge Operations and Safety Study Report are summarized in Section 2.8 of the FEIS. Its findings related to weather and crash rates apply to the Phased Approach/Rodanthe Bridge Alternative (Preferred), in addition to the Pamlico Sound Bridge Corridor.*

8.12.3.7 North Carolina Coastal Federation-December 9, 2005 (page B-261)

Comment: "Bonner Bridge connects with Highway 12 at the Pea Island National Wildlife Refuge, an undeveloped piece of Land set aside by federal law as habitat for wildlife. Pea Island must be allowed to function as a natural system. Because barrier islands migrate, maintaining a highway from Oregon Inlet to Rodanthe poses especially difficult challenges. While beach renourishment and dune building may be acceptable on some barrier islands where human settlement is present, Pea Island is a wild, undeveloped barrier system and must remain so. This is not simply a desire on the part of NCCF, <u>but a requirement under federal law.</u>

According to the designs set forth in the draft EIS, the only alternative that meets the criteria outlined above is the Pamlico Sound Bridge. In addition, the Pamlico Sound Bridge would be designed to last a hundred years. This is far beyond the capacity of an on-the-ground road through Pea Island, which will likely be disrupted by erosion after 50 years, at most.

The Parallel Corridor, all roads, can only be maintained through a program of beach nourishment and dune building that is unacceptable. Halting barrier island migration is difficult on any shoreline. On Pea Island, it will be impossible without extreme engineering tactics that are inappropriate for a wildlife refuge. These include the closure of breaches or inlets that open as the island continues to migrate. The flushing of tidal waters through ocean cuts is an important component of water quality. Any cuts that occur on Pea Island before 2060-and scientists agree that they will occur-must be allowed to remain open and function naturally, without hardened structures or fill. In addition, beach renourishment would produce turbidity plumes in ocean waters and would kill millions of tidewater invertebrates on which fish and migrating birds depend for food. Building dunes of 10 and 20 feet, as described in the DEIS, would hasten, beach erosion and cause sand to be lost from the system as the ocean washes it out to sea. The west bank of Pea Island is already starved for sediment because of the dune building that has occurred over the past seventy years. This has led to extensive loss of wetlands; in fact, shoreline surveys show that the refuge has decreased in land mass from 5,900 in 1935 to only 5,000 acres today. Dune building within the refuge must be stopped. Such engineering tactics will become increasingly necessary as sea level rises. For these reasons, the Parallel Corridor, all road, is unacceptable."

Response: *An alternative involving nourishment was not selected as the Preferred Alternative, and it should be noted that the road component of the Parallel Bridge Corridor with Road North/Bridge South or All Bridge Alternatives does not involve nourishment because of its placement west of the 2060 high erosion shoreline. The phasing scheme for the Phased Approach/Rodanthe Bridge Alternative (Preferred) assumes that four of the five potential breach locations are bridged during Phase II, including the area at Rodanthe where a breach is most likely to occur. It is NCDOT's intent to place a high priority on the implementation of Phase II as soon as it is practicable. The fifth location (former New Inlet area) would be bridged during Phase III.*

Comment: "In reviewing the draft EIS, we were hopeful that the Parallel Corridor, Road North/bridge South or All Bridge options might provide a viable alternative that would allow public access while enabling the island to behave naturally. However, as described in the draft EIS, all alignments of the Parallel Corridor would involve intensive management of the island, including the immediate closure of any breaches or inlets that open in Pea Island. These alternatives would also continue the current practice of using dune building or beach renourishment on portions of the road that may be threatened as the island migrates, including the Canal Zone on the north end. For these reasons, the Parallel Corridor as described is unacceptable.

According to the options set forth in the DEIS, then, the Pamlico Sound corridor is the only acceptable alternative. It would avoid dune building, beach renourishment, and the closure of ocean breaches. It is also the only alternative that would meet the requirements necessary to receive federal permits under the Clean Water Act. But it would prevent the public from having the easy access to Pea Island it currently enjoys, and on which Dare County officials insist.

It should be noted that the alignment of the bridge and Highway 12 has been the subject of long discussion between the state and federal resource agencies (the Merger Team) charged with protecting public safety and the refuge. The Pamlico Sound corridor was endorsed unanimously by Merger Team members. Other corridors were considered, but problems were found with each. Routings that would have taken the road through the wildlife ponds were deemed unacceptable because of the large amount of wetlands that would be destroyed and the destruction of refuge facilities. Nonetheless, NCCF believes that because of the high degree of public opposition to the long bridge, alterative routes should be placed back on the table.

The Dare County Commissioners are on record as opposing the Pamlico Sound corridor for two reasons. First, the Pamlico Sound route would remove the need for the terminal groin on the south end of Oregon Inlet. The commissioners want the groin to remain in place to help stabilize the channel through the inlet. Second, the commissioners fear the Fish and Wildlife Service (FWS) intends to limit public access to the refuge. They demand that the refuge remain easily open to visitors.

NCCF believes it may be possible to work out a compromise that would leave the terminal groin in place and align a series of bridges and roads through the refuge designed to let the Island migrate naturally. We suggest that consideration be given to building a bridge through the northern part of the refuge, with the understanding that it would be engineered to withstand tidal surge. Any breaches or inlets would be allowed to remain open. No dune building or beach renourishment would be allowed. A public access point could be included for the north end. A problem with this suggestion is that it would likely require the road to be moved west from its present location through the north portion of the refuge, into sensitive wetlands with high wildlife value. If so, it would have to be constructed using the more expensive “top-down” construction method, leapfrogging forward a section at a time, to minimize damage to the wetlands. This is essential. Even with top-down construction, mitigation would be required. While it is highly unusual for us to endorse a proposal that would destroy wetlands, we are convinced that the barrier island system, including wetlands and Submerged Aquatic Vegetation, will quickly recover once DOT stops building dunes and moving sand to protect Highway 12.

In the middle portion of the refuge, engineers could align a bridge to follow the current route of the dikes that now form the west wall of the waterfowl impoundments. In the past refuge management has voiced concern about the potential destruction of the wildlife ponds and the disturbance of having vehicles pass too close to feeding, resting, and nesting birds. County officials have countered that the wildlife ponds are heavily manipulated, and therefore not natural habitat. NCCF believes it may be possible to build a bridge to replace the western dikes, reducing wetlands destruction and leaving the middle part of the island undisturbed for wildlife. At the same time, the wildlife ponds could be reconfigured and opened to tidal flushing, thus more closely mimicking a natural estuarine system. If carefully planned, this compromise could restore components of the natural system while allowing a bridge to remain within the refuge.

FWS management says it does not have the funds for such an extensive reengineering of the refuge ponds. It would fall on the state to design and construct a roadway and the surrounding landscape features to meet both its needs and those of the FWS. While this would be highly unusual, we believe it would be much less expensive than nourishing the beaches of Pea Island and closing breaches for the life of the Parallel Corridor. It would certainly be less damaging to water quality and the barrier island system. And it would increase fisheries habitat.

South of the wildlife ponds, a bridge across New Inlet could be tied into the portion of the road that is not currently threatened by erosion. This would reduce the cost of the project. Public access to beaches could be provided in the New Inlet area and south. A bridge would again be required north of Rodanthe, in the S-curves area.

This suggestion corridor is only one of several potential routings that could serve as a compromise. Others include landing a bridge near the northwest corner of North Pond and proceeding south along the dikes. It appears from the maps in the DEIS that such a routing would avoid major beds of Submerged Aquatic Vegetation, but careful surveys would need to be conducted.

Finally, in our conversations with local officials and residents, it has become clear that the favorite public destination point is the north end of the refuge. If another compromise cannot be reached, the simplest solution would be to build the Pamlico Sound corridor with a spur to the north end. The terminal groin could be left in place. (Refuge management has indicated that it might accept leaving the groin in place, if DOT would agree to occasionally spread sand on its south side to maintain habitat for beach-nesting birds.) A spur for providing access to the north end could be included in other road alignments as well.

As a public document, the draft EIS falls short in not examining ways in which the two opposing camps-those who favor the Parallel corridor and those who favor the Pamlico Sound corridor-might be brought together. We intend this only as a starting point from which discussions can move forward. But it is clear to us that policy makers must examine more alternatives than those presented in the draft EIS, and that they must do so quickly. We urge DOT, the resource agencies, and the officials of Dare County to make a sincere and creative effort to find compromises that will satisfy parties on both sides of the issue.

In closing, everyone involved in this decision should recognize that there is no inexpensive, easy solution to this problem-because there is no cheap, impact-free way to maintain a major transportation corridor down a shifting barrier island. Provisions must be made for the changeable nature of the landscape."

> **Response:** *FHWA and NCDOT appreciate the commenter's desire for a compromise solution and the additional suggestions. Regarding the commenter's specific suggestions, the Phased Approach/Rodanthe Bridge Alternative (Preferred) would not involve beach nourishment or dune maintenance. As suggested by the commenter, it would involve a bridge in the northern part of the Refuge with an access point at the northern end of Hatteras Island. However, it would remain in the existing NC 12 easement, minimizing wetland impacts. A bridge also is included in the middle of the Refuge as suggested by the commenter. Natural erosion, however, would affect the ponds. A bridge also is placed in the New Inlet and Rodanthe areas as suggested by the commenter. The merits of an access ramp from the Pamlico Sound Bridge Corridor to the north end of Hatteras Island are discussed in Section 2.5.3 of the SDEIS and the FEIS.*

8.12.3.8 North Carolina Coastal Federation-April 16, 2007 (page B-263)

Comment: "Our comment letter from 2005 read in part: Bonner Bridge connects with Highway 12 at the Pea Island National Wildlife Refuge, an undeveloped of land set aside by federal law as habitat for wildlife. Pea Island must he allowed to function as a natural system. Because Barrier Island migrates, maintaining a highway from Oregon Inlet to Rodanthe poses especially difficult challenges. While beach renourishment and dune building may be acceptable on some barrier islands where human settlement is present, Pea Island is a wild, undeveloped barrier system and must remain so. This is not simply a desire on the part of NCCF, but a requirement under federal law.

The letter further suggested that DOT explore moving part of Highway 12 to the west side of the refuge, perhaps along the dikes that form the west wall of the wildlife impoundments. The dikes could be replaced by bridges, restoring the natural tidal flushing of the ponds while allowing public access. We continue to believe that this alignment or one like it would provide a reasonable compromise to the impasse over the Bonner Bridge replacement. However, in later conversations with representatives of the U.S. Fish and Wildlife Service (FWS) it became clear to us that they were not willing to explore this option. They told us it was not likely to be compatible with the mission of the refuge under the 1997 National Wildlife Refuge Improvement Act. To our disappointment, discussion of the alternative was dropped. We continue to believe that this option might provide a reasonable solution to an unusually sticky problem.

For the current public comment period on the supplemental draft EIS, we feel compelled to reiterate the following points:

- Beach renourishment on a large scale is not acceptable within a national wildlife refuge. Whatever alternative is followed, Pea Island must be allowed to function as a natural barrier island. Thus, the parallel corridor with the beach renourishment option should be removed from consideration.

- The constant construction of high dunes on the east side of Highway 12 is thwarting the natural migration of the barrier island and causing sand to be washed out to sea. As a result, Pea Island is becoming more and more unstable. Thus, dune building as outlined in the supplemental DEIS should be removed from consideration.

- If a bridge is constructed in the Canal Zone portion of Highway 12, within a few years the highway will encroach on the beach, simply because of the unusually high rate of erosion in this stretch (11 to 12 feet a year, 1998 maps). It is impractical to think otherwise. Instead of taking a stroll on a peaceful, deserted strand, visitors could lay out their towels beneath a highway carrying thousands of cars a day. Is this really what DOT intends for Pea Island?

- The alternative that includes relocation of Highway 12 slightly to the west along the wildlife ponds is not likely to be found compatible with the National Wildlife Refuge Improvement Act. If this option is feasible, why not move the road to the far west side of the island?

- In choosing an option, it is vital to recognize the true costs of maintaining Highway 12 through 2060, as summarized on page vii of the document and elsewhere. Even the least expensive options far exceed the money currently available in DOT coffers.

- While the cost of the Pamlico Sound corridor, \$1.3 billion to \$1.8 billion, is higher than other options, it should be recognized that the Pamlico Sound bridge has a life expectancy of 100 years, twice as long as the Parallel Bridge and its various options for passage through Pea Island."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) would not involve beach nourishment or dune maintenance. The visual impacts associated with the alternative are discussed in Section 4.3.2 of the SSDEIS and the FEIS. An alternative immediately west of Hatteras Island is considered and discussed in Section 2.3 of the SDEIS and the FEIS. Like the Pamlico Sound Bridge Corridor, it is not practicable because its full length would have to be built from Bodie Island to Rodanthe and funds are not available to build a single project of that length. Also, unlike the Pamlico Sound Bridge Corridor, it would be placed in an area likely to contain submerged aquatic vegetation (SAV). The Pamlico Sound Bridge Corridor was placed to minimize SAV impacts.*
>
> *The design life assumed in the SDEIS and SSDEIS was 50 years. The bridge structure components of the alternatives could potentially last longer than 50 years and perhaps up to 100 years. Fifty years, however, is the design life typically assumed in bridge planning by NCDOT.*

Comment: "With the above considerations, we do not believe that the options laid out in the supplemental DEIS are suitable for the landscape of Pea Island or the political climate of Dare County. <u>However, it may be possible to amend the designs of both the short bridge and long bridge to make them work.</u> Our suggestions are as follows:

1. If the Pamlico Sound Corridor (long bridge) option is selected, access ramps should be provided to allow public access to Pea Island. A ramp might be brought in at the north end of the wildlife refuge. A second ramp might be designed to provide access to the beautiful beaches on the most stable section of Pea Island, between New Inlet and the S curves. We recognize that the ramps would add significantly to the cost of the project. However, this solution would allow the island to remain natural, provide reliable transportation to Hatteras through the 21st century, and meet the access goals of the local community.

2. If the Parallel Corridor (short bridge) is selected, DOT should work with FWS to find a route for Highway 12 on the west side of the refuge that will meet the three goals (natural island migration, reliable transportation, public access) while also meeting the management needs of the FWS. The route currently proposed through Pea Island places the natural beauty of Pea Island at risk and will force DOT into a losing battle against the ocean. We call on both DOT and FWS to negotiate in good faith on this point, and to view mitigation of impacts as an opportunity to return the wildlife refuge to a more natural landscape.

Finally, NCCF does not believe that DOT can realistically expect to maintain Highway 12 through Pea Island as designed and described in the EIS. Any beach as dynamic as that on Pea Island is a poor candidate for renourishment projects. The technical capacity of DOT to protect the road over the long run is limited and will always be, even if money were no object. If the parallel bridge is built and DOT attempts to keep Highway 12 in or near its current location, state officials and local residents should anticipate frequent disruption of highway services to Hatteras Island."

> **Response:** *The merits of an access ramp from the Pamlico Sound Bridge Corridor to the north end of Hatteras Island are discussed in Section 2.5.3 of the SDEIS and the FEIS. As noted by the commenter, such a ramp would be a costly addition to already expensive alternative. The "Bridge South" component of the Parallel Bridge Corridor with Road North/Bridge South Alternative is a bridge from Rodanthe and the most stable section of Hatteras Island. It would require a section of new easement within the Refuge and like the alternative of which it is a part, not likely to be found compatible with the Refuge. Given Section 4(f) of the Department of Transportation Act of 1966, the requirements of the National Wildlife Refuge Improvement Act (under which a determination of non-compatibility cannot be mitigated), and funding availability, the Phased Approach/Rodanthe Bridge Alternative (Preferred) is the LEDPA. Once complete, the portions of NC 12 threatened by beach erosion prior to 2060 will be on a bridge.*

8.12.3.9 NC Sea Grant-December 12, 2005 (page B-264)

Comment: "In recognition of the intense development that has occurred and is continuing along the Nation's coastal barrier beaches and the special place that our Dare County Outer Banks and the adjacent inland sea of Pamlico Sound represents in the hearts of North Carolinians and the Nation, we urge that the options chosen for bridge replacement and highway 12 alignment preserve the unique environmental, cultural, and social heritage of this region. Natural areas like Pea Island and the Pamlico Sound provide ecosystem and human services that sustain not only fish and wildlife, but our lifestyles and coastal economy. These systems are also important for the rare opportunities they offer for humans to be engaged in a wild beach system. Thus, we urge care in replacement of this bridge and road so as to allow these natural areas to continue to function in a natural manner, while providing access for residents and visitors to enjoy the natural wonders of our Outer Banks.

We recognize that the maintenance of public vehicular access to Hatteras Island has become highly controversial. Two primary options are being considered. The first, supported by most public officials, involves a parallel replacement to the existing Bonner Bridge, combined with Highway 12 maintenance in its current alignment. This option addresses concerns over access to Pea Island and its natural attractions. However, most environmental advocates strongly prefer that access to Hatteras Island be provided by a 17-mile bridge span routed through the Pamlico Sound to avoid negative impacts to wildlife in the Pea Island refuge. Unfortunately, this option may not provide adequate public access to the refuge and will have negative impacts on Pamlico Sound.

Our review of this controversy and the scientific literature available on similar projects leads us to conclude that a compromise solution that can address both goals of environmental preservation and public access is undoubtedly desirable and possible. We would like to suggest that a variation on the Parallel Corridor, Road North/Bridge South may represent the basis for just such a compromise alternative.

One possible alternative would involve the coupling the short bridge with an alignment and design of Highway 12 that includes techniques to avoid certain especially damaging construction and landscape maintenance practices. For example, dredging and filling, channelization, and wetland destruction should be avoided as much as possible. Also “top-down” construction techniques, as noted on several bridge construction projects in Louisiana, provide opportunities to reduce construction impacts on environmentally sensitive areas associated with dredging, channelization, and soil compaction from heavy construction equipment. Impacts from runoff associated with long bridge spans can be minimized using stormwater devices and techniques that treat and disperse the discharge. Importantly, the road alignment must not use techniques that include causeways or dikes that block water flow and impede circulation, flushing, and passage of fish and other marine organisms are critical to maintaining production of ecosystem goods and services. Additionally, upon occasion, projects that improved flushing helped enhance SAV densities in protected bays.

Using the parallel short bridge option, there would be no additional area of the Pamlico Sound newly impacted to provide access to Hatteras Island. If this short bridge option is coupled with an alignment for Highway 12 that includes design and construction techniques that avoid dredge-and-fill, use elevated sections to span the critical hotspots identified in the EIS, render beach nourishment and artificial dune building unnecessary, and allow natural island physical and biological processes to proceed unimpeded, then all interests could be satisfied. Such a solution would require a route, road/bridge design, and maintenance process that would permit breaches in Pea Island to open and fill naturally and overwash to proceed, thereby providing important bird nesting habitat. Furthermore, this design may involve some restoration of function in the ponds to increase the wetland acreage and also SAV habitat as mitigation for SAV losses involved in using the western alignment.

Our assembly and review of the technical literature provided some guidance on practices to avoid and processes to sustain during and after bridge and road construction on a coastal barrier island. In particular, there are ways to design and build bridges and roads to minimize construction, post-construction, and maintenance impacts attributed to shading, disruption of water circulation, dredging and filling, and wetland destruction. Nevertheless, no past study deals with a situation precisely analogous to the Bonner Bridge replacement issue, where access to, yet preservation of, such a valuable natural system as the Pea Island refuge is so critical. Hence, we conclude that more detailed, inspired, and motivated study of an alternative using the short bridge with a route and design for Highway 12 that maintain the environmental functions of Pea Island is advisable. Indeed, with regard to the issue of NC 12 maintenance we reiterate that the Supplemental Draft EIS notes that there is an approach in which “…components could be mixed and matched geographically along the length of NC 12 to create other variations.”

> **Response:** *The commenter’s suggestions on how to improve the implementation of the Parallel Bridge Corridor with Road North/Bridge South are appreciated. It has been concluded, however, that because this alternative uses Refuge land outside the existing NC 12 easement, it cannot be implemented under the terms of Section 4(f) of the Department of Transportation Act of 1966, as amended, and the terms of the National Wildlife Refuge System Improvement Act of 1997. The Phased Approach/Rodanthe*

Bridge Alternative (Preferred), which was presented in the SSDEIS after these comments were made, would "use elevated sections to span the critical hotspots identified in the EIS, render beach nourishment and artificial dune building unnecessary, and allow natural island physical and biological processes to proceed unimpeded" as suggested by the commenter.

8.12.3.10 Sierra Club-December 9, 2005 (page B-265)

Comment: "Executed properly, the Pamlico Sound Bridge Corridor options provide the best balance of reliable, safe transportation, environmental protection, and recreational opportunities. It is our belief that not only can environmental protection and safe, reliable access be co-achieved, but that they are actually co-dependent; that is, given the dynamic nature of this area, the options that best protect the environment also ensure the most reliable transportation. It is our further belief that the Pamlico Sound Bridge Corridor options will be easier to move through the permitting process and, as such, will be better able to meet the urgent demands of the bridge replacement schedule."

Response: *Comment acknowledged.*

Comment: "The Pamlico Sound Bridge Corridor options will unquestionably provide the most reliable transportation to and from Hatteras Island, as these options are the only ones that totally avoid all three existing overwash hotspots on NC 12 through Pea Island National Wildlife Refuge (PINWR). Accordingly, we believe that this would ultimately be the least expensive option when all costs of the bridge options, over the potential 100-year design life cycle, are fully and fairly considered. Each of the Parallel Bridge Corridor options would require some continued maintenance of NC 12 through PINWR, with the "With Nourishment" option requiring the most extensive amount of continual maintenance work, making it the least reliable and likely, the most costly, option."

Response: *Comment acknowledged. The design life assumed in the SDEIS and SSDEIS was 50 years. However, some bridge structure components of the alternatives could potentially last longer than 50 years.*

Comment: "The Pamlico Sound Bridge Corridor is clearly the best option in terms of preserving the ecological and geologic integrity of the northern portion of Hatteras Island. The Sierra Club believes that the bridge replacement offers an excellent opportunity to protect and restore the natural characteristics of Oregon Inlet and the associated barrier island system, which will in turn benefit wildlife, recreational opportunity, and fisheries. As such, we believe that the following should be priorities in the bridge replacement project:

- removal of the terminal groin on the south side of Oregon Inlet;
- no nourishment/bulldozing within PINWR; and
- protection of dry and wet lands within PINWR.

The Pamlico Sound Bridge Corridor avoids submerged aquatic vegetation adjacent to Hatteras Island, and the lands of Pea Island National Wildlife Refuge (PINWR). The Pamlico Sound Bridge Corridor also precludes the need for the terminal groin to stabilize the north end of Hatteras Island as well as the need for nourishment and sand bulldozing within PINWR. In short, the Pamlico Sound Bridge Corridor keeps all options for the management of the northern portion of Hatteras Island open, while the Parallel Bridge Corridor options will tie the hands of the state and federal government to intensive and increasingly difficult and expensive sand management activities within PINWR for the life of the new bridge.

We are sensitive to the need for a reliable navigational channel through Oregon Inlet between the Pamlico Sound and Atlantic Ocean and support the 2002 decision by the White House Council on Environmental Quality (CEQ) to provide state-of-the art navigational aids and to allow the US Army Corps of Engineers to use low-impact dredging to maintain an appropriate navigable channel for the vessels that currently use the inlet. The Sierra Club supports complete removal of the terminal groin and allowing semi-natural (because of the channel maintenance dredging) migration of the inlet. The Sierra Club believes that such an approach to the maintenance of Oregon Inlet for navigation will restore semi-natural barrier island processes south of the inlet, benefiting wildlife and enhancing fisheries in the area, while ensuring safe and reliable navigation for vessels using the inlet for recreation and commerce."

Response: *Position acknowledged.*

Comment: "The Sierra Club recognizes that access to PINWR for recreational activities is a major concern of stakeholders involved in the bridge replacement planning process. Given our diverse membership, we share some of these concerns as well. While we support proposed efforts by the US Fish and Wildlife Service (USFWS) to reach consensus via future public planning sessions regarding access to PINWR and the disposition of NC 12 north of the Pamlico Sound Bridge terminus on Hatteras Island, we suggest that DOT, USFWS, and other critical parties begin this access planning process now in order to better address the public's concerns about these matters.

With respect to access in a Pamlico Sound Bridge Corridor bridge replacement option, the Sierra Club generally supports a less intensive maintenance effort for the existing NC 12, and/or its corridor, north of the south terminus of the new bridge, following the bridge's replacement. This should not include the maintenance of an artificial dune line to protect the highway. The Sierra Club supports continuing to allow access to PINWR and the inlet to the extent possible, consistent with the natural characteristics of PINWR, applicable law, and refuge policy. Such access will allow the public to explore, enjoy, and better appreciate the natural beauty and value of this rare and important barrier island ecosystem.

Likewise, we see no technical reason why fishing access to the inlet proper (such as is provided now via the catwalk on the south side of the Bonner Bridge) cannot continue to be provided in a Pamlico Sound Bridge Corridor replacement. While such a feature would certainly add to the cost of the replacement bridge, technical feasibility has been demonstrated, for example, by the public fishing pier on the Chesapeake Bay Bridge-Tunnel."

Response: *Comment acknowledged. NCDOT recognizes the importance of providing access to Oregon Inlet for fishing and other recreational activities. It should be noted that access to the south side of Oregon Inlet is not provided in the current design of the Pamlico Sound Bridge Corridor.*

8.12.3.11 Southern Environmental Law Center-December 9, 2005 (page B-267)

Comment: "As scientists have developed a better understanding of barrier island dynamics, federal and state agencies are investigating long-term solutions to the problems posed by locating transportation corridors within this volatile system. The series of short-term solutions that have been utilized to-date are costly and perpetual. Between 1987 and 1999, the Department of Transportation has spent as much as $50 million to repair and protect the existing Bonner Bridge and NC 12 from the constant beach erosion and severe weather impacts.

The SDEIS lists a series of additional projects within the proposed project area that continue this short-term fix approach. These additional projects include: relocating NC 12 north of Rodanthe; planning for interim measures to protect NC 12 from sand and ocean overwash at the Sandbag Area Hot Spot; and planning for interim measures to protect NC 12 from sand and ocean overwash at the Canal Zone Hot Spot SDEIS at vi-vii. The need for these costly, temporary fixes will not end so long as NC 12 is located within this area. Furthermore, PINWR cannot be adequately managed in a manner that promotes the environmentally beneficial aspects of the barrier island system."

> **Response:** *The commenter's opinion on the short-term project listed in Section 1.4.3 of the SDEIS and the FEIS is noted. It is important to observe, however, that these short-term projects (NCDOT TIP Project Nos. R-3116D, E/F) are companions to long-term studies for NC 12 maintenance on Hatteras Island and Ocracoke Island. The short-term and long-term studies listed reflect an effort by NCDOT and its environmental resource and regulatory agency partners to address NC 12 maintenance needs on a systematic rather than emergency basis. Short-term studies in the project area are currently on hold (and no longer listed in the TIP), and the Preferred Alternative would be implemented as a long-term solution to on-going NC 12 storm-related maintenance.*

Comment: "After several years of study, the federal and state agencies responsible for this proposed project reached concurrence that the Pamlico Sound bridge corridor would meet established long-term goals for the project area. Through the Outer Banks Task Force, state and federal agencies determined that the long-term goals for this area were (1) to preserve the natural barrier island system; (2) minimize impacts to Hatteras and Ocracoke islands; and (3) maintain access to and on the islands so that the transportation system is safe, efficient, and has minimal impact on the environment. SDEIS at 2-15. The Parallel Bridge corridor alternatives cannot meet these objectives because none preserve the natural barrier island system, all have significant effects on Hatteras Island, and the transportation corridor cannot be maintained safely and efficiently within this dynamic environment. As discussed in greater detail below, the Pamlico Sound Bridge is the only alternative that will work and can be authorized pursuant to applicable federal laws.

1. NCDOT and FHWA must demonstrate that bridge replacement is compatible with the purposes of Pea Island National Wildlife Refuge.

2. Only the Pamlico Sound Bridge alternative complies with the National Wildlife Refuge System Improvement Act.

As recognized in the SDEIS, the continued use of NC 12 thru PINWR is a use that is subject to a compatibility determination. As discussed above, NCDOT and FHWA must demonstrate that a bridge replacement alternative is compatible with PINWR's purpose or it cannot be permitted. None of the ParalIe1 Bridge alternatives comply with the National Wildlife Refuge Improvement Act because the associated operation and maintenance of NC 12 interferes impermissibly with the Refuge's purpose. As explained in more detail below, the only alternative that can be determined to be compatible is the Pamlico Sound Bridge.

Response: *The preference of the commenter for the Pamlico Sound Bridge corridor and the reasons why are noted. The Pamlico Sound Bridge Corridor is not within the Refuge, so that the National Wildlife Refuge System Improvement Act of 1997 does not apply to the alternatives within this corridor. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is confined within the existing NC 12 easement for which NCDOT has a permit. Therefore, a compatibility determination is not required.*

Comment: "As discussed above, PINWR supports a vast array of migratory birds, mammals, and threatened and endangered species. PINWR provides important feeding and nesting grounds for the federally listed piping plover and is a nesting area for loggerhead and green sea turtles.

Building any of the Parallel Bridge alternatives will directly, substantially, and adversely affect the continued utilization of the Refuge as a breeding ground for migratory birds and other wildlife and damage the ecologica1 integrity of the refuge. In order to maintain NC 12 through the northern portion of Hatteras Island, which is a dynamic system with dramatic shoreline erosion and potential for new inlet formation, the needs of the wildlife refuge would be subsumed by the need to move the road, nourish the beaches, and develop an artificial dune system. Currently, the constant beach erosion and severe weather events result in continual maintenance to repair and protect the integrity of NC 12. SDEIS at 2-48. The repair and maintenance of NC 12 degrades the ecological integrity of the refuge and harms the habitat of migratory birds and wildlife.

Response: *The SDEIS, SSDEIS, and FEIS acknowledges that the Refuge supports a vast array of migratory birds, mammals, and threatened and endangered species and the Refuge's concerns about the current level of maintenance on NC 12 and its impact on Refuge resources.*

Comment: "As the SDEIS acknowledges, "Oregon Inlet, Bodie Island, and Hatteras Island are part of a migrating barrier system characteristic of the southeast Atlantic Coast." SDEIS at 3-31. High erosion rates characterize these systems. "The rate of erosion of the Hatteras Island shoreline has accelerated in the last decade (1993-2003). Shoreline erosion and ocean overwash threaten to sever segments of the NC 12 roadway for several miles south of Bonner Bridge." SDEIS at 2-48. Even the inaccurate assessment provided in the SDEIS predicts that the shoreline will erode well into refuge land over the next 50 years. All Parallel Bridge corridor alternatives will require continual NC 12 maintenance, including moving the road, artificial dune creation, and beach nourishment. None of these repair and maintenance methods can occur within PINWR in a manner that is compatible with the Refuge purpose.

Beyond shoreline erosion, the proposed project area is susceptible to large storm events, which dramatically shape PINWR. "North Carolina coast is subject to two types of severe windstorms: extra-tropical northeasters and hurricanes. Northeasters, with accompanying high tides and waves, can rapidly erode the shoulders of Oregon Inlet. Northeasters are fairly common in this area, with between 30 and 35 hitting the coast each year. Hurricanes may be responsible for major events, such as in1et openings and closings and gorge shifts…" SDEIS at 3-36. As discussed in more detail below, the SDEIS underestimates the impact of these large storm events. For the purposes of the compatibility determination, these severe weather events perform important ecological functions and are beneficial to PINWR. Transportation corridors, however, require protection from severe weather events. In protecting NC 12, the natural processes are stunted and PINWR cannot fulfill its purpose."

Response: *The detailed study alternatives assessed in the SDEIS, the SSDEIS, and the FEIS are west of the 2060 high erosion shoreline, placed on bridges, or involve a regular* *schedule of beach nourishment with the expectation that the regular NC 12 maintenance that currently occurs following storm events would no longer occur, or at least be substantially reduced, once the project is complete. The one exception is the effect of breaches that might occur on alternatives that do not bridge potential breach locations.*

An island monitoring program (see Section 2.10.2.5) is proposed with the Phased Approach/Rodanthe Bridge Alternative (Preferred) that will enable future adaptations to the project schedule and construction as future shoreline change evolves.

Comment: "The Pamlico Sound bridge corridor allows PINWR to manage the refuge lands in such a way as to promote habitat creation and protection for the wildlife in the refuge. None of the Parallel Bridge alternatives allows sufficient flexibility for the Fish and Wildlife Service to manage PINWR and, therefore, cannot be compatible.

Within the Bonner Bridge project area, there are two areas that utilize public land. The northern termini of all bridge alternatives will utilize portions of the Cape Hatteras National Seashore. The southern termini of the proposed bridge options all utilize PINWR, but widely diverge on amount and impacts. Although PINWR is part of the Seashore, it is a separate section 4(f) resource and impacts to it must be evaluated separately. All of the Parallel Bridge alternatives adversely affect PINWR. The Pamlico Sound Bridge is the only alternative that completely avoids any impacts and docs not utilize public land within PINWR.

The Pamlico Sound Bridge is a feasible and prudent alternative that prohibits the approval of any other alternative.

Response: *The Phased Approach/Rodanthe Bridge Alternative (Preferred), which was assessed in the SSDEIS after this comment was made, is within the existing NC 12 easement and does not constructively use the Refuge. Therefore, Section 4(f) does not apply to this alternative, except on Bodie Island where it would use land from the Seashore. The Pamlico Sound Bridge Corridor is not practicable based on cost estimates and funding availability. See Section 2.15 for the reasons for selection of the Phased Approach/Rodanthe Bridge Alternative as the Preferred Alternative.*

Comment: The Pamlico Sound Bridge is a prudent and feasible alternative to using PINWR land. It is within the range of accepted engineering to build the Pamlico Sound Bridge and it is a feasible alternative. The Pamlico Sound Bridge does not present any unique problems or unusual factors. Any replacement bridge alternative must meet the SDEIS listed purposes, which are: (1) daily and emergency access across Oregon Inlet; (2) allowing continued navigation of Oregon Inlet while allowing the channel to move and (3) ensuring that any replacement is not threatened by the dynamic shoreline movement as predicted through 2050. SDEIS at 1-5 through 1-6. The Pamlico Sound Bridge achieves the listed purposes. It provides a safe, reliable, transportation corridor that bypasses the dynamic areas of Hatteras Island and avoids impacts to PINWR.

The economic, social, and environmental impacts related to the Pamlico Sound Bridge alternative are not extraordinary. Instead, the Pamlico Sound Bridge is more effective economically, socially, and environmentally. The Pamlico Sound Bridge provides a more dependable daily and emergency transportation route. The Pamlico Sound Bridge is more cost-effective. 'In fact, once a property has been designated as a § 4(f) property, the monetary expense required to protect that property in conjunction with a roadway construction project is of minimal relevance.' Hatmaker v. Georgia DOT by & Through Shackelford, 973 F. Supp. 1058, 1062 (M.D. Ga. 1997). The Pamlico Sound Bridge corridor eliminates the need for costly beach nourishment, dune building, and road maintenance that would occur in perpetuity with any other bridge replacement alternative. Although the SDEIS artificially restricts the project life to 50 years, the actual expected bridge life expectancy is 100 years. SDEIS at 3-39, 3-43. All of the Parallel Bridge alternatives, if built, would require significant annual expenditure well beyond the lifetime of any person currently involved in this project. At the end of the 100 year life-span, the dynamic nature of the barrier island system will not have changed and the state of North Carolina will have thrown away billions of dollars. The Pamlico Sound Bridge eliminates the perpetual and costly maintenance expenses and is a more economically sound bridge alternative. Furthermore, the Pamlico Sound Bridge is more environmentally responsible. By avoiding PINWR, the Pamlico Sound Bridge allows the refuge to be managed to support wildlife conservation and it avoids the adverse environmental impacts associated with beach nourishment, dune building, and other transportation corridor maintenance.

For all these reasons, the Pamlico Sound Bridge alterative is a feasible and prudent alternative and the Secretary is prohibited by Section 4(f) from funding or permitting any of the Parallel Bridge alternatives.

> **Response:** *The Pamlico Sound Bridge Corridor alternatives as noted by the commenter also do not use land from the Refuge. The Pamlico Sound Bridge Corridors, however, were found not to be economically viable. See Section 2.15 for the reasons for selection of the Phased Approach/Rodanthe Bridge Alternative as the Preferred Alternative.*

Comment: The Parallel Bridge alternatives cannot be considered because they do not minimize harm to the refuge, as required by Section 4(f).

Section 4(f) requires any alternative that utilizes public land to "include all possible planning to minimize harm to the…wildlife and waterfowl refuge." 49 U.S.C. & 303 (c) (2). The Parallel Bridge alternatives do not minimize harm to the refuge, but rather are the most harmful alternatives.

The draft 4(f) determination provided in the SDEIS is inadequate because it ignores the required feasible prudent analysis and inadequately addresses the requirement that harm to the refuge is minimized.

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred), which was assessed in the SSDEIS after this comment was made, is within the existing NC 12 easement and does not cause a constructive use of the Refuge and, as such, Section 4(f) does not apply to this alternative in association with the use of Refuge lands. See the least harm analysis in Section 5.4.*

Comment: Although the draft section 4(f) evaluation acknowledges the legal standards for a 4(f) determination, the draft 4(f) analysis omits any reference to whether the alternatives presented are feasible and prudent. SDEIS at 5-1. As discussed above, section 4(f) is an "explicit bar" to any federal approval for utilization of refuge lands. The draft section 4(f) evaluation must first look at any alternatives to using refuge lands. Then, if no feasible and prudent alternatives are found, any alternative that uses refuge land must minimize harm to the refuge. As discussed above, the Pamlico Sound Bridge alternative is feasible and prudent. Therefore, no utilization of refuge land may be permitted and the section 4(f) evaluation is complete. The current draft section 4(f) evaluation, however, recognizes that the Pamlico Sound Bridge alternative "is an avoidance alternative" because it does not use refuge lands, but the evaluation fails to determine that it is a feasible and prudent alternative. SDEIS at 5-41.

> **Response:** *The determination that there is no prudent or feasible alternative is only included in the Final Section 4(f) Evaluation* after *public review of the Draft Section 4(f) Evaluation. The Phased Approach/Rodanthe Bridge Alternative (Preferred) that was added in the SSDEIS is a Refuge avoidance alternative. See the least harm analysis in Section 5.4.*

Comment: Furthermore, the draft section 4(f) arbitrarily states that both the Parallel Bridge and the Pamlico Sound alternatives minimize harm to PINWR equally. SDEIS 5-41. Section 4(f) requires that in the event there is no prudent and feasible alternative that impacts to a wildlife refuge be minimized. The purpose of Wildlife Refuges (as discussed above in the Compatibility Section) is the conservation of wildlife. The impacts on PINWR associated with the Pamlico Sound Bridge alternative are limited to impacts on -the existing visitor's center. The issues related to access by PINWR visitors should not be described as harm to the Refuge. The primary purpose of the refuge is wildlife conservation and the Parallel Bridge alternatives are the only alternatives that impact the wildlife conservation mission of PINWR. Moreover, the existing visitor center could be easily relocated. All other ancillary impacts cannot be characterized as harm to the Refuge because they do not harm the purpose of the Refuge."

> **Response:** *The statement of reference that appears on page 5-41 of the SDEIS acknowledges differing positions on the importance of road access expressed by the full range of stakeholders in the project area, including the public and local government officials. See Section 5.4.1.2.*

Comment: "The SDEIS inadequately analyzes the environmental impacts related to shoreline erosion and new inlet formation; endangered and threatened species; and impacts to wetlands.

The proposed project is located in an extremely dynamic coastal area, which includes an active tidal inlet (Oregon Inlet) and a coast subject to significant shoreline erosion and ocean overwash. Within the project area, NC 12 is subject to perpetual threats from the shoreline erosion and ocean overwash and because of the dynamic nature of the system is subject to regular maintenance. The SDEIS does not adequately analyze the effects of shoreline erosion, inlet creation, and ocean overwash on the proposed project area. Rather, the SDEIS de-emphasizes the damage that these processes can inflict on NC 12 and neglects the beneficial impacts to the environment.

The SDEIS correctly states that the proposed project area is subject to a high rate of erosion. SDEIS at 3-31. It appears, however, that in calculating the average annual shoreline erosion rate that the SDEIS fails to incorporate several important factors.

First, the SDEIS states that shoreline erosion rates have been increasing. SDEIS at 2-48. By utilizing historic annual average erosion rates, however, the erosion rates may underestimate the amount of erosion that will occur and the projected shoreline movement through 2060 may be substantially conservative. Second, nourishment increases the erosion rate over that expected for a natural beach. See, Pilkey, et al, North Carolina Shore and Its Barrier Islands 100 (1998). Although sub-areas within the project area have been nourished in the past, the shoreline prediction rates do not appear to include a factor related to increased erosion from beach nourishment. Third, sea level rise is also predicted to increase erosion rates. Id. at 45. Finally, by utilizing an average erosion rate as LS prediction tool for the shoreline, the SDEIS fails to adequately analyze the importance of large or severe storm events in shaping the proposed project area. Although the effect of Hurricane Katrina on Gulf of Mexico barrier islands is still being evaluated there is no doubt that major weather events shape the barrier islands. This year was the most active hurricane season on record and 2006 is predicted to be of similar magnitude. Historically, major storm events have dramatic effect on the project area- creating inlets, increasing erosion. By failing to account for the impact from severe weather events, the SDEIS arbitrarily discounts the impacts of severe weather. SDEIS at 3-36. Federal regulations require, however, that environmental impact statements analyze reasonably foreseeable catastrophic events, “even if their probability of occurrence is low.” 40 C.F.R. § 1502.22 (2005).

> **Response:** *The average erosion rates include in their calculation, both periods of rapid erosion during storm events and periods of slower erosion when severe storms do not occur. They also include “prediction intervals,” a statistical technique to account for uncertainty (see Section 3.6.2.1 of the SDEIS and Section 3.6.3.1 the FEIS). For the Phased Approach/Rodanthe Bridge Alternative (Preferred) a monitoring program and process for deciding when to implement each phase as the shoreline evolves is presented in Section 2.10.2.5 of the FEIS. This program also takes into account uncertainty and the potential for severe storm events to alter the timing of phase implementation assumed in the SSDEIS and the FEIS.*
>
> *In addition, between the SSDEIS and FEIS, FHWA sponsored a Peer Exchange workshop on global climate change (see Section 4.6.6). Panelists at the Peer Exchange workshop generally agreed that the analysis’s high erosion rate results of future shoreline position may account for a portion of sea level rise caused by future changes in climate. In addition to the future shoreline analysis, past sea level rise in one location as well as a range of potential future sea level rise scenarios for the mid-Atlantic coast were also considered at the workshop. There was consensus that the current global sea level rise analytical models are not fully developed to predict local effects. The wide range of future sea level rise information considered illustrates the uncertainty associated with estimating future sea levels and shoreline locations. Panelists generally agreed that the Parallel Bridge Corridor with Phased Approach/Rodanthe Bridge Alternative (Preferred) with the island monitoring program as outlined in Section 2.10.2.5 is the most practical method for carrying out the project with the given constraints, in part because it gives an opportunity to review and incorporate new analysis prior to commencement of each phase.*

Comment: Inlets are very high energy and difficult to predict. As the SDEIS accurately summarizes, experts have identified five potential inlet locations along Pea Island. The SDEIS ignores, however, the beneficial impacts to the environment of natural inlet creation, migration, and closure. For example, during severe weather events, inlets act as release valves, allowing storm surge that has entered the sound to exit. Inlets also help to protect shallow sand shoals. The Pamlico Sound Bridge corridor confers an environmental benefit on the proposed project area that should be considered in evaluating the alternatives.

> **Response:** *The phasing scheme for the Phased Approach/Rodanthe Bridge Alternative (Preferred) assumes that four of the five potential breach locations are bridged during Phase II, including the area at Rodanthe where a breach is most likely to occur. It is NCDOT’s intent to place a high priority on the implementation of Phase II as soon as it is practicable. The fifth location (former New Inlet area) would be bridged during Phase III. See the new discussion of the positive benefits of allowing natural barrier island change in Section 4.7.7.*

Comment: “Ocean overwash is a natural and essential part of barrier island dynamics. Overwash moves sand to the sound side of barrier islands. Over long time scales, these processes enable barrier islands to respond to sea level rise by moving the island landward. On shorter, multi-year time scales, overwash processes deposit sand and cause landform changes, both of which are needed to maintain a healthy ecosystem for coastal plant and animal species. Because ocean overwash is detrimental to the transportation corridor, engineering practices such as artificial dune building and beach nourishment are used to prevent ocean overwash. This deprives barrier islands of the necessary resilience to respond to sea level rise and prevents habitat creation. The SDEIS does not analyze the environmental benefits from removing the transportation corridor and allowing ocean overwash."

> **Response:** *A discussion of the positive geomorphological and natural resource benefits of allowing the natural movement of the shoreline to take place is added to Section 4.7.7 of the FEIS.*

Comment: "The SDEIS fails to investigate adequately negative biological impacts to beach organisms. Organisms can be harmed either directly by said placement or indirectly through alterations to the beach environment. Indirect impacts from beach nourishment can include diminished reproductive success, reduction in biomass of prey items, and long-term changes to substrate composition at dredging sites. For example, "birds may be displaced by dredges, pipelines, and other equipment dong the beach, or may avoid foraging on the beach if they are aurally affected." Atlantic States Marine Fisheries Commission, "Beach Nourishment: A Review of the Biological and Physical Impacts" (November 2002). Other direct impacts include eggs, hatchlings, and adult birds crushed by sand. Id. Indirect impacts to birds feeding are related to the sediment grain. "If the sediment is too coarse or high in shell content it can inhibit the bird's ability to extract food particles in the sand. Fine sediment that reduces water clarity can also decreases feeding efficiency of 'birds."

> **Response:** *Impacts of nourishment on fisheries and wildlife are noted throughout Section 4.7.6 of the SDEIS and FEIS. Beach organisms are discussed in Section 4.7.6.4. Birds are discussed in Section 4.7.6.7. An alternative involving nourishment was not selected as the Preferred Alternative.*

Comment: "Nourishment can change the geological profile of the target beach. As mentioned above," a steeper beach profile is created when sand is stacked on the beach during the nourishment process. This condition can lead to great wave energy and the beach and greater beachside erosion." Atlantic States Marine Fisheries Commission, "Beach Nourishment: A Review of the Biological and Physical Impacts" (November 2002). Because of this higher erosion rate, the demand for sand increases over the life of the beach. As discussed above, nourishment precludes ocean overwash, leading to further erosion on the sound side."

> **Response:** *The calculations for beach nourishment include a factor that is multiplied by the known (pre-project) erosion rate at the site. This was done to compensate for losses described in the comment. The factor also accounted for end losses, which are not mentioned in the comment.*

Comment: "The SDEIS artificially limits the true cost of the Parallel Bridge/nourishment alterative because it is a cost-estimate based on a 50 year project period. The life expectancy of any of the bridge alternatives is anticipated to be 100 years. SDEIS at 3- 39, If the accurate project life-span is used in nourishment cost calculations, the total cost for nourishment is estimated to be $930,000,000. <u>See</u> Pea Island Shoreline 100-year Assessment, FDH Engineering, Inc. (July 2004). For the long-term, the Parallel Bridge/nourishment alternative far exceeds the cost of the Pamlico Sound Bridge Corridor."

Response: *The design life assumed in the SDEIS and SSDEIS was 50 years. However, some bridge structure components of the alternatives could potentially last longer than 50 years.*

Comment: "The SDEIS states that a parallel bridge corridor is likely to adversely affect the threatened green sea turtle and piping plover. SDEIS at 4-71, 4-73. The Pamlico Sound Bridge alternative is not likely to adversely affect any federally protected species. SDEIS at 4-69 - through 4-77. The SDEIS inaccurately concludes that a parallel bridge corridor is not likely to adversely affect the threatened loggerhead sea turtle. SDEIS 4-73. Loggerhead sea turtles are known to breed on the beaches within the project area and, as with green sea turtles, would likely to be adversely affected by a parallel bridge alternative.

The SDEIS fails to consider the impacts of required long-term nourishment on piping plover or sea turtles. To the extent nourishment is an integral part of a parallel bridge alternative, it must be considered in assessing adverse impacts to threatened or endangered species. Long-term nourishment of 6.3 miles of beaches on a four-year return interval within the project area would have adverse impacts on piping plover and sea turtles. Long-term nourishment has several adverse effects. By utilizing nourishment and large artificial dunes to protect NC 12, the nourishment will prevent overwash. Overwash is part of ecologically important inlet creation, migration and closure and over time, helps to create new moist sand intertidal feeding areas on the sound side. Without overwash, erosion continues to threaten sound side wetlands. By suppressing overwash, nourishment leads to loss of piping plover sound side feeding habitat and nesting habitat. In addition, the nourishment and artificial dune system prevents natural maintenance of existing habitat by increasing vegetative succession. Furthermore, nourishment may result in steeper beach profile, reducing the available intertidal area. National Park Service, Natural Resource Year in Review-2004: Ecosystem Restoration in an Altered Coastal Environment, available at www2.nature.nps.gov/YearinReview/01_A.html (last visited Dec. 8, 2005) ("A berm constructed to reduce the potential for island breaching has prevented natural overwash processes and has reduced habitat availability of piping plover.")

The SDEIS fails to analyze the impacts of nourishment on sea turtles. Beach nourishment can directly impact turtles by burying nests and disturbing nesting turtles. Because nourishment can change the beach, it impacts turtles indirectly. Beach nourishment may result in increased sand compaction and hardness and changes in moisture content and beach slope. Furthermore, as discussed above, nourished barrier islands may erode more quickly than natural beaches. This rapid erosion creates escarpments, which hampers access to nesting sites. In a vicious cycle, the rapid erosion may necessitate re-nourishment: at more frequent intervals, thereby increasing the likelihood of interference with sea turtle nesting."

Response: *An alternative involving nourishment was not selected as the Preferred Alternative. The biological conclusions in Section 4.7.7 of the SDEIS and the SSDEIS for the Parallel Bridge Corridor Alternative are applicable to the alternatives involving nourishment and specific observations related to the nourishment alternative were added to Section 4.7.7 in the SSDEIS. For the Phased Approach/Rodanthe Bridge Alternative (Preferred), FHWA and NCDOT have completed formal consultation with the US Fish and Wildlife Service under the requirements of Section 7 of the Endangered Species Act of 1973, as amended. Its findings, including those for the piping plover and several sea turtles, also are presented in Section 4.7.9 of the FEIS.*

Comment: "The various bridge alternatives assessed in the SDEIS all impact wetlands and will require authorization under Section 404 of the Clean Water Act. SDEIS at 2-116. The Pamlico Sound alternative has substantially less impact on wetlands and the aquatic environment than all of the other alternatives considered: 4.18 to 4.84 acres of wetlands (depending on the terminus) including only .01 acres of CAMA wetlands. Of the alternatives assessed, the Parallel Bridge/road north/bridge south alternative impacts by far the largest amount of wetlands: 78.2 acres of wetlands including 11.8 acres of CAMA wetlands. SDEIS at 4-58, the Parallel Bridge/all bridge alternative impacts the second largest amount of wetlands: 12.3 acres of wetlands including 2.2 acres of CAMA wetlands.

The Parallel Bridge/nourishment alternative would impact an extensive but unquantified amount of wetlands and waters. While the SDEIS slates that this alternative would impact 4.3 acres of wetlands including .3 acres of CAMA wetlands, this estimate does not include extensive filling of near-shore waters associated with the required nourishment. Id. The SDEIS states that 6.3 miles of beach will be nourished every four years. SDEIS at 2-104. The SDEIS further notes that in addition to direct fill impacts, the Parallel Bridge/nourishment alternative would result in "additional impacts associated with dredging for sand and then nourishment of 6.3 miles (10.1 kilometers) of the seashore within the refuge." SDEIS at 4-66. These impacts must be assessed and considered in the 404 permit review as a part of the Parallel Bridge/nourishment alternative per 33 C.F.R. § 325.1 (d)(2): …

The Pamlico Sound Bridge is a practicable alternative with the least impact on aquatic ecosystems and wetlands, and is the only alternative assessed in the SDEIS that may be permitted under Section 404."

> **Response:** *Support for the Pamlico Sound Bridge is acknowledged. The NEPA/Section 404 merger process concluded that the Phased Approach/Rodanthe Bridge Alternative (Preferred), which was assessed in the SSDEIS that was prepared after these comments were submitted, is the LEDPA.*

Comment: "The SDEIS identifies continued access to PINWR as an area of concern. We support continued public access to PINWR. We do not agree, however, the access is contingent upon maintenance of NC 12. Many public lands provide for public access to remote areas. For example, Chincoteague National Wildlife Refuge in Virginia has a transportation plan that provides for access to the barrier island, Back Bay National Wildlife Refuge in Virginia and Santa Anna National Wildlife Refuge in Texas both offer tram services, and Cape Lookout National Seashore provides a boat ferry to dock and transportation to the point.

PINWR Refuge Manager has publicly stated that "U.S. Fish and Wildlife Service will continue to allow people to enjoy compatible, wildlife-dependent recreational uses on Pea Island National Wildlife Refuge." Letter from Mike Bryant, Pea Island National Wildlife Refuge Manager, to Citizens of Outer Banks, (June 26, 2003) (available at http://www.fws.gov/peaisland/images/bonnerbridgeletter62603.pdf). We believe that access to the Refuge can be accommodated within a reasonable refuge management plan and the Fish and Wildlife Service has shown itself capable of managing a reasonable access plan for other National Wildlife Refuges.

We recognize the need to replace Bonner Bridge and support construction of a new bridge that provides dependable transportation to Hatteras Island, is environmentally sound, and is economically reasonable. We support the Pamlico Sound Bridge corridor alternative and believe that it satisfies these objectives."

Response: *Support for the Pamlico Sound Bridge and the acceptability of alternate Refuge access is acknowledged.*

8.12.3.12 Southern Environmental Law Center-April 17, 2007 (page B-276)

Comment: "After reviewing the Supplement, the SDEIS, and associated scientific research, we continue to support the Pamlico Sound Bridge alternative and do not agree that any of the alternatives that utilize the Parallel Bridge corridor, including the new Phased Approach, are viable alternatives.

Response: *The commenter's preference is noted.*

Comment: The Supplement proposes an additional alternative-the Phased Approach- within the Parallel Bridge corridor explained in the SDEIS. This new alternative continues to maintain a transportation corridor at the cost of public safety, reliability, and ecological protection. Furthermore, the Phased Approach is not compatible with the purpose of the Pea Island National Wildlife Refuge, pursuant to the National Wildlife Refuge System Improvement Act, nor is it a viable alternative pursuant to Section 4(f) of the Department of Transportation Act of 1966.

Response: *Section 4(f) lands are not used except in the Seashore on Bodie Island. On Hatteras Island, the Phased Approach/Rodanthe Bridge Alternative (Preferred) remains within the existing NC 12 easement, so it does not use land from the Refuge, nor is there a constructive use of the Refuge; therefore, Section 4(f) does not apply. The Phased Approach/Rodanthe Bridge Alternative (Preferred) is allowed under the terms of its easement permit with the USFWS and a compatibility determination under the National Wildlife Refuge System Improvement Act of 1997 is not required.*

Comment: Pea Island National Wildlife Refuge ("Refuge") is at the core of the debate about the Bonner Bridge replacement. Hatteras Island and Oregon Inlet are part of a dynamic barrier island system and the Refuge relies on this dynamic process for ecological viability. The Refuge is subject to ocean overwash, high shoreline erosion rates, inlet formation, and other impacts associated with large storm events, sea level rise, and general barrier island dynamics. While many of these natural processes are incompatible with transportation corridors, they are beneficial to the abundant wildlife and are instrumental in creating nesting habitat, feeding grounds, and other natural habitats. These tremendous natural resources draw tourists, anglers, birders, and other outdoor enthusiasts. Many members of our organizations regularly recreate and enjoy the natural resources of the Refuge. We support protecting the biological integrity of the Refuge and ensuring continued access for all compatible wildlife-dependent recreational uses of the Refuge that are consistent with the U.S. Fish and Wildlife Service's congressionally mandated mission to "provide for the conservation of fish, wildlife, and plants, and their habitats."

NC 12 and its associated maintenance are steadily degrading the Refuge and the Phased Approach does not protect against this degradation. As discussed more fully below, the Phased Approach is not a viable alternative. The Phased Approach would keep NC 12 under construction for the life of the project as short bridges are perpetually built through the Refuge north of Rodanthe. Furthermore, the "phased" short bridge locations are estimated based on current shoreline erosion and inlet formation predictions. Shoreline changes, however, are often episodic in nature and are difficult to predict precisely. An inlet could form or the shoreline erode prior to or during a planned construction phase. Also, the effect of climate change has not been adequately evaluated. Any increase in storm intensity and/or sea level rise may cause substantial revisions to the current predictions, further exacerbating the uncertainty associated with predicting inlet/breach locations and timing."

> **Response:** *As indicated in Section 2.2.2.4 of the SSDEIS and Section 2.10.2.5 of the FEIS, Phase I is expected to be built in 3.5 years and the other three phases over a period of 3 years each. Thus, while a more extensive construction period than if the project were not phased, construction would not occur over the entire 50-year life of the project. An island monitoring program and process for deciding when to implement each phase as the shoreline evolves is presented in Section 2.10.2.5 of the FEIS. A description of how accelerated sea level rise was considered in the shoreline erosion estimates is presented in Section 3.6.3.3 of the FEIS. Discussions of the impact of accelerated sea level rise are included in Section 4.6.6. Also included in Section 4.6.6 is a description of a Peer Exchange workshop on global climate change sponsored by FHWA for the Bonner Bridge project.*

Comment: "Even if the Phased Approach could be completed in a manner compatible with the dynamic shoreline, the final project is a long bridge in the Atlantic Ocean. As the Supplement acknowledges, the Phased Approach would interfere with fishing, surfing, and other beach activities and will severely limit and reduce access to the Refuge. In contrast, the Pamlico Sound Bridge is safer, more reliable, and more protective of the environment. The Pamlico Sound Bridge would not be subject to ocean overwash, inlet formation, or erosion. It would allow the U.S. Fish and Wildlife Service to preserve and protect the Refuge and the associated wildlife. Furthermore, the Pamlico Sound Bridge is the only alternative that will work and can be authorized pursuant to applicable federal laws."

> **Response:** *The commenter's preference for the Pamlico Sound Bridge is noted. NCDOT and FHWA believe that the Phased Approach/Rodanthe Bridge Alternative (Preferred) can be authorized pursuant to applicable federal laws.*

Comment: "In our comment letter on the SDEIS dated December 9, 2005, we reviewed in detail the legislative history and current cases interpreting the National Wildlife Refuge System Improvement Act (Refuge Act). The Refuge Act continues to be pertinent to the discussion of additional alternatives, but for the sake of brevity that discussion is hereby incorporated by reference.

The Phased Approach and any indirect or cumulative impacts associated with it are subject to a compatibility determination pursuant to the Refuge Act. The Refuge Act prevents any new use or expanded, renewed, or extended use of a refuge to be permitted, "unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety." 16 U.S.C. 668dd(d)(3)(A)(i). To be compatible, uses must preserve a refuge and promote the refuge system's mission. Accordingly, any use of the Refuge must be one that does not degrade the Refuge's ecological integrity nor interfere with its mission to provide a refuge and breeding ground for migratory birds and other wildlife.

All indirect and cumulative impacts that arise from a refuge use must also be considered and determined to be "compatible." The Refuge Compatibility Policy clearly states: "The Refuge Manager must consider not only the direct impacts of a use but also the indirect impacts associated with the use and the cumulative impacts of the use when conducted in conjunction with other existing or planned uses of the refuge, and uses of adjacent lands or waters that may exacerbate the effects of a refuge use." 65 Fed. Reg. 62484, 62490 (Oct. 18, 2000). Because the Phased Approach, and the associated direct and indirect impacts, is a use of the Refuge that "materially interfere[s] with" and "detract[s] from the fulfillment of the mission of the System or the purposes of the refuge," it cannot be found to be compatible. 16 U.S.C. 668ee."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is allowed under the terms of its easement permit with the USFWS and a compatibility determination under the National Wildlife Refuge System Improvement Act of 1997 is not required.*

Comment: "The Phased Approach directly impacts the Refuge. The Phased Approach will maintain a transportation corridor that bisects the Refuge for fifty years (the life of the project). During the life of the project the perpetual construction and associated noise and direct environmental impacts will degrade the Refuge resources, degrade wildlife habitat, and materially interfere with the purpose of the Refuge. The Phased Approach also will have significant indirect impacts. Because of the unpredictable nature of barrier island dynamics-including inlet/breach formation, shoreline erosion rates and locations, and sound side erosion-the Phased Approach will likely require "temporary" or "emergency" actions that will permanently and adversely affect the Refuge. As has been the case for maintaining NC 12 in the past, these temporary measures include sand bags, beach nourishment, dune rebuilding, dune sprigging and fencing. All of these measures interfere with the natural barrier island dynamics that are necessary to sustain naturally the Refuge and the associated wildlife. These measures have severe affects on wildlife and habitat and are reasonably foreseeable indirect impacts associated with the Phased Approach. Furthermore, the final Phased Approach is a bridge in the Atlantic Ocean. This ocean-side bridge will be a new feature on the beach, which the Supplement fails to evaluate adequately. For example, an ocean-side bridge may affect erosion rates, inlet formation, ocean overwash, etc. Once these natural processes are interrupted, the bridge will impact migratory bird and other wildlife habitat. Although the Supplement refers to studies conducted on a pier, it is illogical to assume that a pier would have the same effects on the adjacent shoreline as a bridge that travels parallel to the shore for miles. For these reasons, the Phased Approach is not compatible with the Refuge."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) will place NC 12 on a bridge in locations forecast to be threatened by erosion prior to 2060. It will bridge potential island breach locations. Once complete, the temporary or emergency actions described by the commenter will not occur. An assessment of the expected NC 12 maintenance activities that would occur prior to the implementation of each phase is added to Section 2.10.2.5 of the FEIS. This assessment assumes a monitoring program and process for deciding when to implement each phase as the shoreline evolves also presented in Section 2.10.2.5 of the FEIS. Additional analyses of the effect of the Phased Approach/Rodanthe Bridge Alternative (Preferred) on coastal processes is included in Section 4.6 of the FEIS. Additional assessment of the natural resource impact of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is included in Section 4.7 of the FEIS.*

Comment: "The Supplement incorrectly states that a compatibility determination is only necessary for "alternatives that use Refuge lands outside the existing easement." Supplement at xxiv. First, as discussed above, the Refuge Act specifically mandates that a compatibility determination consider the direct, indirect, and cumulative impacts on refuge land and any adjacent land or waters that affect the Refuge use. The Phased Approach will have direct and indirect adverse impacts on the Refuge and it is therefore subject to a compatibility determination. Furthermore, the NC12 easement is not a carte blanche proclamation that allows NCDOT to pursue any action without respect for the Refuge Act. The Refuge Act itself recognizes that easements and right-of-ways may coexist on national wildlife refuges. Work within easements, however, may be limited by the Refuge Manager and may be subject to a compatibility determination. For example, maintenance of an existing right-of-way is subject to review and approval by the U.S. Fish and Wildlife Service and is restricted to minor actions such as minor expansions or minor realignments to meet safety standards. See Final Compatibility Policy Pursuant to the National Wildlife Refuge System Improvement Act of 1997, 65 Fed. Reg. 62484, 62490 (Oct. 18, 2000). The Phased Approach's impacts on the Refuge are far from minor, include significant direct and indirect effects, and cannot be determined to be compatible."

"Finally, the Supplement and the SDEIS are inadequate because the information is not sufficient to prove that any of the Parallel Bridge alternatives, including the Phased Approach, could be compatible. North Carolina Department of Transportation and Federal Highway Administration have the burden to prove that a use is compatible. "Compatibility, therefore, is a threshold issue, and the proponent(s) of any use or combination of uses must demonstrate to the satisfaction of the Refuge Manager that the proposed use(s) pass this threshold test. The burden of proof is on the proponent to show that they pass; not on the Refuge Manager to show that they surpass." 65 Fed. Reg. 62484,62490 (Oct. 18,2000) Nothing in the Supplement or the SDEIS proves that any Parallel Bridge alternative, including the Phased Approach, could possibly be found to be compatible and the NCDOT and FHWA have not met the burden of proof."

> **Response:** *The Phased Approach/Rodanthe Bridge Alternative (Preferred) is allowed under the terms of its easement permit with the USFWS and a compatibility determination under the National Wildlife Refuge System Improvement Act of 1997 is not required.*

Comment: "Pursuant to Section 4(f), the Refuge may not be used for a transportation corridor absent a finding by the Secretary of Transportation that no alternative exists to utilizing the Refuge land.

We remain concerned that the draft Section 4(f) determination provided in the Supplement is inadequate because it fails to acknowledge that the Pamlico Sound Bridge is the only alternative that exists to utilizing the Refuge and inadequately evaluates how the other alternatives minimize harm to the Refuge. Although the draft Section 4(f) evaluation acknowledges the legal standards for a Section 4(f) determination, the draft Section 4(f) analysis omits any application of those standards. Section 4(f) is an "explicit bar" to any federal approval for utilization of refuge lands. The draft Section 4(f) valuation must first look at any alternatives to using refuge lands. Then, if no feasible and prudent alternatives are found, any alternative that uses refuge land must minimize harm to the refuge.

The Pamlico Sound Bridge alternatives are the only alternatives to using Refuge lands and the Supplement and SDEIS recognize it as the "avoidance" alternative for Section 4(f) purposes. None of the other alternatives, including the Phased Approach, can be considered to avoid the impacts on the Refuge. Because the Pamlico Sound Bridge satisfies the first prong of the Section 4(f) evaluation, Section 4(f) explicitly bars any other alternative."

> **Response:** *Both the Pamlico Sound Bridge Corridor and the Phased Approach alternatives (including the Preferred Alternative) are Section 4(f) avoidance alternatives from the perspective of the Refuge. See the Final Section 4(f) Evaluation (Chapter 5) for more information. Section 5.3 discusses the avoidance alternatives and concludes that there are no alternatives that do not use Section 4(f) property. Section 5.4 documents that the Preferred Alternative is of the least overall harm in light of the statute's preservation purpose and includes all possible planning to minimize harm.*

Comment: "The Phased Approach will have significant adverse impacts on the Refuge that the Supplement fails to adequately evaluate. As discussed in our comments on the SDEIS, hereby incorporated by reference, all Parallel Bridge alternatives, including the Phased Approach, will be impacted by shoreline erosion, inlet formation, and ocean overwash. The shoreline erosion and inlet formation evaluation is particularly pertinent in evaluating the Phased Approach. Because these events are episodic by nature, it is impossible to predict precisely when and where an inlet might form or erosion imminently threaten NC 12. Although it is impossible to predict dates and times, past experience and current modeling predict that NC 12 is subject to perpetual threats. The Supplement and the SDEIS fail to take a "hard look" at the adverse impacts from placing a transportation corridor within such a dynamic system. The Phased Approach does not avoid these impacts. The schedule for the "phased" bridges may or may not coincide with the natural movement of Hatteras Island or with predicted inlet formations. A bridge might be under construction when an inlet forms underneath it or an inlet may form prior to construction even beginning. The SDEIS and the Supplement fail to analyze the reasonably foreseeable impacts to the Refuge from temporary or "emergency" measures taken to protect a phased bridge under construction or an area that is not slated for construction until decades after the threat. These temporary or emergency measures including, for example, sand bags, road relocation, beach nourishment, dune building (and rebuilding), all have permanent and adverse ecological impacts that severely affect biota, geology, and overall ecology of the Refuge. Finally, the final outcome of the Phased Approach is a bridge in the Atlantic Ocean. The placement of a bridge of this length and size on a dynamic shoreline raises many concerns. How will the bridge withstand the natural forces, including increased impacts from wind, in a manner that provides a safe and reliable transportation corridor? How will the presence of a bridge parallel to the shore impact long shore sediment transport, erosion rates, and inlet formation? The Supplement relies on a single study of a pier and analogizes to the ocean-side bridge that is parallel to the shore. This analysis lacks substance and is inadequate. Without thoroughly and completely evaluating the impacts on the environment from these measures, the Supplement and the SDEIS fail to take a "hard look" at the reasonably foreseeable effects from the Parallel Bridge alternatives."

> **Response:** *An assessment of the expected NC 12 maintenance activities that would occur prior to the implementation of each phase of the Phased Approach/Rodanthe Bridge Alternative (Preferred) is added to Section 2.10.2.5 of the FEIS. This assessment assumes a monitoring program and process for deciding when to implement each phase as the shoreline evolves also presented in Section 2.10.2.5 of the FEIS. Additional analyses of the effect of the Phased Approach/Rodanthe Bridge Alternative (Preferred) on coastal processes is included in Section 4.6 of the FEIS.*

Comment: "The Supplement also proposes a "mix and match approach that cannot be supported by the NEPA analysis. The "mix and match" approach assumes that any and every combination of impacts has been adequately analyzed. Unfortunately, this approach fails to recognize that each alternative-bridges, nourishment, and dune building-will have different environmental impacts (direct, indirect, and cumulative) depending on the magnitude of the alternative (e.g. the total miles and location of nourishment), the sequence of chosen alternatives, the timing relative to shoreline changing events, and the scope and location of the initiating event (e.g. location and size of a breach or punctuated shoreline erosion). The Supplement and the SDEIS inadequately evaluate the reasonably foreseeable environmental impacts and cannot support a "mix and match" approach."

> **Response:** *A "mixed and matched" approach was not selected as the Preferred Alternative. The Phased Approach/Rodanthe Bridge Alternative (Preferred) was assessed in the SSDEIS and in this FEIS.*

Comment: "The various bridge alternatives assessed in the SDEIS and the new alternatives evaluated in the Supplement all impact wetlands and will require authorization under Section 404 of the Clean Water Act. SDEIS at 2-116. The Pamlico Sound alternative impacts on wetlands and the aquatic environment are 4.18 to 4.84 acres of wetlands (depending on the terminus) including only .01 acres of CAMA wetlands. Of the alternatives assessed, the Parallel bridge/road north/bridge south alternative impacts by far the largest amount of wetlands: 78.2 acres of wetlands including 11.8 acres of CAMA wetlands. SDEIS at 4-58. The parallel bridge/all bridge alternative impacts the second largest amount of wetlands: 12.3 acres of wetlands including 2.2 acres of CAMA wetlands. Id. The parallel bridge/nourishment alternative would impact an extensive but unquantified amount of wetlands and waters. While the SDEIS states that this alternative would impact 4.3 acres of wetlands including .3 acres of CAMA wetlands, this estimate does not include extensive filling of near-shore waters associated with the required nourishment. Id. The SDEIS states that 6.3 miles of beach will be nourished every four years. SDEIS at 2-104. The SDEIS further notes that in addition to direct fill impacts, the parallel bridge/nourishment alternative would result in "additional impacts associated with dredging for sand and then nourishment of 6.3 miles (10.1 kilometers) of the seashore within the refuge." SDEIS at 4-66.

The Supplement states that the Phased Approach would impact 3.1 acres of wetlands, including 0.3 acres of CAMA coastal wetlands. Supplement at 4-31. This lower wetland impact appears to be based on the assumption that sand movement will naturally fill wetlands prior to implementing "phases" that include wetlands that currently exist. Supplement at 4-31. This assumption fails to adequately consider the impacts from construction of the phases and the timing of the phases. As the Supplement acknowledges, construction impacts from the Phased Approach include constructing a service road that will be in service for decades. Also, when and where wetlands are naturally filled may or may not be within the same time frame as construction of the Phased Approach. Therefore, the Supplement may underestimate the wetland impacts by assuming that the Phased Approach will occur in coordination with the natural erosion and overwash cycle. Furthermore, if overwash occurs before a planned construction phase, the NCDOT will push back any sand to recreate dunes and to stabilize NC 12. This action prevents the natural filling of wetlands in the right of way, making it more likely that the actual construction of the Phased Approach will require the fill of jurisdictional wetlands. Again, these assumptions may underestimate the actual impact to wetlands from the Phased Approach.

These impacts must be assessed and considered in the 404 permit review as a part of the Phased Approach per 33 C.F.R. § 325.1 (d)(2):

All activities which the applicant plans to undertake which are reasonably related to the same project and for which a DA permit would be required should be included in the same permit application. District engineers should reject, as incomplete, any permit application which fails to comply with this requirement. For example, a permit application for a marina will include dredging required for access as well as any fill associate with construction of the marina. 33 C.F.R. § 325.1 (d)(2).

The Supplement summarily dismisses these impacts and fails to evaluate the total wetland impacts from the Phased Approach.

Furthermore, the total temporary and permanent biotic impacts (which include wetland impacts) from construction of either of the phased approaches are not insignificant (48.5 acres temporary biotic impact, Supplement to SDEIS, p. 4-30). The Pamlico Sound Bridge is a practicable alternative with the least impact on aquatic ecosystems and wetlands, and is the only alternative assessed in the SDEIS or Supplement that may be permitted under Section 404."

> **Response:** *The wetland impact calculations for the Phased Approach alternatives (including the Preferred Alternative) in the SSDEIS and the FEIS assume the presence of the wetlands that currently exist. All project activities will be included in the Section 404 permit application for each phase, including temporary and permanent impacts. The Pamlico Sound Bridge was found not to be a practicable alternative because it is not economically viable. The NEPA/Section 404 merger process concluded that the Phased Approach/Rodanthe Bridge Alternative (Preferred) is the LEDPA.*

Comment: "Furthermore, the phased alternatives present a likely adverse impact to federally endangered populations of both piping plover (Supplement to SDEIS, p. 4-37) and green sea turtle (Supplement to SDEIS, p. 4-38). The supplement to the SDEIS incorrectly concludes that the phased alternatives would not likely adversely affect loggerhead sea turtles, based on observations from 2003 and 2004 (Supplement to SDEIS, p. 4-39). The area should be re-evaluated before making such conclusions. The eventual presence of bridge pilings in the surf or on the beach would certainly impact the quality of nesting habitat for this species.

The SDEIS states that a parallel bridge corridor is likely to adversely affect the threatened green sea turtle and piping plover. SDEIS at 4-71, 4-73. The Pamlico Sound Bridge alternative is not likely to adversely affect any federally protected species. SDEIS at 4-69 to 4-77. The Supplement changes the SDEIS biological conclusion for green sea turtles and piping plovers to "unresolved." The SDEIS and Supplement inaccurately conclude that a parallel bridge corridor is not likely to adversely affect the threatened loggerhead sea turtle. SDEIS at 4-73. Loggerhead sea turtles are known to breed on the beaches within the project area and, as with green sea turtles, would likely to be adversely affected by a parallel bridge alternative.

The Supplement and the SDEIS fail to consider the impacts of a long-term construction schedule, as is proposed in the Phased Approach, required long-term nourishment, or any combination thereof on piping plover or sea turtles. It is of particular concern that the Supplement appears to propose any mix and match of short bridge construction, beach renourishment, and dune building. Each of these will have specific impacts on protected species, such as the piping plover and sea turtles, as well as impacts to the natural biota. For example, if nourishment is an integral part of a parallel bridge alternative, the adverse impacts to threatened or endangered species must be more completely assessed. Long-term nourishment of 6.3 miles of beaches on a four-year return interval within the project area would have adverse impacts on piping plover and sea turtles. Long-term nourishment has several adverse effects. By utilizing nourishment and large artificial dunes to protect NC 12, the nourishment will prevent overwash. Overwash is part of ecologically important inlet creation, migration and closure and over time, helps to create new moist sand intertidal feeding areas on the sound side. Without overwash, erosion continues to threaten sound side wetlands. By suppressing overwash, nourishment leads to loss of piping plover sound side feeding habitat and nesting habitat. In addition, the nourishment and artificial dune system prevents natural maintenance of existing habitat by increasing vegetative succession. Furthermore, nourishment may result in a steeper beach profile, reducing the available intertidal area. The Supplement fails to asses and evaluate the true impacts on fisheries, wildlife, and protected species and the Phased Approach therefore cannot be a permitted alternative."

> **Response:** *For the Phased Approach/Rodanthe Bridge Alternative (Preferred), FHWA has completed formal consultation with the US Fish and Wildlife Service under the requirements of Section 7 of the Endangered Species Act of 1973, as amended. Its findings are presented in Section 4.7.9 of the FEIS.*

Comment: "The SDEIS identifies continued access to the Refuge as an area of concern. We support continued public access to the Refuge, as stated above and in our comments on the SDEIS, as long as access is compatible with Refuge's mission. We reiterate that access is not contingent upon maintenance of NC 12 and many public lands provide for public access in ways that are compatible with the nature of the public lands and associated resources. We strongly recommend that access be accommodated within a reasonable refuge management plan.

The Phased Approach, however, will not provide compatible access and will severely limit or eliminate fishing, surfing, birding, and other resource dependent activities. Because the Phased Approach does not provide access, eliminates Refuge uses, and threatens Refuge resources, it is not a viable alternative."

> **Response:** *The position of the commenter is acknowledged. The Phased Approach/Rodanthe Bridge Alternative (Preferred) was found to be the LEDPA. The Refuge could provide additional access opportunities if they wish, just as they have said they would with the Pamlico Sound Bridge Corridor Alternative.*

Comment: "The Supplement states that the life expectancy of a replacement bridge is estimated to be as long as 100 years (approximately 2110). Supplement at xxvii. Yet, the Supplement illogically truncates the cost estimates through 2060. A true accounting of the costs associated with the various alternatives should be calculated on a timeframe comparable to the life expectancy of the bridge, rather than the artificial project endpoint of 2060. By limiting the cost analysis to 50 years, any options that include long-tern beach nourishment, dune rebuilding, or other shoreline stabilization have associated costs that are unfairly discounted. This limited cost analysis unfairly weights the cost against the Pamlico Sound Bridge. Furthermore, the cost estimates for the Phased Approach may also be affected by limiting the project life to 50 years. Given the higher wave energy and greater maintenance costs for a bridge in the ocean and the uncertainty associated with this unique approach, it is likely the Phased Approach costs are underestimated and unfairly exclude costs associated with an ocean-side bridge with a 100 year life span. Given that substantial public funds will be used for construction, the public should be informed of the maximum costs that could be incurred."

> **Response:** *The design life assumed in the SDEIS and SSDEIS was 50 years. The bridge structure components of the alternatives could potentially last longer than 50 years, possibly up to 100 years. Fifty years, however, is the design life typically assumed in bridge planning by NCDOT.*

Comment: "In addition, the Supplement notes that construction costs for all alternatives have increased. The costs, however, have not increased uniformly for all alternatives. For example, the Pamlico Sound Bridge construction costs have increased by approximately 2.25 times. Construction costs for the Parallel Bridge alternatives have only increased by 1.3 times. Such inconsistencies across alternatives raise concerns that the cost analysis is biased against the Pamlico Sound Bridge. We are concerned that the supporting documentation for the new costs is inadequate to support the revised analysis and strongly recommend revising the costs."

Response: *Section 2.3.1.2 of the SSDEIS and Section 2.12.1.2 of the FEIS present the reasons for increases in construction cost between the SDEIS and the SSDEIS. The new costs prepared by NCDOT were verified by an independent consultant with bridge construction experience and the FHWA.*

Comment: "The Supplement cites to and appears to rely on a letter from the Secretary of Interior Dirk Kempthorne. Secretary Kempthorne addressed a letter to Senator Richard Burr in which he declared a preference for separating the replacement of Bonner Bridge from the realignment of NC 12. See Supplement Appendix A-2. This letter incorrectly states that a replacement of Bonner Bridge could be compatible, "if it is constructed within the same alignment or with minor changes to the current alignment." *See id*. This unsupported analysis is in direct conflict with the National Environmental Policy Act (NEPA) and the National Wildlife Refuge Improvement Act.

As discussed more thoroughly above, the Refuge Act requires any use of a wildlife refuge to be "compatible" and not materially interfere with the purpose of the refuge or the mission of the refuge system. Because an evaluation of any proposed use (new or existing use) must include the direct and indirect impacts and include impacts that result from using adjacent lands or waters, the construction of a replacement bridge cannot be separated from maintenance of NC 12. To the extent that Secretary Kempthorne's letter suggests that separation of the bridge from the road alleviates the need for a compatibility determination, the letter is in direct conflict with the Refuge Act and the Department of Interior's implementing guidance.

Not only is the Secretary's letter in conflict with the laws and regulations on "compatibility," the severance of a replacement bridge from NC 12 may be in violation of NEPA. As discussed more fully above, NEPA prohibits improper segmentation of projects and requires that all direct, indirect, and cumulative impacts be evaluated in environmental impact statements.

Building a replacement bridge in a similar location to the existing Bonner Bridge necessitates a full environmental impact analysis of maintaining NC 12 through the Refuge. Secretary Kempthorne cannot segment the projects and avoid the associated NEPA analysis. The indirect and cumulative impact analysis cannot defer consideration of the effects of maintaining NC 12 in its current location. Building a Parallel Bridge alternative, including the Phased Approach, will forever marry maintenance of NC 12 in a manner and location that is fundamentally incompatible with an unpredictable environment. The decision to maintain NC 12 in its current location has environmentally devastating consequences that must be fully evaluated and cannot be severed from an environmental impact analysis of a replacement bridge.

We recognize the need to replace Bonner Bridge and support construction of a new bridge that provides dependable transportation to Hatteras Island, is environmentally sound, and is economically reasonable. We support the Pamlico Sound Bridge corridor alternative and believe that it satisfies these objectives."

Response: *The SDEIS, SSDEIS, and FEIS do not evaluate the Oregon Inlet bridge separately from the long-term maintenance of NC 12. The Phased Approach/Rodanthe Bridge Alternative (Preferred) incorporates both an Oregon Inlet bridge and additional bridges that would provide for the long-term maintenance of NC 12.*

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