NC 12 Hot Spots

AREAS LOCATED FROM MARC BASNIGHT BRIDGE (FORMERLY “BONNER BRIDGE”) TO OCRACOKE ISLAND

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NCDOT DIV 1
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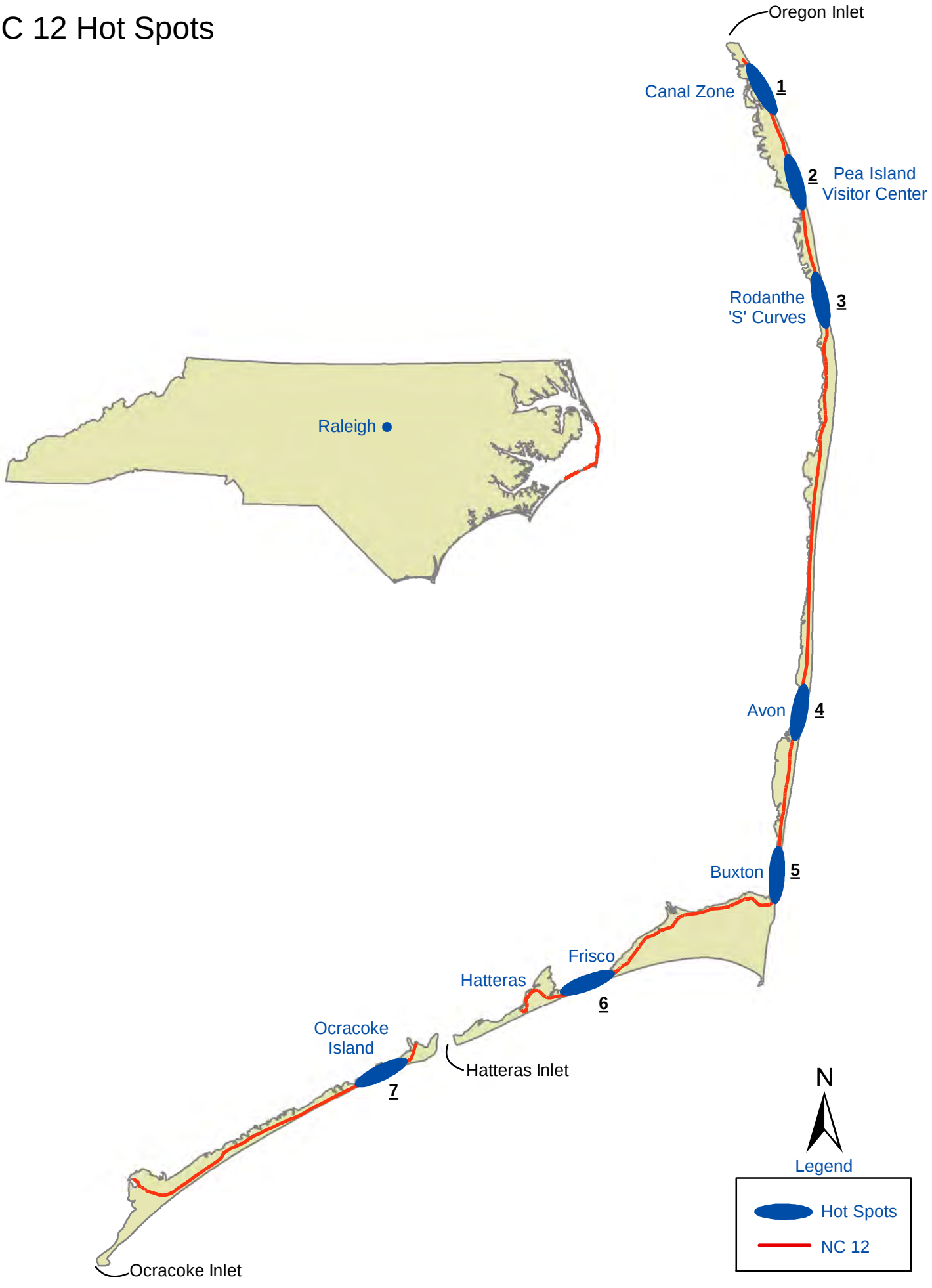
NC 12 Hot Spots



Introduction

Since 2010 more than $72 million dollars has been spent to make NC 12 passable in locations south of Bonner Bridge to, and including, Ocracoke Island following various storm events. The events listed in the table below include hurricanes, nor'easters and other severe storms that have caused rising tides that breached dunes in particular areas, indicated as Hot Spots, that have been constructed to keep ocean water from washing over NC 12. Noted below in the table there were two years, 2014 and 2015, when Ocracoke was exclusively majorly impacted by hurricanes.

2010	Hurricane Earl
2011	Hurricane Irene
2012	Hurricane Sandy
2013	No Named Storm
2014	No Named Storm; Hurricane Arthur (Ocracoke)
2015	No Named Storm; Hurricane Joaquin (Ocracoke)
2016	TS Hermine/Hurricane Matthew
2017	Hurricane Florence
2018	No Named Storm
2019	Hurricane Dorian November Nor'easter
2020	Nor'easter

As sea levels continue to rise and with water temperatures increasing leading to more frequent and severe storm events the expectation is an increase in the need for maintenance until more permanent mitigation can be achieved through future projects.

NC 12 Hot Spot

Canal Zone (1)

The Canal Zone Hot Spot is just south of the new Marc Basnight Bridge. The term Canal Zone has been incorporated because large dunes run the length of NC 12 on either side and if the ocean side dunes are breached the two linear dunes act as barriers keeping the water between them and NC 12 essentially becomes a canal.

After the water recedes what is left is a large volume of displaced material. Following a major storm event, it takes days to push all the material back into the dune system. In the short term this is the only means to keep mobility possible following major storm events. Please see the added two photos that show the erosion and the linear dunes on either side of NC 12.

Long Term Mitigation

Long term mitigation strategies for the Canal Zone Hot Spot include depositing traffic from the Marc Basnight Bridge further south bypassing NC 12 using a Connector Bridge and constructing bridges in the current easement of NC 12. On the following page is a map illustrating the Connector map Alternatives.

Recommendations

The bypassing of the Canal Zone Hot Spot was included in the original project B-2500, the construction of the Marc Basnight Bridge. Unfortunately, due to various hurdles the canal zone could not be addressed with this project. There have been no recent studies or new recommendations.

NC 12 Hot Spot

Pea Island Visitor Center (2)

The Pea Island Visitor Center Hot Spot is the area located around the Pea Island national Wildlife Refuge. Like the Canal Zone, as the ocean washes over and breach the dunes, many reinforced with sandbags, material is displaced for several miles on NC 12. Also like the Canal Zone, the short-term mitigation is to use heavy equipment to push the material back into the liner dunes. Please see the added two photos that show the erosion and the linear dunes on either side of NC 12.

Long Term Mitigation

Long term alternatives that contain the south end of the Pea Island Visitor Center Hot Spot are included in the "ALTERNATIVES STUDY REPORT for NC 12 – Pea Island Long-Term Improvements Bonner Bridge Replacement Project Phase IIa", February 2017. Three bridge alternatives are analyzed with one alternative constructing a bridge in the existing ROW and two alternatives with bridges being constructed in the Pamlico Sound. That document can be found here;

https://www.ncdot.gov/projects/nc-12-pea-island/Documents/phase_IIa_alternatives_study_report.pdf

Recommendations

Bridge within Existing NC 12 Alternative

The Bridge within Existing NC 12 Easement Alternative would involve building a bridge in the existing NC 12 easement to replace the existing surface road. The total length of this alternative is

approximately 2.4 miles. The bridge component, approximately 2.1 miles in length, is designed to account for the potential reopening and migration of the current inlet in the future in that it bridges the entire area considered geologically susceptible to breaches in the Pea Island inlet area. It would start near the southern end of the Refuge's South Pond, within the southern portion of the Pea Island Visitor Center Hot Spot, continue to the south past the southern end of the area considered susceptible to breaches in the Pea Island breach area, and end at the northern end of the 2.1-mile section of NC 12 in the southern half of the Refuge that is not expected to be threatened by shoreline erosion prior to 2060. The Bridge within Existing NC 12 Easement Alternative would likely encompass the following characteristics unique to the alternative:

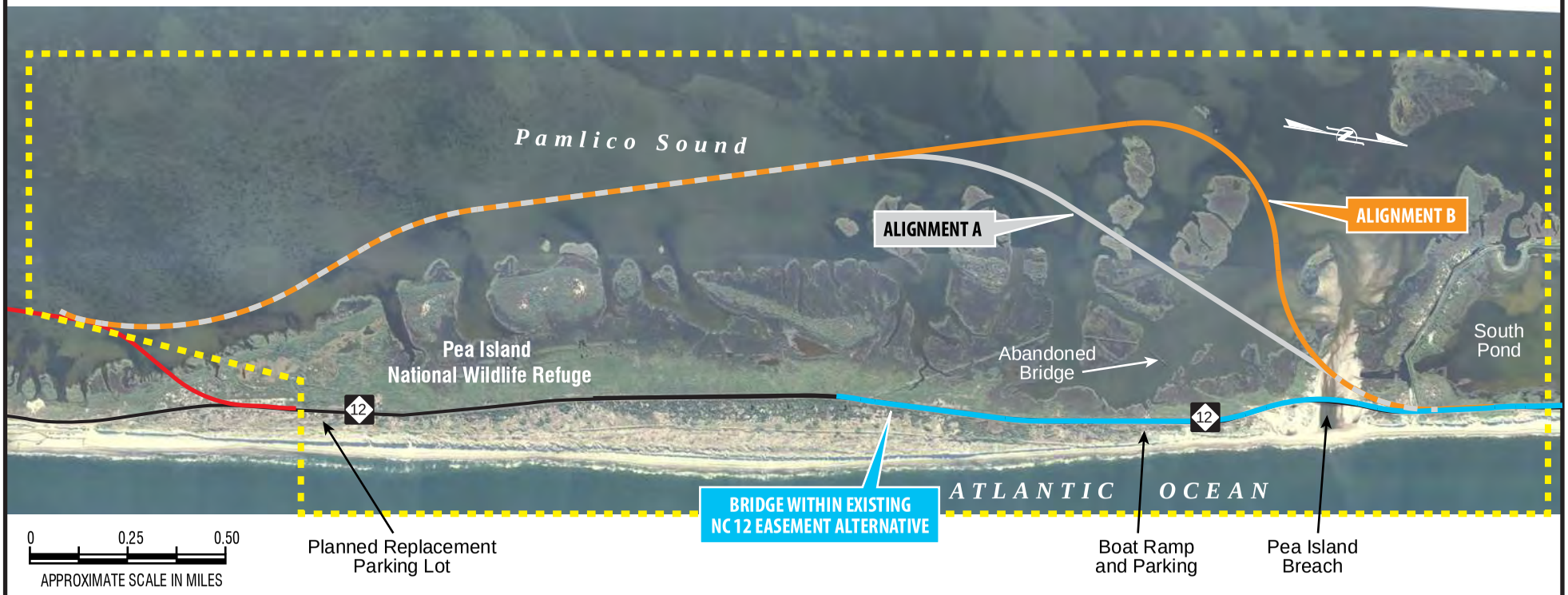
- Bridge location on the ocean side of the NC 12 easement. A temporary traffic maintenance road would be built on the sound side of the NC 12 easement. As described in Section 2.1.3, this is a change from the alternative selected in the 2013 Phase IIa ROD. It is the only change.
- Permanent access road within the existing easement between the southern end of the alternative and the Refuge's boat ramp/parking lot.
- Approach fills at each end of the bridge (including an approximately 580-foot-long fill section at the south end of the bridge and a 687-foot-long fill section at the north end) with the fill held by a retaining wall where needed to keep approach fills within the NC 12 easement.
- Construction activity would be primarily confined to the existing NC 12 easement, including a temporary traffic maintenance road. However, approximately 0.8 acres of temporary construction easement would be needed to construct Phase IIa. A narrow (5 feet or less) temporary construction easement is included for approximately 680 feet of the alternative on at least one side of the existing NC 12 easement, and on both sides in four locations for short distances. The purpose of this narrow easement would be primarily to provide room for construction workers to erect erosion control measures (fencing) along the edge of the existing NC 12 easement. Pile jetting pipe easements likely would be placed between NC 12 and the Pamlico Sound on 10-foot wide temporary easements.

Bridge on New Location Alternative

The Bridge on New Location Alternative two alignments illustrated on map would involve leaving existing NC 12 easement within the Refuge at a point nearing the southern end of South Pond. It would follow the Pamlico Sound shoreline until connecting at its south end with the Phase IIb Bridge on New Location Alternative selected for implementation in the 2016 Phase IIb ROD. Alignment A is approximately 5.14 miles long. Alignment B is approximately 5.5 miles long. The alignments are designed such that NC 12 is on a bridge when it leaves the existing easement in the Refuge at their north ends. The bridge is approximately 5.05 miles long with Alignment A and approximately 5.4 miles long with Alignment B. This alternative would bypass the area within the expanded Phase IIa project area considered geologically susceptible to breaches. This alternative also would bypass the 2.1 miles of NC 12 within the expanded Phase IIa project area that would not be affected by shoreline erosion through 2060 and is not of geologically susceptible to breaching. The designs of the Bridge on New Location Alternative alignments assume the following characteristics unique to the alternative:

- A 475-foot-long approach fill section that would include a retaining wall where needed to keep approach fills within the existing NC 12 easement.

- Approximately 4.3 miles of existing NC 12 pavement within the Refuge would be removed and that portion of the transportation easement would be returned to the Refuge. The Phase IIb bridge connection to the Refuge would be removed. The option of retaining, as a Refuge owned and maintained road, the Phase IIb bridge connection to the Refuge, as well as the pavement along a portion of the 4.3 miles of the NC 12 existing easement returned to the Refuge, is discussed in Section 5.3.2.
- Construction activity would be primarily confined to the existing or new easement. A temporary construction easement would be needed for a temporary traffic maintenance road to take traffic around the northern bridge approach. This temporary easement would be approximately 0.26 acre in size.



Aerial date: 2014

Bridge within Existing NC 12 Easement

Bridge on New Location Alternative

Alignment A

Alignment B

Expanded Project Area Boundary

Impact	Bridge within Existing NC 12 Easement Alternative	Bridge on New Location Alternative	
		Alignment A	Alignment B
Cost (millions)	$99,300,000	$250,100,000	$267,300,000

PHASE IIa STUDY ALTERNATIVES

Figure 4

NC 12 Hot Spot

Rodanthe S-Curves (3)

The S-Curves Hot Spot is just north of Rodanthe. Like the Canal Zone and Pea Island Visitor Center Hot Spots NC-12 is within 150 feet of the ocean depending on the tide. During storm events the ocean washes over the dunes and meets the Pamlico Sound on the west side of the island. Material from the dunes are displaced along NC-12 and into the wetlands on other side of NC-12. The short-term mitigation for this Hot Spot is like the others, use heavy equipment to push the material back into the linear dunes.

Long Term Mitigation

A 2.4-mile bridge, known as the “jug handle” bridge, is under construction and is scheduled to be complete fall of 2021. This bridge will bypass the S-Curves and deposit traffic south of Pappy Lane.


April to May 2020
June to July 2020
Aug. to Sept. 2020
BENT NO. 30
BENT NO. 40
BENT NO. 50
BENT NO. 60
BENT NO. 70
BENT NO. 80
BENT NO. 20
TO RODANTHE
PAMLICO SOUND
South End of Project
Anticipated Work Areas For Work Trestle Installation and Bridge Pile Driving Represented in Blue
(Prepared March 24, 2020)
North End of Project
Anticipated Work Areas For Work Trestle Installation and Bridge Pile Driving Represented in Blue
(Prepared March 24, 2020)
Aug. to Sept. 2020
June to July 2020
BENT NO. 90
TO NAGS HEAD
BENT NO. 100
END OF BRIDGE
April to May 2020
BENT NO. 10
624'
1372'
1324'
1124'
BENT NO. 1
BEGINNING OF BRIDGE
PEA ISLAND NATIONAL WILDLIFE REFUGE

NC 12 Hot Spot

Avon (4)

Avon Hot Spot is south of Rodanthe and north of Buxton. During storm events the ocean washes onto NC-12 because dunes have eroded leaving no real defense against over wash. Unfortunately, there are no viable outlets to allow the water on NC-12 to recede, so water stands on NC-12 for several days.

Long Term Mitigation

Long term alternatives for the Avon Hot Spot can be found in the Feasibility Study "NC 12 Improvements From Buxton to Avon", October 2015. Long term alternatives range from beach nourishment leaving NC 12 where it is and constructing several bridges over the various Hot Spots. That document can be found here;

https://www.ncdot.gov/projects/nc-12-south/Documents/R-4070B_feasibility_study.pdf

Recommendations

Detailed explanations of the alternatives are included in the Feasibility Study but long term alternatives are shown following the discussion of the Buxton Hot Spot. A preferred alternative has not been selected so all five of the Long Term Mitigation alternatives are being considered.

NC 12 Hot Spot

Buxton (5)

The Buxton Hot Spot is at the northern end of Buxton at the Cape Hatteras Motel. Dunes are on the east, oceanside of NC-12 and there are wetlands and creeks on the west, soundside. As with other Hot Spots the ocean will wash over and breach the dunes that line NC-12 and carry material into the roadway and redistribute the material into the wetlands and creeks. Short term mitigation is to push material back into the linear dunes and to dig a ditch so water may channel back into Pamlico Sound.

Long Term Mitigation

Long term alternatives for the Buxton Hot Spot can be found in the Feasibility Study "NC 12 Improvements From Buxton to Avon", October 2015. Long term alternatives range from beach nourishment leaving NC 12 where it is and constructing several bridges over the various Hot Spots. That document can be found here;

https://www.ncdot.gov/projects/nc-12-south/Documents/R-4070B_feasibility_study.pdf

Recommendations

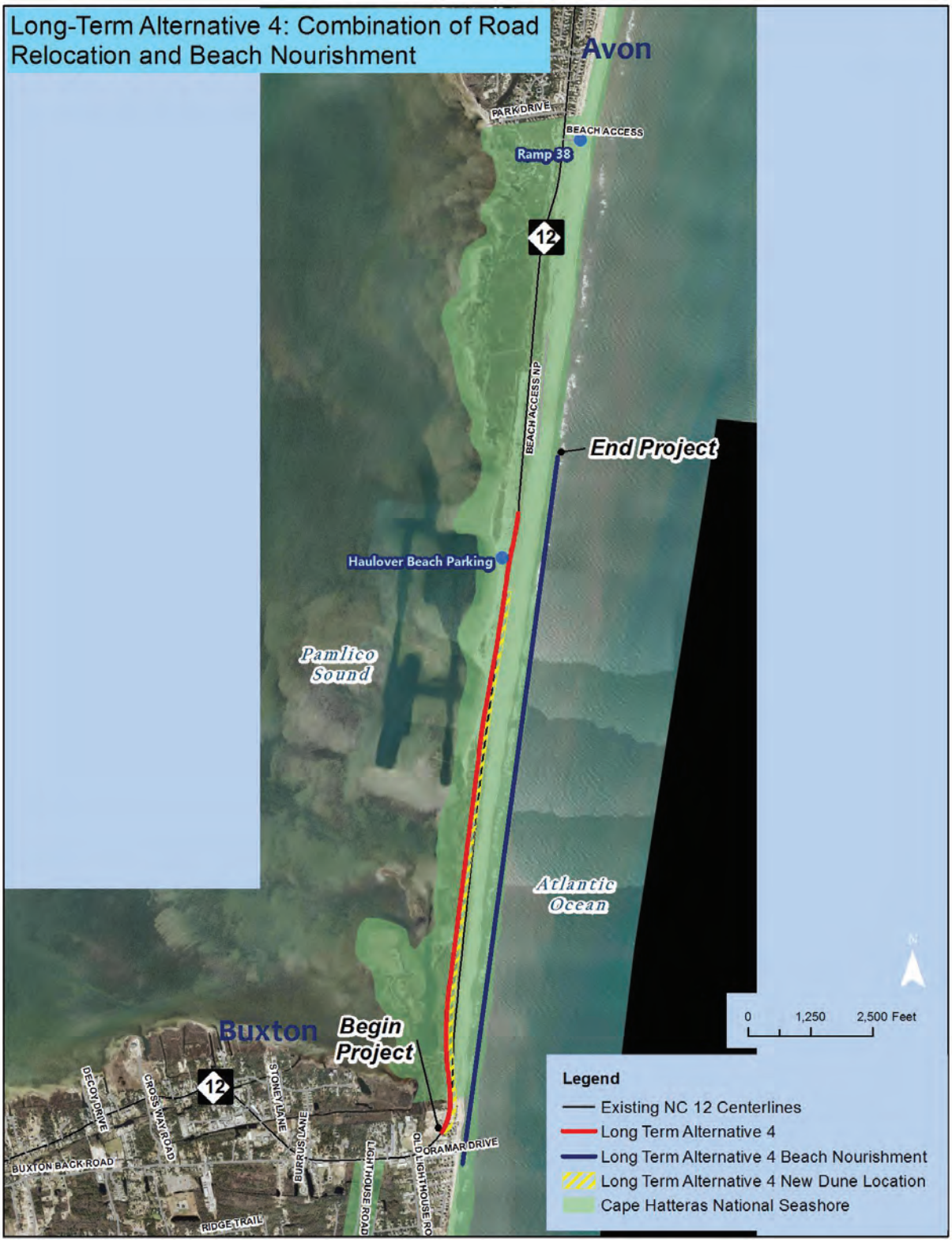
Detailed explanations of the alternatives are included in the Feasibility Study but long term alternatives are shown on the following pages. A preferred alternative has not been selected so all five of the Long Term Mitigation alternatives are being considered.

Long Term Alternatives	Construction	Beach Nourishment	Total
Alt 1: Road Relocate 245'-330' West, Length 2.3 miles w/ Bridge	$ 81,100,000.00	$ -	$ 81,100,000.00

Long Term Alternatives	Construction	Beach Nourishment	Total
Alt 2: 2-mile Bridge in Existing Easement	$ 154,700,000.00	$ -	$ 154,700,000.00

Long Term Alternatives	Construction	Beach Nourishment	Total
Alt: 3: 2.5-mile Bridge on New Location into Pamlico Sound	$ 145,400,000.00	$ -	$ 145,400,000.00

Long Term Alternatives	Construction	Beach Nourishment	Total
Alt 4: Road relocate 90'-160' West, Length 2-miles & Nourishment	$ 16,800,000.00	$ 115,600,000.00	$ 132,400,000.00



Long Term Alternatives	Construction	Beach Nourishment	Total
Alt 5: Beach Nourishment	$ -	$ 115,600,000.00	$ 115,600,000.00

NC 12 Hot Spot

Hatteras Village (6)

The Hatteras Village Hot Spot is located between Hatteras Village and Frisco. Dunes are on the east, oceanside of NC-12 and there are wetlands and creeks on the west, sound side. As with other Hot Spots the ocean will wash over and breach the dunes that line NC-12 and carry material into the roadway and redistribute the material into the wetlands and creeks. Short term mitigation is to push material back into the linear dunes. Inlets have been created at this location and the potential for this is high because in some locations there is less than 500 feet between the Atlantic Ocean and the Pamlico Sound.

Long Term Mitigation

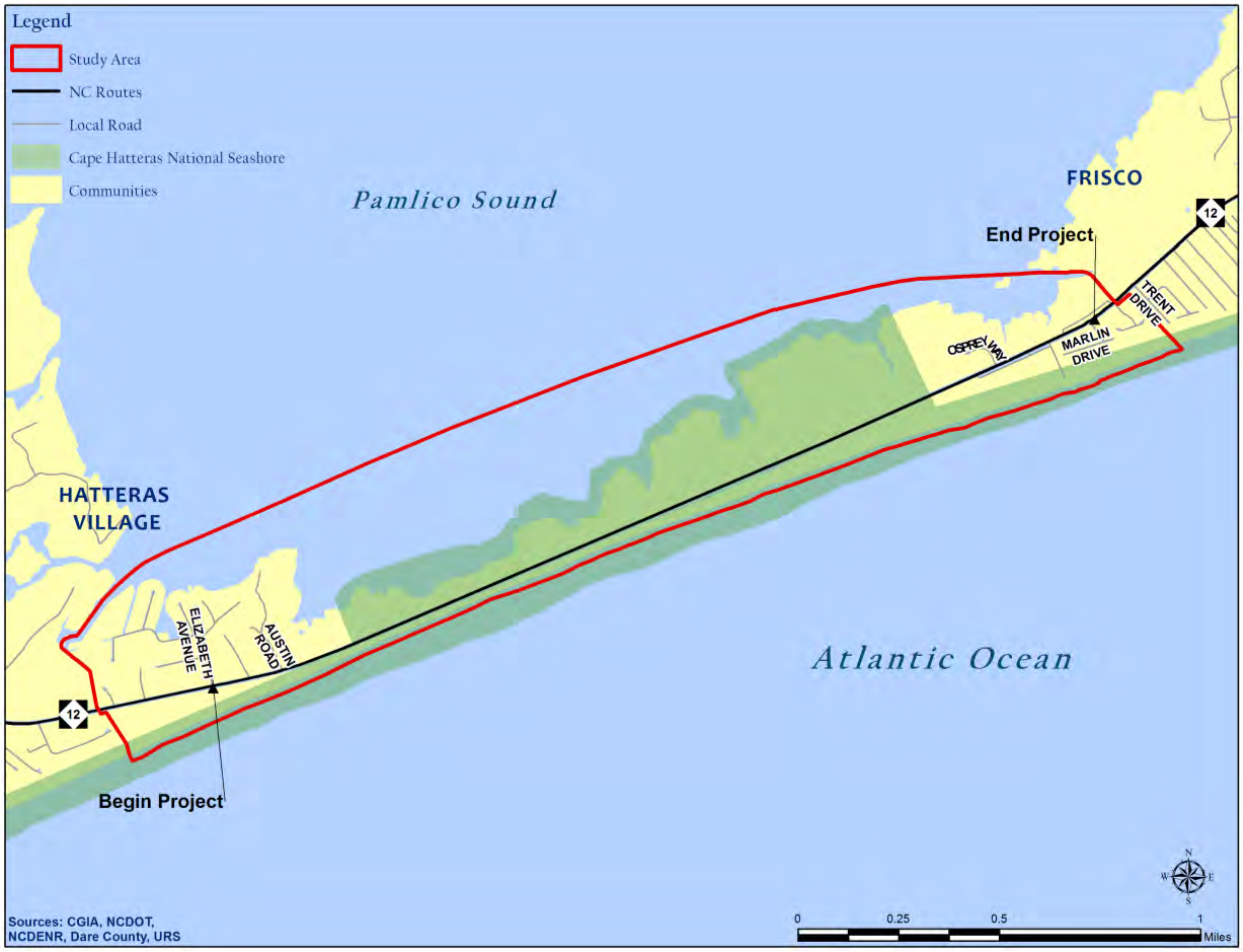
Long term alternatives for the Hatteras Village Hot Spot can be found in the Feasibility Study "NC 12 Improvements Hatteras Village", February 2016. Long term alternatives range from beach nourishment leaving NC 12 where it is and constructing a bridge. That document can be found here;

https://www.ncdot.gov/projects/nc-12-south/Documents/R-3116B_feasibility_study.pdf

Recommendations

Detailed explanations of the alternatives are included in the Feasibility Study but long term alternatives are shown on the following pages. A preferred alternative has not been selected so all four of the Long Term Mitigation alternatives are being considered.

Project Vicintiy Map



Long Term Alternatives	Construction	Beach Nourishment	Total
Alt 1: Road Relocate West with Three-Quarter Mile Prestressed Bridge	$ 45,800,000.00	$ -	$ 45,800,000.00

Long Term Alternatives	Construction	Beach Nourishment	Total
Alt 2: Road Relocate West with One Mile Prestressed Bridge	$ 67,400,000.00	$ -	$ 67,400,000.00

Long Term Alternatives	Construction	Beach Nourishment	Total
Alt 4: 1.5 Mile Prestressed Bridge in Existing Alignment with Beach Nourishment	$ 77,600,000.00	$ 60,700,000.00	$ 138,300,000.00

Long Term Alternatives	Construction	Beach Nourishment	Total
Alt: 3: Existing Alignment with Beach Nourishment	$ -	$ 84,700,000.00	$ 84,700,000.00

NC 12 Hot Spot

Ocracoke (7)

The Ocracoke Hot Spot is next to a stretch of NC-12 on the north end of the island. If you are driving south from the Ocracoke-Hatteras Ferry Dock the Hot Spot is in the stretch approximately 1.0 mile to 3.0 miles from the ferry dock. There is less than 150 feet from the ocean to NC-12 in some locations and during storm events the ocean will wash over and breach the dunes displacing a large volume of material. Short term mitigation has been to push material back into the dunes and sandbag various locations.

Long Term Mitigation

Long Term Mitigation strategies have been discussed and were included in a feasibility study found here;

https://www.ncdot.gov/projects/nc-12-south/Documents/nc-12-feasibility-study-addendum.pdf

Below are the various alternatives discussed;

Beach Nourishment Options

- The nourishment of the beach, berm and dune alternatives will likely have minor potential impact on recreational resources.
- These alternatives have the potential for Section 4(f) impacts. If federal funds are used, FHWA will determine the applicability of Section 4(f) regarding the Seashore.

- NPS permits and policy guidelines would need to be completed and followed for beach nourishment.
- Minor visual resource impacts may occur with these alternatives.
- Minor temporary impacts to protected species, SAVs and EFH. No impact anticipated to Significant Natural Heritage Areas or wetlands.
- The availability of sand for fill both in the short- and long-term, its transport method and permitting concerns are key constructability considerations for these alternatives. Sand from dredging operations is no longer available
- Costs for these alternatives are expected to range from approximately $6 million to $550 million.

Road and Bridge Options

- Constructability concerns include: the ability to obtain permits from appropriate agencies, the manner of transporting and staging of construction materials in existing ROW, the ability to transport prefabricated bridge parts, and construction methodology. In addition, limitation on construction activities during peak tourist season is also a factor. There are campgrounds near the study area. Construction activities could be limited to minimize impacts to such areas during peak tourist season.
- NCDOT Division 1 stated that there is concern with the shoreline erosion rate, and shoreline and sound erosion from storms. The road setback requirement in roadway re-alignment alternatives may be readjusted because of sound erosion after storms.
- These alternatives are expected to have moderate impacts to recreation access points.
- These alternatives will enhance bicycle and pedestrian travel.
- Permanent use and potential for constructive and temporary use under Section 4(f).
- Visual impacts range from minor with roadway relocation alternative to substantial for new bridge alternatives.
- These alternatives are most likely to affect sea turtles, piping plover and red knot. Only the Pamlico Sound Bridge (Long Term Alternative 1) is expected to impact SAV and EFH. Impacts to SNHA range from approximately 12 acres to approximately 68 acres.
- The near-term alternative has an estimated cost of $62.6 million and the longterm alternatives have a range of costs between $220 million and $273.9 million.

Ferry Options

- Constructability concerns include: land acquisition, channel development, terminal facility development, and permitting.
- Travel time to and from the island will be increased with implementation of a new terminal north of Ocracoke Village. This could affect visitors to the island and delivery of goods and services.

- The Alternative 7 options will reduce access to some recreational opportunities, including bicycle and pedestrian access, if NC 12 is not maintained north of the ferry terminal.
- If federal funds are used and the conversion of the NPS land to develop new transportation facilities alters access, there could be a Section 4(f) determination.
- There could be moderate visual impacts from additional ferry infrastructure and new ferry terminal.
- There is limited potential for impact to protected species, SNHA, or wetlands. Dredging for a new ferry route in Alternative 7, Option B could disrupt SAV and EFH habitats.

Recommendations

A project has recently been submitted for prioritization that would relocate the ferry dock at the north end of Ocracoke Island to a location known as the "Pony Pens". By relocating the ferry dock traffic would be deposited south of the Hot Spot. The cost of the project listed on the NCDOT Prioritization 6.0 Project Summary of $52,700,000 is for construction only. The cost for operations and maintenance of the vessels and terminal has yet to be determined.

NCDOT Prioritization 6.0 Project Summary

SPOT ID: F192626 **Mode:** Ferry **Status:** Submitted

New Route

Location: North End of Ocracoke Village

Specific Improvement Type: 11 - Other shipyard infrastructure

Project Category: Regional Impact

TIP #:

Fully Funded in Draft STIP? No

Cost to NCDOT: $52,700,000

Description:

Replace Terminal at South Dock with service to New Ferry Terminal at the north end of Ocracoke Village with dredging to allow ferries to dock closer to shore.

Division(s) :

County(s) :

MPO(s)/RPO(s) :

Project Location

Comparative Cost Analysis

NC 12 Expenditures Dare County 2010-2020(Calendar Year)

Calendar Year	Maintenance Expenditures(1)	Natural Event Expenditures		Total
2010	$772,763.15	$128,527.83	Hurricane Earl	$901,290.98
2011	$470,980.36	$16,790,159.93	Hurricane Irene	$17,261,140.29
2012	$762,304.03	$29,238,221.16	Hurricane Sandy	$30,000,525.19
2013	$1,181,217.48	$-	No Named Storm	$1,181,217.48
2014	$2,194,162.48	$-	No Named Storm	$2,194,162.48
2015	$1,862,534.96	$2,345,645.89	Joaquin	$4,208,180.85
2016	$1,707,067.42	$1,101,720.09	TS Hermine/Hurricane Matthew	$2,808,787.51
2017	$1,007,101.88	$11,476.52	Hurricane Florence	$1,018,578.40
2018	$928,851.47	$-	No Named Storm	$928,851.47
2019	$1,182,396.27	$248,395.12	Hurricane Dorian November Nor'easter	$1,430,791.39
2020(Jan. thru July)	$552,669.61	$215,502.32	Hurricane Dorian/ November Nor'easter	$768,171.93
TOTALS	**$12,069,379.50**	**$49,864,146.54**		**$61,933,526.04**

(1) Expenditures are based on known locations along NC 12 South of Oregon Inlet Bridge (With the exception of the Hot Spot in Kitty Hawk)

NC 12 Expenditures Ocracoke County 2010-2020(Calendar Year)

Calendar Year	Maintenance Expenditures(1)	Natural Event Expenditures		Total
2010	$ 41,550.27	$ 202,706.92	Hurricane Earl	$ 244,257.19
2011	$ 4,332.09	$ 625,613.95	Hurricane Irene	$ 629,946.04
2012	$ 56,985.65	$ -	No Named Storm	$ 56,985.65
2013	$ 33,628.19	$ 138,363.67	Hurricane Sandy	$ 171,991.86
2014	$ 356,280.73	$ 540,297.24	Arthur	$ 896,577.97
2015	$ 166,957.38	$ 467,807.58	Joaquin	$ 634,764.96
2016	$ 50,176.72	$ -		$ 50,176.72
2017	$ 11,792.21	$ 1,243,670.71	Hurricane Florence	$ 1,255,462.92
2018	$ 63,124.04	$ -	No Named Storm	$ 63,124.04
2019(through Dec 19, 2019)	$ 48,717.10	$ 6,695,320.84	Hurricane Dorian November Nor'easter	$ 6,744,037.94
TOTALS	**$ 833,544.38**	**$ 9,913,780.91**		**$ 10,747,325.29**

NC 12 Project Costs

Project	Cost A	Cost B
NC 12 Pea Island Bridge Alternatives	$99,300,000.00	$267,300,000.00
Avon and Buxton	$81,100,000.00	$154,700,000.00
Hatteras Village	$45,800,000.00	$138,300,000.00
Ocracoke Ferry Dock Relocation	$52,700,000.00	$52,700,000.00
TOTALS	**$278,900,000.00**	**$613,700,000.00**

Cost of Storm Maintenance over the previous 10 years is $72,680,851. If you multiply that total by five, totaling 50 years, which is the lifespan of most projects, you arrive at a dollar total of approximately **$363.4 million**. This dollar amount does not take into consideration inflation, nor does it include the current project at Rodanthe which will reduce the need for maintenance and natural event expenditures.

From the NC 12 Project Cost table Cost A represents total dollars spent if the lowest cost alternatives were selected. Cost B represents total dollars spent if the highest cost alternatives were selected.