

R-2576 Mid-Currituck Bridge

Attachment 6B:

**Mid-Currituck Bridge
ICE Technical Report
Addendum,
October 2012**

MID-CURRITUCK BRIDGE STUDY

INDIRECT AND CUMULATIVE EFFECTS TECHNICAL REPORT ADDENDUM

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CURRITUCK COUNTY
DARE COUNTY

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Preface

This addendum to the *Indirect and Cumulative Effects Technical Report* (East Carolina University, 2011) (referenced throughout this addendum as the 2011 ICE report) for the Mid-Currituck Bridge Project was prepared to document additional indirect and cumulative impacts analyses that were performed in response to comments received on the *Final Environmental Impact Statement* (FEIS). Some of these comments were concerned with the potential indirect and cumulative impacts to the non-road-accessible or Carova portion of the Currituck County Outer Banks associated with additional development and day visitors as a result of the proposed bridge. Some comments also were concerned with indirect and cumulative impacts to water quality in the project area as a result of new development on the sound side of the Outer Banks.

New data was collected for this effort in July 2012. This data was collected through various means, including: in-person and telephone interviews; geographic information system (GIS) and aerial photograph analysis; additional research of laws and regulations; traffic counts; and field surveys.

The following sections of the 2011 ICE report are amended based on the results of the additional analyses documented in this addendum:

- Summary – the full summary from the 2011 ICE report is repeated in this addendum with amendments reflecting the additional findings presented in later sections of this addendum.
- Section 4.0 (Impact-Causing Activities) – a new Section 4.2.6 (Potential for Increase in the Number of Trips on the Non-Road-Accessible Outer Banks) is added to the end of Section 4.2 (Access-Alteration Effects [Project-Induced Growth]);
- Section 6.0 (Analyze Indirect/Cumulative Effects) – Section 6.2 (Indirect Effects) and Section 6.3 (Cumulative Effects) are amended by the revised sections in this addendum;
- Section 7.0 (Evaluation of Analysis Results) – Section 7.3 (Potential Impacts of Permanent Resident Increase on the Outer Banks), Section 7.4 (Potential Impacts of Increased Amounts of Day Visitors on the Outer Banks), and Section 7.5 (Potential Impacts of Increased Demand for Residences on the Non-Road Accessible Outer Banks) are amended by the revised sections in this addendum; and
- Section 9.0 (References) – new references (documents and personal communications) related to the additional analyses documented in this addendum are added to this section.

With the exception of the Summary, only the amended sections of the 2011 ICE report are included in this addendum. The 2011 ICE report and this addendum are available for inspection on the NCTA web site at <http://www.ncdot.gov/projects/midcurrituckbridge/>.

The additional assessment presented in this report re-affirmed the findings presented in the 2011 ICE report related to the impact of day visitors induced by MCB2, MCB4, and the Preferred Alternative and constrained levels of development with the No-Build Alternative and ER2, specifically as they relate to the non-road accessible area on the Outer Banks. This additional assessment also re-affirmed the 2011 ICE report's findings related to indirect water quality impacts.

Summary

This assessment of indirect and cumulative effects was prepared in accordance with the *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina* (NCDOT, 2001). The specific approach used for each step of the assessment was developed by the study team at East Carolina University, in association with an indirect and cumulative effects analysis specialist at the private engineering firm of Parsons Brinckerhoff and NCTA staff. The approaches were reviewed and discussed with state and federal environmental resource and regulatory agencies at a meeting on October 7, 2008. Currituck and Dare county land use and economic development plans were an important input into the assessment. The time horizon for this assessment is 2035. Comments made on the November 2009 *Indirect and Cumulative Effects Technical Report* and the related text in the March 2010 Draft Environmental Impact Statement (DEIS) were taken into consideration in developing the revised November 2011 *Indirect and Cumulative Effects Technical Report*. Comments made on the 2011 ICE report and the related text in the January 2012 Final Environmental Impact Statement (FEIS) were taken into consideration in developing this addendum.

In the indirect and cumulative effects (ICE) study area, impact-causing activities are primarily associated with:

1. The proposed project and its detailed study alternatives;
2. Private development and the provision of infrastructure to serve that development;
3. Other transportation projects presented in the *2009 to 2015 State Transportation Improvement Program* (STIP) and included in the No-Build Alternative;
4. Logging in forested areas, including wetlands;
5. Beach and other driving in the non-road-accessible Outer Banks; and
6. Accelerated sea level rise.

Activities associated with 2 to 6 generally would occur with or without the implementation of one of the detailed study alternatives, including the Preferred Alternative.

Activities associated with 1, the proposed project and its detailed study alternatives, are considered in the FEIS. Direct project-related actions are found in six types.

1. Modification of regime;
2. Land transformation and construction;
3. Resources extraction;

4. Land alteration;
5. Changes in traffic, and
6. Access alteration.

The alternatives, however, also could alter the patterns of private development through the changes in access, road capacity, and circulation patterns that they involve. Thus, the study examined this possibility of project-induced change from six perspectives.

1. What is the potential for an increase in permanent residents on the Outer Banks?

It was concluded that negligible change in permanent population would be associated with ER2 and a negligible or slight increase would be associated with MCB2, MCB4, and the Preferred Alternative.

2. What is the potential for an increase in the number of day trips to the Outer Banks? Where would an increased number of day trips potentially occur? What would be the nature of those trips?

It was concluded that a negligible increase in day trips from the mainland would be associated with ER2. With MCB2, MCB4, and the Preferred Alternative, there would be some potential for an increase in day trips from the mainland over the No-Build Alternative with the potential higher in the non-road, four-wheel drive accessible area.

3. Would development in the paved NC 12-accessible Outer Banks change in terms of future development location, rate, or type?

It was concluded that for the NC 12-accessible Outer Banks, there would be no reasonably foreseeable change in the demand for homes and businesses with implementation of the detailed study alternatives, including the Preferred Alternative, compared to the No-Build Alternative. Furthermore, the communities are currently planning for this level of development. Consequently, there is no reasonably foreseeable change in the type and density of development. No notable increase in the rate of development on the Outer Banks as a whole would be foreseeable over the No-Build Alternative, although the detailed study alternatives, including the Preferred Alternative, would reduce the potential for severe congestion to constrain the demand for new development in the ICE study area. Congestion is most acute on changeover days (summer weekends), when the levels of service associated with the No-Build Alternative or ER2 could result in a differential effect on development. Severe congestion could limit the practical development of rental cottages and hotel rooms north of Duck as congestion becomes a more prevalent factor in a tourist's decision to come to these beaches or go elsewhere. MCB2 would reduce this potential constraint the most, followed by MCB4 and the Preferred Alternative, and then ER2.

The introduction of a Mid-Currituck Bridge with MCB2, MCB4, or the Preferred Alternative would substantially reduce travel time from points north of the bridge on the mainland to the Currituck County Outer Banks. As such, the order in which available lots on the NC 12-accessible Outer Banks would develop in response to market demand would likely change, with more Currituck County lots developing before Dare County lots.

4. Would development within the non-paved-road accessible area north of the terminus of NC 12 on the Currituck County Outer Banks change in terms of future development location, rate, or type?

For the non-road-accessible Outer Banks, it was concluded that there would be no reasonably foreseeable change in the demand for development with implementation of the detailed study alternatives compared to the No-Build Alternative. Consequently, there is no reasonably foreseeable change in the location, rate, or type of development with implementation of the detailed study alternatives, including the Preferred Alternative, compared to the No-Build Alternative.

Given the severe congestion forecasted for the Outer Banks on changeover days (summer weekends), the levels of service associated with the No-Build Alternative or ER2 could result in a differential effect on development. Although the demand for development on the Outer Banks does not vary with the different scenarios, severe congestion could limit the practical development of rental cottages as congestion becomes a more prevalent factor in a tourist's decision to come to the non-road-accessible area or go elsewhere. Although any of the bridge alternatives will bypass the traffic chokepoint at the Dare-Currituck County line, there would be no difference between any of the alternatives in the level of service at the end of NC 12.

5. Would development in mainland Currituck County change in terms of future development location, rate, or type?

It was concluded that it is reasonably foreseeable that the introduction of a Mid-Currituck Bridge with MCB2, MCB4, and the Preferred Alternative would alter the location of some future Outer Banks service-oriented businesses. Some business development that might otherwise have been scattered in planned commercial areas on the Outer Banks and mainland near the Wright Memorial Bridge would concentrate at locations on the mainland near the terminus of the Mid-Currituck Bridge at US 158. This change would represent a net gain in business development in a concentrated location on the Currituck County mainland, creating a potential for a notable indirect and cumulative impact focused on the mainland bridge terminus. Land potentially involved is estimated to be approximately 68 acres. This estimate is based on analysis presented here as well as in *Economic Development Strategy "Vision Plan" for Currituck County, North Carolina* (Lane and Jolley, 2008). Considering the performance requirements that Currituck County enforces for commercial development, this might be expected to increase impervious cover in the county by 44 acres. This would be a shift in impervious cover from the Outer Banks to the

Currituck County mainland. Although ER2 would increase road capacity and improve traffic flow, it would not change the accessibility of the road system to developable properties. Thus, it is not reasonably foreseeable that ER2 would shift expected new business development to a concentrated location on the mainland.

6. What is the potential for an increase in the number of vehicular trips on the non-road-accessible Outer Banks between now and 2035?

It was concluded that such trips would increase between now and 2035 with any alternative, including the No-Build Alternative. These non-road-accessible trips would be notably greater with the planned and expected development levels, plus bridge induced mainland day trips, with MCB2, MCB4, and the Preferred Alternative, than with the estimated development levels constrained by traffic congestion on NC 12, plus no induced mainland day trips, with the No-Build Alternative and ER2. The growth in driving in the non-road-accessible area with or without a Mid-Currituck Bridge could be reduced with a permit system implemented by Currituck County.

The assessment of indirect effects found that there is adequate land considered suitable for development to accommodate business development likely to occur near the US 158/Mid-Currituck Bridge interchange with MCB2, MCB4, and the Preferred Alternative. Potential visual and traffic impacts would be associated with that development. Also, with MCB2, MCB4, and the Preferred Alternative, shifts in the timing of development on the Outer Banks are likely, i.e., more Currituck County lots developing before Dare County lots. These two effects would be compatible with area land use plans, social health and well-being goals, economic opportunity goals, and ecosystem protection goals. The increase in traffic in the non-road-accessible area could be mitigated through enforcement, public education, and potentially a permit system.

The assessment of cumulative effects found that those effects would be primarily associated with future growth in Currituck County irrespective of a detailed study alternative, including the Preferred Alternative, being implemented. The growth trend assumed in area land use plans, with a horizon year of 2025, does not appear to be sustainable to 2035 on the Currituck County mainland. If plan densities and growth continue, then most land suitable for development, including land designated as Rural Areas in the current plan, would be developed. This appears to conflict with current plan goals.

Should forecasted 2035 development occur, based on Currituck County requirements, such development could add 10,000 acres of impervious surface. This increase would occur with the No-Build Alternative and would be generally unaffected by the detailed study alternatives, including the Preferred Alternative. The total additional impervious surface of the detailed study alternatives would be 89 acres for ER2 (54.3 acres without a third outbound lane for hurricane evacuation), 120.0 to 126.8 acres for MCB2 (114.8 to 121.6 without a third outbound lane), 80.6 to 86.6 acres for MCB4 (74.0 to 80.0 without a third outbound lane), and 71.5 acres for the Preferred Alternative. Induced development with MCB2, MCB4, and the Preferred Alternative would shift

approximately 44 acres of future impervious surface growth from the Outer Banks to the mainland. Thus, in the worst case scenario, the detailed study alternatives account for less than 2 percent of the increase in impervious surface in the ICE study area by 2035.

Substantial indirect effects would be visual and traffic effects at the US 158/Mid-Currituck Bridge interchange with MCB2, MCB4, and the Preferred Alternative. The potential for driving in the non-road-accessible Outer Banks to affect natural resources would be greater with MCB2, MCB4, and the Preferred Alternative. Substantial cumulative effects are those associated with continued development in Currituck County. NCTA would mitigate direct impacts associated with the US 158/Mid-Currituck Bridge interchange itself. Minimization of other impacts, including the indirect visual and traffic effects of induced development, would be the responsibility of Currituck County.

4.0 Impact Causing Activities

The following section is added to Chapter 4.0 of the 2011 ICE report to reflect new information gathered and new evaluations prepared for the purposes of this addendum. Sections of the 2011 ICE report's Chapter 4 not included here remain unchanged.

4.2.6 Potential for Increase in the Number of Trips on the Non-Road-Accessible Outer Banks

This section discusses the potential for an increase in the number of trips on the non-road-accessible Outer Banks. This discussion addresses the following trip types:

- Trips by owners and renters of properties in the non-road-accessible area.
- Trips by day visitors staying in beach houses and hotels in the road-accessible portions of the project area. These trips would include both those in personal off-road vehicles (owned or rented) and in group trams.
- Trips by day visitors coming from their home on the mainland.

Section 4.2.2 of the 2011 ICE report discussed the potential for an increase in the number of day trips to the Outer Banks. It concluded:

- ER2 – No or negligible increase;
- MCB2 – Some potential for an increase over the No-Build Alternative with the potential higher in the non-road-accessible area; and
- MCB4 and the Preferred Alternative – Some potential for an increase over the No-Build Alternative with the potential higher in the non-road-accessible area.

Section 4.2.3 of the 2011 ICE report concluded that a potential differential in realized development on the Outer Banks could occur if traffic congestion on NC 12 becomes a constraint with the No-Build Alternative and ER2. There would be no such constraint posed by MCB2, MCB4, and the Preferred Alternative, but the No-Build Alternative could create a practical build-out of 70 percent for the Outer Banks from the Virginia Line to Southern Shores. It would be 75 percent for ER2. The traffic forecasts for the project assume 85 percent of full build-out from the Virginia Line to Southern Shores in 2035.

To aid in the identification of potential differences in all trips on the non-road-accessible area, summer weekday and summer weekend traffic counts were taken just before the end of the pavement on NC 12 of traffic entering and leaving the beach on July 12 and 20, 2012 (weekday) and July 21 and 22, 2012 (weekend). These counts are shown in Table 1. Table 1 shows hourly counts for both northbound (entering the beach) and southbound (leaving the beach) travel on each day, as well as the difference between the northbound and southbound counts during each hour and the cumulative arrivals and

Table 1. Summer 2012 Counts of Vehicles Arriving and Departing the Beach in Currituck County

Start Time	Weekday								Weekend							
	Thursday 7/12/2012				Friday 7/20/2012				Saturday 7/21/2012				Sunday 7/22/2012			
	Arrivals (Northbound)	Departures (Southbound)	Net Arrivals and Departures	Cumulative Arrivals and Departures	Arrivals (Northbound)	Departures (Southbound)	Net Arrivals and Departures	Cumulative Arrivals and Departures	Arrivals (Northbound)	Departures (Southbound)	Net Arrivals and Departures	Cumulative Arrivals and Departures	Arrivals (Northbound)	Departures (Southbound)	Net Arrivals and Departures	Cumulative Arrivals and Departures
Midnight	2	1	1	1	4	3	1	1	3	2	1	1	3	3	0	0
1:00 AM	1	0	1	2	2	1	1	2	5	7	-2	-1	1	3	-2	-2
2:00 AM	3	2	1	3	1	2	-1	1	3	7	-4	-5	2	0	2	0
3:00 AM	0	2	-2	1	1	0	1	2	0	2	-2	-7	0	0	0	0
4:00 AM	1	2	-1	0	0	2	-2	0	4	32	-28	-35	0	1	-1	-1
5:00 AM	7	7	0	0	7	7	0	0	6	48	-42	-77	0	11	-11	-12
6:00 AM	9	9	0	0	12	19	-7	-7	18	81	-63	-140	9	24	-15	-27
7:00 AM	27	33	-6	-6	24	40	-16	-23	32	66	-34	-174	25	47	-22	-49
8:00 AM	57	42	15	9	77	52	25	2	45	73	-28	-202	39	82	-43	-92
9:00 AM	80	74	6	15	47	64	-17	-15	77	106	-29	-231	71	68	3	-89
10:00 AM	141	114	27	42	127	114	13	-2	120	130	-10	-241	108	106	2	-87
11:00 AM	197	125	72	114	169	118	51	49	136	86	50	-191	126	70	56	-31
Noon	137	111	26	140	143	120	23	72	116	84	32	-159	119	77	42	11
1:00 PM	130	110	20	160	152	109	43	115	135	104	31	-128	126	97	29	40
2:00 PM	101	90	11	171	102	125	-23	92	110	143	-33	-161	97	106	-9	31
3:00 PM	84	154	-70	101	109	153	-44	48	151	118	33	-128	120	94	26	57
4:00 PM	89	134	-45	56	107	167	-60	-12	79	72	7	-121	99	131	-32	25
5:00 PM	60	159	-99	-43	64	101	-37	-49	65	45	20	-101	102	93	9	34
6:00 PM	102	91	11	-32	70	57	13	-36	76	57	19	-82	101	95	6	40
7:00 PM	81	59	22	-10	64	64	0	-36	49	26	23	-59	44	57	-13	27
8:00 PM	66	82	-16	-26	41	27	14	-22	31	14	17	-42	46	60	-14	13
9:00 PM	44	28	16	-10	32	6	26	4	35	12	23	-19	30	20	10	23
10:00 PM	44	7	37	27	18	10	8	12	49	14	35	16	17	12	5	28
11:00 PM	4	4	0	27	3	2	1	13	15	6	9	25	11	6	5	33
TOTAL	1,467	1,440	27		1,376	1,363	13		1,360	1,335	25		1,296	1,263	33	

departures. The latter is presented to illustrate how many vehicles are on the beach at any given time. In many cases the hourly number is negative, meaning more vehicles have come off the beach in that hour and the hours preceding than went on. This is possible because in the non-road-accessible area there is a notable owner/renter population that may have arrived on an earlier day. These counts likely reflect higher levels of day visits that may have resulted from recent descriptions of the wild horses in Currituck County Outer Banks tourism promotions and the new beach driving permit requirements on Hatteras Island. The following can be observed in Table 1:

- The number of vehicles entering and leaving the beach is similar on both weekdays and weekends, ranging from 1,263 to 1,467 vehicles per day by direction of travel. The lower numbers occur on the weekend.
- The number of vehicles entering the beach and leaving the beach is about the same every day. On weekdays this reflects day visitors entering and leaving during the day, as well as some owner/renters leaving the non-road-accessible area for activities in the road-accessible area and then returning. On weekends, the same travel pattern as on the weekday should occur, but the change over from one renter to another also is reflected.
- On weekdays, day visitors begin arriving in the morning and leave in the afternoon. This can be seen by the arrivals outnumbering the departures in the morning, with the reverse in the afternoon, and the cumulative arrivals and departures peaking in the early afternoon.
- The pattern is very different on the weekend where departures outnumber arrivals beginning in the morning and arrivals outnumber departures in the afternoon. This is reflective of renters departing when their one week rental period ends and new renters arriving in the afternoon to take their place.
- Also on weekdays and weekends in the evening the cumulative arrivals and departures are a negative number for part of the evening, likely reflecting owners/renters leaving the non-road-accessible area for an evening activity in the road-accessible area. They then return in the late evening.

Using the count data and other assumptions, Table 2 provides a rough indication of potential levels of use of the non-road-accessible area in 2035 and how these levels might vary with the detailed study alternatives. A current summer average daily number of drivers entering or leaving the beach (one-way trips) is indicated as 2,770. This was calculated by averaging the weekday counts over five days and the two-day weekend count. The table also shows the number of current (2007) Outer Banks dwelling units (Southern Shores to the Virginia Line), the planned and expected 2035 units (which could be served by MCB2, MCB4, and the Preferred Alternative), and the constrained units associated with the No-Build Alternative and ER2. These numbers were documented in a February 2012 memorandum (revised October 12, 2012) prepared by Parsons Brinckerhoff titled "Analysis of Potential Traffic Capacity Constraints on Land

Table 2. Potential Levels of Use of the Non-Road-Accessible Area in 2035

	Average Daily One-Way Trips at Beach Entrance (Summer)	Development Units Southern Shores to Virginia Line			
		Current (2007)	2035 Planned and Expected (Bridge Alternatives)	2035 Constrained No-Build	2035 Constrained ER2
		2,770	9,036	13,122	10,847
Average Daily One-Way Non-Road-Accessible Area Trips					
	Current (2007)	2035 Planned and Expected (Bridge Alternatives)	2035 Constrained No-Build	2035 Constrained ER2	
Average Daily One-Way Trips at Beach Entrance (Assuming Direct Correlation Between Growth from Southern Shores to the Virginia Line)	2,770	4,020	3,330	3,550	
Average Daily One-Way Trips on Beach from Homes and Back	3,670	5,120	4,240	4,520	
Additional Day Visitors Because of Mid-Currituck Bridge (10 Percent of Average Daily One-Way Trips)	0	277	0	0	
Total Average Daily Summer One-Way Non-Road-Accessible Area Trips	6,440	9,417	7,570	8,070	
Percent Increase in One-Way Trips from Current Levels		46%	18%	25%	
Difference from 2035 Planned and Expected (Bridge Alternatives)			-1,847	-1,347	
Percent Decrease from 2035 Planned and Expected (Bridge Alternatives)			-20%	-14%	

Use Growth to Support Updated Indirect and Cumulative Effects (ICE) Analysis for Mid-Currituck Bridge Final Environmental Impact Statement (FEIS).”

Table 2 also provides an estimate of total average daily summer trips in the non-road-accessible area broken down by an estimate of one-way trips at the beach entrance, an estimate of trips made by owners/renters that are confined to the non-road-accessible area, and an estimate of additional day visitors with the Mid-Currituck Bridge, as was described in general terms in Section 4.2.2. Several assumptions considered reasonable based on the study team’s knowledge of the project area and available data were used in generating these numbers. However, available data is limited and, as such, the numbers generated are not a precise forecast of future non-road-accessible area driving, but do identify the relative differences between alternatives and provide a reasonable order of magnitude for discussion. The data that would be necessary to allow a precise forecast does not exist and would require extensive surveys of summer non-road-accessible area visitor behavior to assemble the needed data. As such, the numbers presented here are primarily used to consider potential relative differences between alternatives, which are

sufficient to address the relative differences in indirect impacts to the non-road-accessible area discussed in Section 6.2.

The following assumptions were made to generate the non-road-accessible driving numbers presented in Table 2:

- It was assumed that there was a direct correlation between the one-way trips at the beach entrance and development on the Outer Banks from Southern Shores to the Virginia Line. This assumption captures increases in both the arrivals and departures of owners/renters throughout the week by assuming that new owners/renters will have the same travel patterns as current owners/renters. It also takes into consideration the growth in day trips from persons staying in the road-accessible Outer Banks and visiting the non-road-accessible Outer Banks.
- The growth in trips internal to the non-road-accessible area by owners/renters was taken into consideration by assuming six one-way trips per day from each dwelling unit. An example of a one-way trip is driving a vehicle from a vacation house to the beach. The trip back would be a second one-way trip. The numbers shown were generated by multiplying by six the current (2007) units of 611, the 2035 planned and expected units of 854, the 2035 No-Build Alternative constrained units of 706, and the 2035 constrained units of 754. The figure of 854 units and how it was derived is documented in a February 2012 memorandum (revised October 12, 2012) prepared by Parsons Brinckerhoff titled “Analysis of Potential Traffic Capacity Constraints on Land Use Growth to Support Updated Indirect and Cumulative Effects (ICE) Analysis for Mid-Currituck Bridge Final Environmental Impact Statement (FEIS).” The other 706 and 754 result from applying the percent reduction in 2035 development associated with the two alternatives to the 854.
- With respect to day trips from the mainland, Section 4.2.2 indicates that with a Mid-Currituck Bridge there could be: “Some potential for an increase over the No-Build Alternative with the potential higher in the non-road-accessible area.” To estimate this potential, the current average number of daily trips of 2,770 was increased by 10 percent.

As shown in Table 2, non-road-accessible trips would increase between now and 2035 with any alternative, including the No-Build Alternative. Non-road-accessible trips would be notably greater with the planned and expected development levels, plus bridge induced mainland day trips, with MCB2, MCB4, and the Preferred Alternative, than with the estimated development levels constrained by traffic congestion on NC 12, plus no induced mainland day trips, with the No-Build Alternative and ER2 (a 46 percent increase versus an 18 to 25 percent increase, respectively). Table 2 also indicates the absolute and percent difference in trips between MCB2, MCB4, and the Preferred Alternative and the No-Build Alternative and ER2.

Note that if the number of internal trips was doubled from six to 12, these percentages would be 44, 17, and 25 percent, respectively, a nominal difference from those presented in Table 2. If the 10 percent assumption for additional day trips from the mainland is

doubled to 20 percent, the planned and expected trip number plus bridge induced mainland day trips would then be 51 percent over current trip levels rather than 46 percent. As indicated below, induced day trips from the mainland are potentially the easiest to control with a system of permits issued to beach drivers.

As is noted in Section 8.3.2 of the 2011 ICE Report, Currituck County has the authority to develop and implement regulations governing beach driving. Table 3 provides an indication of how such regulations and an associated permit system might affect the beach driving findings shown in Table 2.

Table 3. Potential for Limiting Day Trips with Permits

		Current (2007)	2035 Planned and Expected (Bridge Alternatives)	2035 No- Build	2035 ER2
Day Trip Estimate (No Limits)					
Average Daily Summer One-Way Trips by Non-Road-Accessible Area Owners/Renters	1.5				
Estimate of Average Daily One-Way Summer Day Trips		1,850	3,020	2,270	2,420
Estimate Total Average Daily One-Way Trips if Day Trips Are Limited by Permit to Estimated Existing Levels					
Number of One-Way Trips (Renter/Owner and Day Trips)			8,250	7,150	7,500
Percent Increase in One-Way Trips from 2007			28%	11%	16%
Difference from 2035 Planned and Expected				-1,100	-750
Percent Decrease from 2035 Planned and Expected				-13%	-9%
Estimate of Average Daily One-Way Day Trips if Total Trips Are Limited by Permit to Estimated Existing Levels					
Number of One-Way Day Trips			40	1,140	790
Percent of Total Day Trips Occurring Today			2%	62%	43%

It is assumed that only day trips could be controlled by a permit system. The trips of owners/renters in the non-road-accessible area could not be controlled by a permit system because the beach is the only available way to get to the non-road-accessible area. They have a right of access to their properties. Only day trips by people staying in the NC 12-accessible area or coming from the mainland could be controlled by a permit system. Thus, to estimate the potential for a permit system to control beach driving, an understanding of the purpose of the trips arriving and departing the non-road-accessible area is needed in terms of whether they are owners/renters or day visitors. However, this information does not exist. Thus, as noted in Table 3, it was assumed that over the course of a summer week owners/renters make an average of 10.5 one-way trips in or out of the non-road-accessible area per dwelling unit, or an average of approximately 1.5 trips per day. This assumes the following: three trips per unit arriving on the weekend (taking into account that most beach houses are designed to accommodate more than

one family); three trips per unit departing on the weekend; four other one-way (or two round trips) to the road-accessible Outer Banks over the course of a week's stay; and 0.33 one-way trips on the weekend for cleaning crews (i.e., $3 + 3 + 4 + 0.33$ divided by 7 equals 1.5).

The numbers shown in the second row of the first section of Table 3 are the numbers of day trips that result from the removal of the estimated trips by owners/renters from the overall trip numbers presented in Table 2.

The second section of Table 3 estimates the total number of one-way trips in the non-road-accessible area if the permit system restricted the number of day trips to the 1,850 day trips estimated to occur currently (2007). The end result would be an overall growth in non-road-accessible trips of 28 percent with MCB2, MCB4, and the Preferred Alternative; 11 percent with the No-Build Alternative; and 16 percent with ER2, notable reductions from the 46, 18, and 25 percent, respectively, presented in Table 2 with no permit system.

The third section of Table 3 estimates the number of day trips in the non-road-accessible area if the permit system restricted the number of day trips in a manner that the total number of trips (renter/owner plus day trips) in the non-road-accessible area remained the same as what was estimated for 2007 (6,440 trips in Table 2). To do that, the number of day trips permitted per day would be limited to 40 with MCB2, MCB4, and the Preferred Alternative (essentially zero) and between 1,140 and 790 with the No-Build Alternative and ER2. One can conclude from these numbers that it is virtually certain that trips in the non-road-accessible area would be higher in 2035 than they currently are even with a permit system since day trips are in demand. In addition, with MCB2, MCB4, and the Preferred Alternative, it would be extremely difficult to hold the number of trips in the non-road-accessible area at current levels given that essentially no day trips would be allowed.

If the 1.5 figure assumed to represent the average daily number of summer one-way trips on and off the beach is increased, then the number of potential day trips shown in Table 3 that could be permitted would drop. If the 1.5 figure is decreased, then the number of potential day trips shown in Table 3 that could be permitted would rise. However, neither change would affect the conclusion in the previous paragraph.

In summary, the following conclusions can be reached about the potential for an increase in the number of trips within the non-road-accessible portion of the Outer Banks between now and 2035:

- ER2 and the No-Build Alternative would result in notably less future growth in driving in the non-road-accessible area than that with planned and expected development plus induced day trips from the mainland with a Mid-Currituck Bridge.
- Growth in driving in the non-road-accessible area could be reduced with a permit system, but only day trips could be controlled with a permit system.

- Control of the growth in driving in the non-road-accessible area is made more difficult with the growth of development in the area. The more development there is, the fewer the day visitor permits that could be issued, assuming the county's objective would be to use beach driving permits to stabilize the number of trips in the non-road-accessible area. Another option that would result in fewer vehicles, but more visitors, to the non-road-accessible area would be to emphasize vender permits so that more visitors would use tram type vehicles rather than personal vehicles. This would not only control traffic volumes, but also where driving occurs in the non-road-accessible areas and associated impacts.

Finally, it is possible that non-road-accessible driving could be self-limiting just as the capacity of NC 12 at Duck and associated severe congestion could limit the demand for development north of downtown Duck. Unlike paved roads, there are no studies of a beach's capacity to carry traffic. Thus, there is no way to estimate such a constraint. However, like the NC 12 capacity-related constraint, for beach driving to be self-limiting it would have to be because the growth in demand tapers off and stabilizes as crowding diminishes the quality of the experience in the non-road-accessible area. A reduction in the quality of the experience by crowding could affect both the demand for new development in the non-road-accessible area and the demand for day trips.

6.0 Analyze Indirect/Cumulative Effects

Sections 6.2 and 6.3 of the 2011 ICE report are revised to reflect new information gathered and new evaluations prepared for the purposes of this addendum. Sections of the 2011 ICE report's Chapter 6 not included here remain unchanged.

6.2 Indirect Effects

6.2.2 Effects of Induced Change on Notable Environmental Elements

6.2.2.1 *Dune System*

In terms of existing impacts to the primary (beachfront) and secondary (interior) dunes, the following is known:

- During field surveys in the non-road-accessible Carova area in July 2012, driving on the primary dunes was observed only on designated vehicle access points (sand roads) and private entrances from beachfront homes.
- During winter/early spring storms (nor'easters) it becomes necessary for residents to drive on the primary dune line because of especially high tides (personal communication, Wesley Stallings, Corolla Wild Horse Fund, July 2012).
- Unauthorized "thrillseeker" driving occurs in the secondary dune area, often on undeveloped platted private lots (personal communication, Lynne Wilson, Homeowner, July 2012).
- Unauthorized foot traffic was observed in the field, where a few groups of people were seen walking up into the primary dune line, likely to explore, look for horses, or take photographs.
- Secondary dunes have incurred damage because of behaviors associated with avoiding potholes on poorly maintained off-beach sand roads in Carova. To avoid potholes (discussed further in Section 6.2.3.5), it was observed that vehicles have driven onto secondary dunes to get around them.

The dune system could potentially be further affected in the above ways by increased visitors to Carova. The potential for increased visitors is discussed in Section 4.2.6 of this addendum. The potential for increased visitors and impact would be the greatest with MCB2, MCB4, and the Preferred Alternative. This impact would occur largely as a result of unauthorized driving or walking through prohibited areas, which has the potential to cause habitat degradation or loss. Foot and vehicular traffic through dunes could trample and destroy vegetation that is essential to the diet of wild horses and other wildlife and could cause general habitat disturbance.

Regulations and laws prohibiting trespassing to protect the dunes do exist. Currituck County Ordinance, Section 10-61 – Destruction of Natural Features Prohibited,

specifically protects all dunes in the county from vehicular damage: “No person shall operate any vehicle, moped, motorcycle or motor vehicle or use any horse on or across any dune barrier or in such a manner as would destroy natural vegetation.” The Currituck County Sheriff is responsible for enforcing county regulations, and has a presence of four deputies on ATVs and one truck patrolling Carova at most times between 10:00 a.m. and 4:30 p.m. This force was recently increased from two ATVs; a change which officials said has improved enforcement. According to an interview with officials from the Sheriff’s Office, the largest problems with cars on the beach are speeding and parking. At the time of the interview, 28 tickets, at \$50 each, had been issued in June and July of 2012 (personal communication, Lieutenant Jason Banks, Currituck County Sheriff’s Office, July 2012).

In addition, the Currituck National Wildlife Refuge routinely closes critical habitat areas to all entry through the use of signage. Currently, the large parcel that includes the beach and dunes in the first 1.5 miles of the non-road-accessible area is closed to parking, and the dunes are closed to any access (pedestrian and vehicular) whatsoever.

Occurrences of rule-breaking in this respect are likely to increase proportionately to any increase of cars and people on the beach. Enforcement of these regulations and public education on the reasoning behind them would help to avoid or reduce this effect. This could involve the expansion of the Currituck County Sheriff’s Office non-road accessible area enforcement team.

As discussed in Section 4.2.4, there is no reasonably foreseeable induced development on the Outer Banks with MCB2, MCB4, and the Preferred Alternative; however, if development is constrained because of traffic congestion in the absence of a bridge (No-Build Alternative or ER2), there could be less land disturbance in the dunes. Regulations exist through the Coastal Area Management Act (CAMA) to protect ocean erodible areas from development.

6.2.2.3 Estuaries/Water Quality

The area of the induced development zone would be adjacent to Great Swamp and Maple Swamp and near the Intracoastal Waterway. The primary threat to water quality would be additional loading from impervious surface area run-off and on-site septic facilities. County ordinance and state law address the potential for increased pollution associated with development by imposing runoff control requirements on development. The 68 acres that are likely to see induced development on the Currituck County mainland would be governed by the County’s Unified Development Ordinance (UDO) (Currituck County, 2012). The UDO permits up to 65 percent lot coverage for commercial development, which would translate to increased impervious coverage of 44 acres. Also, in terms of runoff quantity, the UDO requires new development to implement measures to reduce peak runoff from the 10-year storm event (approximately 6 inches of rainfall) down to a predevelopment level for a two-year storm event (Currituck County, 2012). In terms of water quality, new development must treat the first 1.5 inches of runoff from additional impervious surface areas, to the maximum extent practicable, through a combination of pollutant source control and capture and

treatment. Furthermore, at the state level, all new development also must comply with NC Session Law 2008-211 (An Act to Provide for Improvements in the Management of Stormwater in the Coastal Counties in Order to Protect Water Quality), which requires new development to capture and treat the first 1.5 inches of runoff from new impervious surfaces. In addition to the requirements for stormwater capture mentioned above, in terms of runoff quality, a state-required Stormwater Management Permit requires that 85 percent of Total Suspended Solids (TSS) be removed from site runoff. The 85 percent TSS removal requirement is a threshold used by most states to sustain the quality of receiving waterbodies. The period of actual construction is also a window where increased sediment could be transported to estuaries, although this would be avoided or minimized through the use of erosion and sedimentation control measures.

The runoff impact would be partially offset by the fact that most of the land suitable for development is currently in cultivated crops. Agricultural land has perennial negative impacts to runoff water quality stemming from increased sediment from plowed fields as well as fertilizer and pesticide/herbicide transport. The Currituck County mainland does not have a significant livestock presence, so the common agricultural problem of animal waste is less of an issue here. Coastal counties do not have any nutrient reduction requirements.

On the Currituck County Outer Banks, where development could occur in the near-term, runoff is generally handled by infiltration into the soil, with runoff entering Currituck Sound only from properties immediately adjacent to the sound or canals in the Carova area. Thus, these are the properties that have the potential to place any development-related pollutants in the sound. Of the approximately 1,900 undeveloped parcels (as of 2007) in the road-accessible portion of the Currituck County Outer Banks, approximately 110 sound-side lots are available for development. This count of 110 includes all of the undeveloped lots that are adjacent to the sound or adjacent to sound-side marshland, so as to potentially send runoff into the sound rather than infiltrating into the ground. If the constrained development associated with the No-Build Alternative and ER2 were to result in a notable reduction in sound-side development, then the potential for development-related pollutants would drop. However, because of the desirable nature (water access and views) and limited supply of these lots, it is likely that they would develop despite any constraint on overall development associated with the No-Build Alternative and ER2.

Of the 2,539 undeveloped platted lots in the non-road-accessible areas (as of 2007), there are approximately 456 undeveloped buildable sound-side and canal-side lots. The preference has been to develop rental properties on the ocean side. Sound-side and canal-front lots tend to be developed as permanent and semi-permanent residences, and as discussed in Section 4.2.1, few new permanent residences are expected to develop in this area with the construction of the bridge (personal communication, Ben Woody, Director, Currituck County Planning, July 2012). There are sufficient undeveloped ocean-front and near-ocean-front lots to absorb planned and expected demand by 2035 (243 units over the 2007 number of 611 units, for a total of 854 units). Since the demand for sound-side and canal-front properties is low and there is an adequate supply of

beach-front and near-beach-front lots, the constraint on development associated with the No-Build Alternative and ER2 should not result in a notable change in the development of sound-side and canal-front lots.

All new development on the Outer Banks is subject to the same water capture and turbidity reduction requirements stated above. Post construction monitoring is conducted by the county on a case-by-case basis, and is usually complaint based (personal communication, Ben Woody, Director, Currituck County Planning, July 2012). While there is no way to ensure 100 percent compliance or effectiveness, it is reasonable to assume that future development practices will make the necessary provisions to comply with these regulations. Field observations showed that developed lots in the Carova area rarely include grassy lawns or paved driveways, which reduces the threat of fertilizers or vehicle-associated pollutants in sound-side or canal-side runoff. With these stormwater regulations in place and taking into account the canal-side and sound-side conclusions above, impacts to water quality from Outer Banks development is not expected to differ between the detailed study alternatives.

With regard to project-related runoff, NCTA would comply with NC Session Law 2008-211 to the maximum extent practicable for the additional impervious surface area that would be created by the construction of the Preferred Alternative if it is selected for implementation. Of the approximately 71.5 acres of additional impervious surface area (new built upon area) with the Preferred Alternative, about 28 acres would be associated with the bridge over Currituck Sound and 11 acres would be associated with the bridge over Maple Swamp. The remaining approximately 33 acres would be associated with US 158 improvements, interchange ramps/ bridges, toll facilities, local road connections, parking areas, and NC 12 widening. In addition, there are about 18 acres of existing impervious surface area in the project area associated with existing US 158 and the portions of existing NC 12 to be widened.

Compliance with NC Session Law 2008-211's requirement for new development to capture and treat the first 1.5 inches of runoff from additional impervious surface areas would be met, to the maximum extent practicable, through a combination of pollutant source control and capture and treatment. Source control would be through the use of pavement sweeping and vacuuming on bridge decks. Capture and treatment would be through the use of bridge closed drainage systems for parts of the Maple Swamp and Currituck Sound bridges, stormwater wetlands, wet detention basins, rooftop rainwater harvesting, and other traditional roadway Best Management Practices (BMPs), to the maximum extent practicable. (See Section 2.1.7 of the FEIS).

6.2.2.6 *Maritime Forests*

Maritime forests do not exist on the Currituck County mainland. They do exist on the Outer Banks in lots subdivided by development, largely on the sound side. As those lots develop, the forest would become more fragmented, although the subdivision of lots and the creation of paved and unpaved roads in both the road-accessible and non-road-accessible Carova parts of the Outer Banks has already created forest habitat fragmentation.

In the non-road-accessible Carova area, current levels of adjoining vacant parcels leave corridors of forest sufficient to allow wildlife passage and seed dispersal. If all or most of the lots were developed, it would be less likely that a corridor of sufficient size would remain to link the fragmented areas. Additionally, clearing lots for development increases the likelihood of invasive species changing the composition of these maritime forest areas. However, development trends have shown a preference for beach-front and near-beach-front lots and maritime forests tend to occur on the sound side of the Outer Banks (personal communication, Ben Woody, Director, Currituck County Planning, July 2012). Thus, it is likely that future Carova development with any of the detailed study alternatives would not notably worsen maritime forest fragmentation.

Also, the vast majority of lots platted in maritime forests have not been cleared (except for the blading of sand roads) and are undeveloped. Desirable sound view lots, which have been platted more recently, are subject to zoning with larger size requirements. These lots are much larger than those that were grandfathered-in when the area was first subdivided, and their size allows plenty of maritime forest to remain.

6.2.2.9 Coastal Marshes

Coastal marshes around Currituck Sound are not developable; therefore, there would be no indirect effect from any of the detailed study alternatives, including the Preferred Alternative, except to the extent that degraded runoff from sound-side lots might affect these marshes. It is reasonable, however, to assume that development on any of the sound-, marsh-, or canal-front lots would comply with county and state guidelines for water capture and turbidity reduction requirements, as discussed in Section 6.2.2.3 above.

6.2.2.11 Waterbirds

The induced land use changes would not substantially affect waterbirds or their habitat. None of the areas of induced land use change are notable areas of waterbird habitat. On the mainland, induced development is expected along US 158 in areas that are largely developed or agricultural and not important bird areas. On the Outer Banks, neither changing the order of development, nor increasing day visitors to the beaches, would cause a net impact on waterbird habitat. Increased development is not likely to result in harmful runoff into Currituck Sound because it is reasonable to assume that development on any of the sound-, marsh-, or canal-front lots would comply with county and state guidelines for water capture and turbidity reduction requirements, as discussed in Section 6.2.2.3 above. Also, as discussed in Section 6.2.2.3, notable differences in the development of sound-, marsh-, or canal-front lots are not expected between the detailed study alternatives.

Even in the case of induced beach driving, the marginal effect would be minor; the current levels and growth of year-round beach driving already degrade the beaches north of NC 12 for shorebirds.

6.2.2.14 Protected Species

Protected species in Currituck and Dare counties are listed in Appendix B of the 2011 ICE report. They include species on the federally endangered species list, as well as bald eagles which are protected by the Bald and Golden Eagle Protection Act. As per the *Biological Assessment (BA)* (CZR Incorporated, 2011a) and the *Natural Resources Technical Report* (CZR Incorporated, 2011b), there are no protected species habitats in the induced development zone on the Currituck County mainland or in developable habitats on the Outer Banks; therefore, there would be no indirect effect from any of the detailed study alternatives, including the Preferred Alternative, in these areas. The northern beaches have in the last 20 years provided habitat to piping plovers and loggerhead sea turtles, although incidents have been infrequent. Unrestricted beach driving is credited with degrading this habitat. Increased beach driving in the future could exacerbate this problem. Seabeach amaranth has not been noted in the ICE study area since 1988. This species requires extensive areas of barrier island beaches and inlets that function in a relatively natural and dynamic manner, allowing it to move around and colonize sparsely vegetated sand. These do not occur in the area.

The BA identified increased beach driving as a potential indirect effect on protected species as a result of the Preferred Alternative. However, the effect determination for beach driving on protected species was determined to be “May Affect, Not Likely to Adversely Affect” (see Table 6 of the BA). This determination was based in part on the “minimization measure” that sea turtle nests on the beach will continue to be roped off by USFWS personnel to reduce disturbance. In addition, the presence of protected species in the area is “rare,” and the biological response of protected species to areas with beach driving is “avoidance” (see Table 6 of the BA). Coordination with USFWS in March 2011 on the issue of increased beach driving indicated that beach driving has been a concern, but the area is already very disturbed by current off-road driving. In addition, the USFWS representative was not aware of any current sea turtle nesting in the area. The findings of the BA were affirmed in a July 8, 2011 letter from USFWS (see Appendix F of the *Natural Resources Technical Report* [CZR Incorporated, 2011], page F-1).

6.2.2.15 Wild Horses

Wild horse habitat in the northern beaches could be affected with increased day visitors to this area. Current regulations prohibit people from coming within 50 feet of a wild horse, and it is prohibited to feed a wild horse. Despite these regulations, these rules are commonly broken by tourists who either are not aware of them, or do not understand their importance to the health and well-being of the animals. There is evidence that foot and vehicular traffic on the dunes has damaged and degraded vegetation required by the horses. Because the horses use the entire width of the land from the sound to the ocean, the presence of cars on the beach compromises the wild horse habitat. Collisions on the beach between cars and horses have occurred, and four horses were hit by cars between 2009 and 2012. Peak foaling season for the horses coincides with the peak tourist season in Carova, and the increase in cars during summer creates a stressful environment for the horses (personal communication, Wesley Stallings, Corolla Wild Horse Fund, July 2012).

The presence of more four-wheel drive vehicles would increase the chance of horse-human interactions and the likelihood of collisions with the animals. Vehicular traffic through dunes could trample and destroy vegetation that is essential to the diet of wild horses. An increase in cars would also exacerbate an already stressful environment for foaling horses. Constrained growth that could result with the No-Build Alternative and ER2 would result in less use of the non-road accessible area than with MCB2, MCB4, and the Preferred Alternative, thereby resulting in less damaging effects on wild horse habitat.

6.2.2.16 CBRA Areas, Natural Heritage Areas, and Conservation Areas

In Currituck County, the non-road-accessible northern Outer Banks and the Audubon Society's refuge near the Currituck/Dare County line are designated Coastal Barrier Resources Act areas (see Figure 3-5 of the 2011 ICE report). Also, there are 34 natural heritage areas listed in the Currituck County land use plan, as well as natural heritage elements in the Dare County towns, notably Kitty Hawk Woods. Two areas (Maple Swamp and Great Swamp) are adjacent to the induced development zone on the Currituck County mainland. Section 6.2.2.10 of the 2011 ICE report discusses the absence of indirect impacts on these natural areas with development in the mainland induced development zone. On the Outer Banks, the induced change between the different detailed study alternatives would be to likely alter the order of development of lots that are already subdivided. However, there would be no net indirect impact on designated conservation areas on the Outer Banks other than those that could be associated with increased users of the non-road-accessible northern Outer Banks. That use would be less with the No-Build Alternative and ER2, as discussed in Section 4.2.6.

Currently, a low amount of visitor trespassing has been reported in the protected areas. During the field visit, a few groups of people were observed walking into the primary dune line of these protected areas, likely to explore, look for horses, or take photographs. The Sheriff's deputies patrolling the beach provide enforcement to keep people out of these areas, along with posted signage (personal communication, Lieutenant Jason Banks, Currituck County Sheriff's Office, July 2012). Additionally, the extension of the no parking area to 1.5 miles beyond the NC 12 ramp has helped to decrease the numbers of people trespassing on protected lands. However, an increase in the number of visitors could cause a rise in incidents of trespassing, both pedestrian and vehicular, on designated conservation areas. Increased enforcement potentially would be needed to help to avoid or diminish these incidents. During winter/early spring storms (nor'easters), it becomes necessary for residents to drive on the primary dune line the length of the beach, including on protected lands, because of especially high tides (personal communication, Wesley Stallings, Corolla Wild Horse Fund, 2012; Claudia Jones, Currituck Banks, July 2012). However, nor'easters do not come during the tourist season, and visitors and residents would be evacuated before high tides associated with hurricanes could become a problem.

Induced development and activity on the mainland would have the potential to cause the introduction of invasive species during both the construction phase and the ongoing use of the facilities. This effect could spread out from the site. Studies have found that

in the case of invasive species being introduced along roads, the farthest reported distance that species have spread from the roadside into adjoining land was 394 feet, but the bulk of species invaded only 33 feet from a roadside (Forman, Sperling et al., 2003).

There were five species from the North Carolina Department of Transportation (NCDOT) Invasive Exotic Plant List for North Carolina (Smith, 2008) observed within the Mid-Currituck Bridge project area. Threat Level 1 species (common reed, Chinese privet, and Nepalese browntop) are known to be invasive and degrade habitat. Threat Level 2 species (Japanese honeysuckle and mimosa) do not currently pose a substantial threat to natural communities (CZR, Incorporated, 2011b).

6.2.3 Effects of Induced Change on Notable Cultural and Socioeconomic Conditions

The following sections have been amended to reflect new information gathered and new evaluations prepared for the purposes of this addendum. Sections not mentioned remain unchanged.

6.2.3.5 Circulation and Access

The two induced development pattern changes associated with MCB2, MCB4, and the Preferred Alternative would not cause additional changes in access. In terms of traffic circulation, it would continue within development on the Outer Banks as intended when the Outer Banks subdivisions were established. Because only the order of Outer Banks development would be affected, levels of congestion forecasted for 2035 would be unchanged. Increased day visitors could increase traffic on the Currituck County Outer Banks. If the No-Build Alternative or ER2 is chosen, levels of development could be constrained as a result of increasing congestion on NC 12 in Duck. This restraint on development, in both the road- and non-road-accessible areas, would reduce beach driving in the non-road-accessible areas to less than what would come from planned and expected development with MCB2, MCB4, and the Preferred Alternative.

Flooding of poorly maintained off-beach roads in the non-road-accessible Carova area has become a problem that affects access and connectivity in the developed areas of Carova. Observations in the field revealed that to avoid driving through the extensive water-filled potholes that have formed in some areas, drivers are using alternate methods that are causing harm to surrounding secondary dunes. Drivers either drive around the edge, which further erodes the surrounding sand and expands the potholes, or they create short “detour” routes through surrounding secondary dunes to circumvent the water. In the absence of county maintenance of these roads and/or infrastructure to manage excess water, these potholes will likely further expand and deteriorate with an increase in the number of cars that drive these roads for the purposes of accessing homes, horse watching, and general exploration. In addition, this problem will likely increase at a rate faster than the rate of driving because it is believed to be a result of not only poorly maintained roads, but also a lack of infiltration ponds in the area to handle excess waters, resulting in short-term flooding when rain falls faster than it can infiltrate into the soil.

Commercial development on the mainland, if allowed to develop with individual driveways for each business, would create additional turning movements off of US 158, potentially increasing congestion. Consolidated driveways in new concentrations of development are today common practice, and this would be expected to be required both by the county and NCDOT.

6.2.3.7 Scenic and Natural Area Character

The shifting of the order of development that would occur in Outer Banks subdivisions would not affect the manner in which these communities would develop. It also would not affect the already expected effect of Outer Banks subdivisions on scenic and natural character.

Increased visitation to the non-road-accessible Carova area would increase the intensity of beach use – the beaches would be more crowded. Because of the nature of beach use in the non-road-accessible Carova area, where beach goers and vehicles must share the sand, a reduced quality of experience for residents, renters, and day visitors would likely result as the beach becomes more congested with increasing numbers of cars. The constrained development associated with the No-Build Alternative and ER2 would result in less growth in beach driving through 2035, as documented in Section 4.2.6.

Current levels of congestion and density on the beach have already caused a decline in experience (personal communication, Lynne Wilson, Homeowner, July 2012; Currituck County Beach Driving Committee, 2011). In addition to the discomfort of crowding from high numbers of cars parked on the sand, this congestion also leads to concerns about safety. When the tide is low and cars are driving on the foreshore, beachgoers must cross a line of traffic to get to the water.

With MCB2, MCB4, and the Preferred Alternative, the introduction of the US 158/Mid-Currituck Bridge interchange would substantially change the visual character of that area (as discussed in the revised *Other Physical Features Technical Report* [Parsons Brinckerhoff, 2011] in its assessment of visual impacts). Existing features would be lost and new man-made vertical elements would be introduced. The interchange would be a substantial change for an area defined in the visual impact assessment as having high visual quality. The potential introduction of businesses in the interchange area would have a similar impact. The extent of the visual impact would depend upon the appearance requirements that would be the responsibility of Currituck County to establish.

6.3 Cumulative Effects

6.3.2 Cumulative Effects on Notable Environmental Elements

6.3.2.1 Dune System

Increased non-road-accessible area visitation north of NC 12 could create added impacts on the dune system. This potential for impact would be less with the No-Build Alternative and ER2 than with MCB2, MCB4, and the Preferred Alternative, as documented in Section 4.2.6. The dunes, particularly in the conservation areas, are not

equipped to accommodate foot or vehicular traffic. Increased trips would increase the numbers of cars driving in the non-road-accessible area, which would raise the potential for foot or vehicular trespassing on dune areas. The cumulative impacts of increased foot and vehicular traffic by beachgoers seeking privacy could trample important vegetation and disturb animal habitat. Anticipated and planned development would occur in part in the dune area. A permit system to limit day visitors and/or increasing enforcement and public education would help to avoid or reduce this effect to an extent, as discussed in Section 4.2.6.

There are no bridge-related actions that would combine with accelerated sea level rise to create a cumulative effect on this notable feature. Private development in the next 25 years could begin to be concerned with sea level rise. Dune maintenance could be seen as desirable and occur to protect existing and future beach front homes from beach erosion or sea level rise.

6.3.2.3 Estuaries/Water Quality

Recent investigations indicate that the waters of Currituck Sound are potentially threatened by four sources: nutrient loading associated with non-point source runoff from agriculture, logging, and urban development; septic wastewater contamination from increased development on the Currituck County Outer Banks; increased turbidity caused by human- and naturally-induced perturbations; and saltwater intrusion and pollution from canals linking Currituck Sound to southeast Virginia (US Army Corps of Engineers [USACE], 2010). The indirect and cumulative effects to water quality from bridge construction and operation, as well as development growth would largely be increased turbidity and its negative feedback loop. Submerged aquatic vegetation (SAV) is often used as an indicator of system health because of its importance in trophic webs and its sensitivity to environmental perturbations. Multiple studies have documented the decline of SAV in Currituck Sound (USACE, 2010; Fine, 2008). These studies concluded that turbidity is the leading cause, but also hypothesized that salinity is a correlated factor. Many factors can contribute to turbidity, including dredging; however, there would be no dredging in Currituck Sound with the Preferred Alternative. In SAV habitat (including existing beds), turbidity curtains would be used when driving piles and pile jetting would be avoided. USACE's most recent water quality study of Currituck Sound was conducted in 2007-2008, and found the water quality conditions to be "good." However, the study did not make any direct correlations between the conditions of the water and any particular drivers, such as development (personal communication, Barry Bunch, USACE, July 2012).

Estuaries and water quality in the ICE study area would continue to be affected by current trends with all of the detailed study alternatives, and would be affected by the operation of a Mid-Currituck Bridge. Development could be less on the Outer Banks with the No-Build Alternative and ER2 compared with MCB2, MCB4, and the Preferred Alternative. Also, with MCB2, MCB4, and the Preferred Alternative development would be induced on the mainland. In comparing the No-Build Alternative and the detailed study alternatives and their associated future land use scenarios, the important

factors are land uses in the watershed, bridge runoff, and land disturbance during construction. The first two are enduring through the study period (to 2035). The effects of induced growth associated with MCB2, MCB4, and the Preferred Alternative would be minor since the induced growth area on the mainland would be small (see Section 6.2.2.3 of the 2011 ICE report and this addendum). The constraining of development with the No-Build Alternative or ER2 would result in less potential for impact to estuaries and water quality. However, the reduction would be small within the context of all future development in the ICE study area, and by state law the first 1.5 inches of runoff from new impervious surface areas must be captured and treated. Thus, the impact of development on estuaries and water quality would be virtually the same for all of the detailed study alternatives, including the Preferred Alternative.

Increased development in the ICE study area would create greater impervious surface areas (however, by state law the first 1.5 inches of runoff from new impervious surface areas must be captured and treated), as well as more septic or package treatment systems that would have the potential to negatively affect both Currituck Sound and North River. Some of the land converted would be current agricultural land, which has its own existing negative effects on water quality. The majority of this new development is expected to be residential. Bridge operations would affect water quality through runoff. With MCB2, MCB4, and the Preferred Alternative, bridge runoff would flush pollutants directly into Maple Swamp and Currituck Sound from the bridges. (See the water quality discussion in the revised *Natural Resources Technical Report* [CZR Incorporated, 2011b].) With regard to project-related runoff, NCTA would comply with NC Session Law 2008-211 to the maximum extent practicable for the Maple Swamp and Currituck Sound bridges. Source control would be through the use of pavement sweeping and vacuuming on bridge decks. Capture and treatment would be through the use of bridge closed drainage systems for parts of the Maple Swamp and Currituck Sound bridges. (See Section 2.1.7 of the FEIS.)

While models of the levels of pollution in the sound do not exist, an increase in development using septic systems and traffic crossing the sound are both likely to diminish the quality of Currituck Sound. Land development regulations, low impact development, and best management practices are all local policies that can be used to limit the extent of non-point source pollution from the land.

The North River estuary would be similarly affected by increased development, although much of its shoreline in the upper reaches of the estuary is protected or managed conservation areas of Great Swamp. There would be no bridge runoff effect in North River.

6.3.2.6 Maritime Forests

There are no foreseen project-related activities or project-induced changes that would affect the maritime forests. Thus, future impacts to maritime forests would be similar for all of the detailed study alternatives, including the Preferred Alternative and the No-Build Alternative. Large patches of maritime forest exist in protected conservation areas. Existing trends of maritime forest loss would continue as existing subdivided lots

are developed, as described in Section 3.3.3.2 in the 2011 ICE report. Maritime forests occurring on wetlands would be less likely to be affected because of unsuitability for construction and wetlands protections. Increased development throughout the Outer Banks would continue to degrade and fragment maritime forests.

6.3.2.9 Coastal Marshes

Coastal marshes are Class III land, which indicates serious hazards for development (Currituck County, 2006). They are strongly protected from land development activities by municipal plans, as well as state and federal laws. The future development of sound-side lots has the potential to increase runoff into the sound and associated coastal marshes. However, while there is no way to ensure 100 percent compliance or effectiveness, it is reasonable to assume that future development practices will include the necessary provisions to comply with state and local regulations for runoff capture and turbidity reduction, thereby limiting the cumulative effect of runoff from future development on coastal marshes. Therefore, bridge runoff as a result of the presence of a Mid-Currituck Bridge within Currituck Sound would be the only notable reasonably foreseeable potential addition to the cumulative effect on coastal marshes in the ICE study area. However, the Preferred Alternative would be located so that no coastal marshes would be disturbed. (See the revised *Natural Resources Technical Report* [CZR Incorporated, 2011b].)

6.3.2.11 Water Birds

The ICE study area contains extensive water bird habitats. Declining numbers since 1950 suggest environmental stresses to these habitats (USACE, 2010). The No-Build Alternative and ER2 would pose the least potential cumulative impact because they would use already developed land. With MCB2, MCB4, and the Preferred Alternative, the activity of some water birds could be disrupted near the Mid-Currituck Bridge during construction, mostly during winter months, but the primary feeding/foraging, resting, and nesting sites for waterfowl and water birds throughout the year are associated with marshy and shallow water areas to the north and south of the preferred bridge alignment. Although waterfowl usage of the sound is often variable year to year and over time and seems to be declining, the sound could easily become more important to waterfowl in the future. The presence of a bridge in the mid-portion of the sound would be unlikely to alter substantially the existing or future number of waterfowl that may use Currituck Sound because impacts to habitat would be confined to 4.8 acres of SAV habitat (including existing beds) by shading. This impact would be mitigated. Increased development is not likely to result in harmful runoff into Currituck Sound because it is reasonable to assume that development on any of the sound-, marsh-, or canal-front lots would comply with county and state regulations for runoff capture and turbidity reduction.

6.3.2.14 Protected Species

Protected species in Currituck and Dare counties are listed in Appendix B of the 2011 ICE report. They include species on the federally endangered species list, as well as bald eagles which are protected by the Bald and Golden Eagle Protection Act. As per the *Biological Assessment* (BA) (CZR Incorporated, 2011a) and the *Natural Resources Technical*

Report (CZR Incorporated, 2011b), there are no protected species habitats in the induced development zone on the Currituck County mainland or in developable habitats on the Outer Banks; therefore, there would be no indirect effect from any of the detailed study alternatives, including the Preferred Alternative, in these areas. The northern beaches have in the last 20 years provided habitat to piping plovers and loggerhead sea turtles, although incidents have been infrequent. Unrestricted beach driving is credited with degrading this habitat. Increased beach driving in the future could exacerbate this problem. Seabeach amaranth has not been noted in the ICE study area since 1988. This species requires extensive areas of barrier island beaches and inlets that function in a relatively natural and dynamic manner, allowing it to move around and colonize sparsely vegetated sand. These do not occur in the area.

6.3.2.15 Wild Horses

There are no foreseen project-related activities which would affect the wild horses or their habitat. Continued future private development of the non-road-accessible northern Outer Banks would be expected to affect the horses adversely. Increased land development and altered vegetation would reduce and fragment their habitat. Increased incidences of foot and vehicular trespassing on dunes would trample and destroy vegetation that is essential to the diet of wild horses. Furthermore, increased vehicular traffic that would occur because of development (both owners/renters and day visitors from the road-accessible Outer Banks), along with an increase in mainland day visitors associated with MCB2, MCB4, and the Preferred Alternative, would create a greater likelihood of horse-vehicle collisions. Cumulatively, these could combine to degrade horse habitat (personal communication, Wesley Stallings, Corolla Wild Horse Fund, July 2012). The county's policy emphasis for the area is to allow "very low to medium density residential development without infrastructure or service investments" (Currituck County, 2006). A permit system to limit day visitors and/or increasing enforcement and public education would help to avoid or reduce this effect.

6.3.3 Cumulative Effects on Notable Socioeconomic Features

6.3.3.7 Scenic and Natural Area Character

Change in scenic and natural character in the ICE study area would mirror those described for neighborhoods and villages. Except for those portions of the ICE study area considered unsuitable for development and water features, by 2035 much of the scenic and natural character in the ICE study area would be lost. This change would be similar for the No-Build Alternative and the detailed study alternatives. The one difference among the detailed study alternatives is that MCB2, MCB4, and the Preferred Alternative would introduce the Mid-Currituck Bridge to views of Currituck Sound. Logging would affect the scenic and natural character of the areas logged. Sea-level rise would affect the estuarine edges by changing ecosystems determined by depth to water table. Of particular note would be the expansion of coastal marshes into areas that are currently forested swamps. In addition, continued increased visitation to the non-road-accessible area would increase the intensity of beach use. Vehicles must share the sand, so a reduced quality of experience for residents, renters, and day visitors would likely

result as the beach becomes more congested with increasing numbers of cars. The constrained development associated with the No-Build Alternative and ER2 would result in less growth in beach driving through 2035 than the other detailed study alternatives.

7.0 Evaluation of Analysis Results

This chapter in the *Indirect and Cumulative Effects Technical Report* (East Carolina University, 2011) evaluated the assumptions made in the previous sections and considered uncertainty and how that uncertainty could influence the range of indirect and cumulative effects. This consideration is called for in Step 7 of the *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina* (NCDOT, 2001).

The impact causing activities, described in Chapter 4 of the 2011 ICE report, are primarily associated with development. The exceptions are logging and accelerated sea-level rise. Development impacts include encroachment alteration effects from development forecasted for the No-Build Alternative (Section 4.1 of the 2011 ICE report) and the access alteration effects associated with the detailed study alternatives, including the Preferred Alternative (Section 4.2 of the 2011 ICE report), including those related to:

1. Increased permanent residents;
2. Increased day visitors;
3. Increased development on the NC 12-accessible Outer Banks;
4. Increased development on the non-road-accessible Outer Banks; and
5. Increased development in mainland Currituck County.

The following sections have been amended to reflect new information gathered and new evaluations prepared for the purposes of this addendum. Sections not included remain unchanged.

7.3 Potential Impacts of Permanent Resident Increase on the Outer Banks

Section 4.2.1 of the 2011 ICE report concluded that there would be a negligible or slight potential for an increase in permanent residents on the Outer Banks with MCB2, MCB4, or the Preferred Alternative. If notable numbers of new permanent residents were to move to the Outer Banks, the following effects could occur:

- The construction of smaller single family residences in existing subdivisions;
- Increased non-summer traffic;
- Loss of vacationer tourism and summer sales tax revenue, but an increase in year-round sales tax revenue;
- Change in the pattern of use of utilities;

- Increased need for businesses and public services, such as schools, places of worship and police protection, which cater to permanent residents; and
- Increased permanent resident on the sound- and canal-front lots in the non-road-accessible Carova area and associated potential water quality impacts.

These changes do not represent a notable change in the patterns, location, and densities of development from what is currently expected. As such, no changes in ecosystem impacts or the area's ability to meet its ecosystem goals would be expected. None of the changes listed above would create substantial impacts on socioeconomic features or the area's ability to meet its socioeconomic goals. More permanent residents would simply create a change in community planning and public service focus.

7.4 Potential Impacts of Increased Amounts of Day Visitors on the Outer Banks

Section 4.2.2 of the 2011 ICE report concluded that with MCB2, MCB4, or the Preferred Alternative, there would be an increased demand for day visits to the Outer Banks, but the realized demand would be mitigated by significant constraints. Nonetheless, increased day visits to the NC 12 communities could occur, with a greater increase to the northern beaches. Errors in this assessment could come from unforeseen construction of new day service areas, insufficient services for day visitors from Virginia Beach, or a miscalculated demand for 4-wheel drive beach excursions in the non-road-accessible areas. If the numbers of day visitors did increase significantly in the NC 12 or non-road-accessible areas, the following effects could occur:

- NC 12-Accessible Communities. The effects in these town areas from increased day visitors would all be socioeconomic.
 - Traffic would increase, although there is feedback in this variable because if traffic increased to the point of substantially reduced level of service, it would then slow the number of day visitors.
 - Parking would likely become the greatest concern because of the relatively limited public parking areas on the Currituck County Outer Banks. This could lead to calls for more parking to be constructed or increased day parking regulation and enforcement.
 - Facilities with restrooms and/or changing facilities would be in greater demand.
 - Economic activity for tourist-serving establishments would increase.
 - Issues of public order from the increased day population could require additional police and paramedic services.
- Non-Road-Accessible Northern Outer Banks. The effects in the non-road-accessible area would be both ecosystem and socioeconomic as this is a more natural landscape

that has no tourist related services. A permit system of day passes could be instituted for the area for day visitors. Such a permit system would limit the growth in day visitors.

- Increased use of the beach areas would also lead to increased use of the dune areas in conservation, both foot and vehicular, even though access is technically restricted. Such increased uses could lead to greater destruction of important vegetation and habitat essential to wild horses and other wildlife.
- Additional traffic and pedestrian visitors would create a greater likelihood of conflicts between humans and wild horses.
- Traffic would increase further on NC 12 and on the beach itself. With increased use and persons present on the beach, the speed limit goes down to 15 mph. The beach, as a road itself, could experience a serious reduction in level of service.
- Because there are no restroom facilities, unsanitary practices would increase, creating environmental and public health problems. Demand for these types of facilities would increase.
- Economic activity for the businesses on NC 12 would increase.
- Issues of public order from the increased day population could require additional police and paramedic services.
- Increased crowding and congestion on the beach would result in a decreased quality of experience for all beach users, including day visitors, renters, and residents.

7.5 Potential Impacts of Increased Demand for Residences on the Non-Road-Accessible Outer Banks

Section 4.2.4 of the 2011 ICE report concluded that there would be no foreseeable difference in the location, rate, or type of development between the detailed study alternatives, including the Preferred Alternative, and the No-Build Alternative. This could be in error in one of two ways. Under the No-Build Alternative, congestion could become so bad that economic activity and development are slowed in this area; the potential extent of this reduction in development is described in Section 4.2.3 of the 2011 ICE report. Or, with improvements in access associated with the detailed study alternatives, unexpected and unmet demand for Outer Banks housing is diverted to this area, despite the severe hindrances of difficult access, CBRA restrictions, lack of public services, and absence of tourist amenities.

A slowing of activity in this area would lessen the detrimental effects from development on notable ecological features, such as the dunes, wild horses, maritime forests, and protected species. This would not be inconsistent with the goals of the Currituck County land use plan. It would also reduce the amount of economic activity, although

this area represents only about one tenth of the rental capacity on the Currituck County Outer Banks (Currituck County, 2006).

An unexpected acceleration of development on the non-road-accessible northern Outer Banks could arise from unforeseen and unlikely development of a paved road access, miscalculation in the popularity of “high end, low service” beach vacations, or unexpectedly high investments on the Outer Banks as an entire region. If the demand for residences in the area did increase beyond predictions, the ecosystem and socioeconomic effects could be:

- Accelerated loss of important dune, forest, and estuarine coast habitats, including those essential to wild horses and other wildlife. Currently, new development is oriented towards the oceanfront. Accelerated development could affect the sound front and interior properties to a greater extent. Despite the state and local regulations in place, development in the sound-front area could increase the likelihood of runoff into the sound caused by higher levels of impervious surface areas.
- The free ranging wild horses could become increasingly seen as a nuisance.
- Existing problems with flooding on subdivision roads could accelerate with higher than anticipated levels of development. The need for county road maintenance would increase.
- Pressure could mount for “improved” roads within the non-road-accessible communities. These could be anything from bladed sand to paved roads within existing subdivisions.
- Pressure could mount for better access than what currently exists. This pressure would likely conflict with the county, state, and federal goals of limiting road access. Hurricane evacuation issues could become more critical.
- With an increase in potential residents or vacationers going back and forth between the road-accessible and non-road-accessible areas, traffic on the beach road would increase, leading to potentially more accidents between vehicles, persons and any horses that may venture into the area.
- With the development of more vacation homes the need for a greater police, fire, and emergency medical service presence would increase.
- Under current plans, residences here must rely on onsite sewer and water. If the carrying capacity of the landscape is exceeded with respect to these services, demands would grow for public services.
- A large amount of investment, especially at the oceanfront, could increase calls by property owners to have protections for their investments. Potentially, this could range from delisting from CBRA to beach nourishment projects.

- The demand for some commercial development in this area, such as grocery or convenience stores, could increase.
- However, under the current planning and regulatory regimes, there is no support to encourage development in the non-road-accessible northern Outer Banks. In fact, there are redundant limitations put in place by the county and federal governments, as well as North Carolina and Virginia.

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