5.0 ENVIRONMENTAL CONSEQUENCES

This section is the scientific and analytic basis for the comparisons of the alternatives. The following section includes the anticipated changes to the existing environment including direct, indirect, and cumulative effects. Table 23, located at the end of this section, provides a summary of the impacts and changes expected to result from the implementation of each alternative. Table 12 acreage amounts are based on the following:

- June 2003 aerial photography, biotic community mapping and the GIS developed for the project.
- For Alternatives A-C, erosion rates along Emerald Isle (EI) were determined using the 10-year analysis with a 60 ft/yr erosion rate (See Figure 8) and the GIS. Shoreline erosion rates along Dudley Island are based on a 10 year analysis and calculated from the erosion rates identified in Appendix B – Section 3.18. Erosion estimates were then interpreted from the 2003 shoreline using the GIS.
- For Alternatives E and F, erosion and accretion rates along Emerald Isle and Bear Island are based on the 1978 to 2001 shorelines. The Emerald Isle shoreline erosion estimates were identified between Transects 6 to 13 (Figure 9). At Transect 12, the 2001 shoreline was extended to Transect 13 following the 2003 MHW. The Bear Island shoreline accretion estimates were identified between Transects 25 to 37 (Figure 9).

Table 12
Physical Effects of Alternatives on Habitats (Net Change)

Habitat Types	Total Approx. Acreage Project Area/Permit Area	Alternative A No Action	Alternative B Relocate Homes	Alternative C Sandbag Revetments	Alternative E Channel Relocation Without Beach Nourishment	Preferred Alternative F Channel Relocation With Beach Nourishment
Aerial Mapping (June 2003)						
Residential	463/180 acres	-15 acres (EI)	-15 acres (EI)	-15 acres (EI)	0 acres	0 acres
Beach and Fore Dune	290/248 acres	-36 acres (EI)	-36 acres (EI)	-36 acres (EI)	-17.9 acres (EI shoreline) +33.2 acres (BI shoreline)	-17.9 acres (EI shoreline) +33.2 acres (BI shoreline)
Subtidal	4956/2438 acres	-141.5 (offshore borrow area)	-141.5 (offshore borrow area)	-141.5 (offshore borrow area)	-69.8 (channel/dike) +127.5(sand spit) acres	-69.8 (channel/dike) +127.5(sand spit) acres
Intertidal	896/617 acres	-0.05 (EI temporary sandbags MLW-MHW) acres	0 acres	-0.05 (EI sandbags MLW-MHW) acres	-2 (dike) acres	-2 (dike) acres
On-Site Investigations and Mapping (September 2003)						
SAV	27/5.1 acres	0 acres	0 acres	0 acres	0 acres	0 acres
Shellfish Strata W Habitat (identified in permit area only)	3.5 acres	0 acres	0 acres	0 acres	0 acres	0 acres
Shellfish Strata V Habitat*	1198/330 acres	-3 (EI) -1.5 (DI) acres	-3 (EI) -1.5 (DI) acres	-3 (EI) -1.5 (DI) acres	0 acres	0 acres
Dune Grasses	366/277 acres	-7 (EI) -1.7 (DI) acres	-7 (EI) -1.7 (DI) acres	-7 (EI) -1.7 (DI) acres	0 acres	0 acres
Beach (unvegetated	224/116 acres	-4 (DI) acres	-4 (DI) acres	-4 (DI) acres	0 acres	0 acres

sand)						

Table 12 (cont.)
Physical Effects of Alternatives on Habitats (Net Change)

Habitat Types	Total Approx. Acreage Project Area/Permit Area	Alternative A - No Action	Alternative B - Relocate Homes	Alternative C - Sandbag Revetments	Alternative E - Channel Relocation Without Beach Nourishment	Preferred Alternative F - Channel Relocation With Beach Nourishment
Upland Scrub Shrub	181/82 acres	0 acres	0 acres	0 acres	0 acres	0 acres
Wetland Scrub Shrub	14/3 acres	-0.05 (DI) acres	-0.05 (DI) acres	-0.05 (DI) acres	0 acres	0 acres
Low Salt Marsh	1198/330 acres	-3 (EI) -1.5 (DI) acres	-3 (EI) -1.5 (DI) acres	-3 (EI) -1.5 (DI) acres	0 acres	0 acres
High Salt Marsh	110/57 acres	-5 (EI) -1.3 (DI) acres	-5 (EI) -1.3 (DI) acres	-5 (EI) -1.5 (DI) acres	0 acres	0 acres
Upland Hardwood Forest	68/3 acres	0 acres	0 acres	0 acres	0 acres	0 acres
Wetland Hardwood Forest	4/0.2 acres	0 acres	0 acres	0 acres	0 acres	0 acres
Upland Mixed Forest	219/50 acres	-0.5 (EI) acres	-0.5 (EI) acres	-0.5 (EI) acres	0 acres	0 acres
Wetland Mixed Forest	20/4 acres	0 acres	0 acres	0 acres	0 acres	0 acres

Notes: (-) Erosive or negative effects
(+) Positive or accumulative effects
* corresponds with low salt marsh habitat
EI = Emerald Isle; DI = Dudley Island; BI = Bear Island shoreline

5.1 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Alternative D (suspension of USACE channel maintenance), Alternative G (hard structure), and Alternative H (inlet sand management) have been eliminated from further consideration and evaluation.

Alternative D has been eliminated from further consideration because it does not meet the project needs and is an action that is regulated and administered by the USACE beyond the scope of the Bogue Inlet Channel Erosion Response Project. Continued channel maintenance activities will continue as a Congressionally-mandated activity operating under separate and distinct regulatory authority (Section 933) of the USACE maintenance dredging program administered by the Wilmington District USACE – Navigation Branch. For these reasons, the cessation of maintenance dredging activity alternative is eliminated from further consideration.

Alternative G, use of hard shoreline protection structures to stabilize the inlet shoreline and channel does not satisfy the project needs. Furthermore, the use of hard structures as a shoreline erosion response measure for ocean and inlet shorelines is prohibited by the State of North Carolina. Prior to 2003, the hard structure prohibition was controlled by regulations enacted by the N.C. Coastal Resources Commission in response to the Coastal Area Management Act (CAMA). In 2003, the N.C. State Legislature pass a law (Session Law 2003-427, § 113A-115.1) specifically prohibiting the construction of breakwaters, bulkhead, groins, jetties, revetments, seawalls, and similar structures in response to ocean and inlet shoreline erosion. Therefore, this alternative has been eliminated from further consideration.

The development and implementation of an Inlet Sand Management Program (Alternative H) is in compliance with several of the project needs, but is outside the scope of this project and does not address the issue of remedial actions required to immediately address channel migration and erosion along the Emerald Isle segment of the Bogue Inlet shoreline. Alternative H has been eliminated from further consideration in the following analysis of potential actions.

5.2 GENERAL ENVIRONMENTAL CONSEQUENCES (FOR PERMIT AREA)

The alternative actions carried forth and considered for implementation have environmental consequences associated with them and are discussed in greater detail in the following sections. Although the scope of the habitat and resource mapping conducted by the Town of Emerald Isle encompass a much larger survey area (Appendix C) only those resources within the USACE defined Permit Area (Appendix C) have been discussed and evaluated. The Permit Area for the project has been defined as that segment of the Bogue Inlet complex that are likely to receive direct and immediate indirect impacts from project construction and equilibration based on geotechnical evaluation and engineering models of the proposed alternatives.

Table 23 provides a summary of the alternatives and the associated physical

effects expected to result from their implementation. The summary information in Table 12 provides an acreage estimate of effect expected to result from the implementation of each alternative on the specific marine, estuarine, and upland habitat within the project and permit areas. This general overview of effects based on habitats is provided to allow the reviewer the opportunity to evaluate the specific alternatives and their effect on the biological communities within the permit area. Further evaluation of the direct, indirect, and cumulative effects of each alternative on specific environmental resources is presented in recognition that many of the resources are found within, or utilize numerous habitats through their life cycle. Also refer to Appendix F – Cumulative Effects Assessment. Table 12 provides a summary of the direct and indirect impacts to specific resources anticipated to result from the implementation of each alternative.

5.3 **VEGETATION**

A variety of vegetative resources exist within and adjacent to the Bogue Inlet complex as described in Section 4 of the EIS. The following section provides an impact assessment resulting from implementation of the various alternatives on the vegetative resources in the permit area.

5.3.1 **Maritime Hammock**

Alternatives A, B, and C

Alternatives A, B, and C would all have the following impacts on maritime hammocks.

Direct and Indirect Impacts. In the event that the inlet channel naturally migrates toward Bear Island and results in erosion of the shoreline to a point where maritime hammock resources are threatened, the Alternatives A, B, and C may have a direct impact on these resources. Likewise, natural changes in the channel location may increase the erosion currently occurring on the southern shore of Dudley Island, and may result in the loss or degradation of the resource to a point where maritime hammock resources are threatened. The recent history of the inlet does not indicate that channel migration is likely and therefore, no direct or indirect impacts to maritime hammock are expected to result.

Cumulative Effects. The eastern migration of the Bogue Inlet channel is not expected to impact the maritime hammocks located on Bear Island and Dudley Island, in the near future. Future actions within the inlet complex, with the exception of development on Bear or Dudley Islands, or natural events that alter or destroy the resource beyond the point of sustainability are not anticipated. No adverse cumulative impacts should result from Alternatives A, B, and C.

Compatibility with Project Objectives. The maritime hammocks on Bear Island and Dudley Island are not directly associated with the stated project needs and objectives.

Alternatives E and F

The impacts of Alternatives E and F on maritime hammocks would be essentially the same.

Direct and Indirect Impacts. Construction activities will be centrally located in the Bogue Inlet complex and should not affect the maritime hammocks present on Dudley Island and Bear Island. Erosion along southern Dudley Island should be temporally reduced but should resume once the Emerald Isle sand spit reforms and merges with the sand dike. This should not influence the maritime hammock on Dudley Island as the hammock community is situated well north of the eroding south shoreline of Dudley Island. No direct or indirect impacts to maritime hammock resources is expected.

Cumulative Effects. Alternatives E and F are expected to cause accretion along Bear Island. Maritime hammocks are found upland from the beach environment and additional beach habitat may lead to increased land for maritime hammock growth. Therefore, cumulative impacts to maritime hammock may be positive.

Compatibility with Project Objectives. The maritime hammocks on Bear Island and Dudley Island are not directly associated with the stated project needs and objectives.

5.3.2 **Beach and Dune Communities**

Alternatives A and B

The impacts of Alternatives A and B on beach and dune communities would be the same as described below.

Direct and Indirect Impacts. Beach and Dune communities are typically composed of beach grasses and woody shrubs. These species can be found across the primary and secondary dune features. The eastern migration of the inlet channel and shoreline is likely to continue under Alternatives A and B for a period of at least four years and perhaps as long as 10 years. This would result in the loss of beach and dune communities along the inlet shoreline and the ocean shoreline for a distance ranging from 240 feet to 600 feet east of the existing inlet. Continued erosion of the inlet shoreline could also result in a breach of the sand spit in an area just north of the existing sand bag revetments. Such a breach would connect the old Coast Guard Channel with Bogue Inlet resulting in a new circulation pattern in Bogue Inlet. The new circulation pattern would isolate the north end of the existing Bogue Banks sand spit which could result in this feature becoming an over-wash terrace rather than a dry beach area.

Erosion of the ocean shoreline along the eastern 7,500 feet of Bear Island is likely to continue as long as the inlet channel maintains a position adjacent to the west end of Emerald Isle. Erosion of the east end of Bear Island may result in the loss of beach and dune habitat.

The Town of Emerald Isle would use offshore borrow areas to obtain material to nourish the 23,831 feet of beach included in Phase 3 of its beach nourishment project. The offshore borrow material used to nourish other sections of Bogue Banks under the county-wide beach nourishment project have contained high concentrations of shell and shell hash, however the high shell content does not appear to have an impact on the recovery of the flora and fauna within the nourishment area.

Cumulative Effects. The erosion of Emerald Isle inlet shoreline is expected to continue and thus, loss of beach and dune plants and their habitat may result. Erosion on the east end of Bear Island is also likely to continue. The loss of beach and dune plants and their habitat on the west end of Emerald Isle and the east end of Bear Island could lead to negative cumulative impacts.

Compatibility with Project Objectives. Alternatives A and B would not restore the 700 feet of inlet shoreline presently protected by sandbag revetments. Erosion of the Emerald Isle sand spit north of the existing sandbag revetments will likely continue and could result in a breach of the sand spit connecting Bogue Inlet with the old Coast Guard Channel.

Alternative C – Without Project - Sand Bag Revetments

Direct and Indirect Impacts. Under this alternative, a series of sand bags would be placed to protect threatened houses for two years. While the sand bag revetments would slow the rate of inlet shoreline erosion over a 10-year period, a breach could still occur in the sand spit north of the existing sand bags. If a breach occurs, the isolated portion of the sand spit would slowly evolve into an over-wash terrace with resulting replacement of the beach and dune resource with another habitat either intertidal or subtidal. Erosion of the ocean shoreline on the east end of Bear Island will also likely continue with the same impacts as Alternatives A and B.

Cumulative Effects. After two years, sand bags would be required to be removed and thus, erosion of western Emerald Isle would likely continue. A new row of sand bag revetments may be constructed to protect newly threatened homes and roadways. Negative cumulative impacts could result due to the loss of habitat for beach and dune plant communities from continued shoreline erosion and the construction of the sand bag revetments. Since the sand bag revetments can only be constructed to protect homes and infrastructure, erosion of the sand spit north of the existing sand bags could continue and could result in a breach between the

inlet and the old Coast Guard Channel and the resulting loss of beach and dune resources in the area. Erosion of the east end of Bear Island would likely continue resulting in the loss of additional beach and dune habitat.

Compatibility with Project Objectives. The series of sand bag revetments would not restore the inlet beach and dune habitats, rather, the sand bags and inlet shoreline erosion would contribute to the continued deterioration of the natural beach and dune communities along the sections of the inlet shoreline protected by the sandbags. If a breach occurs between the inlet and the old Coast Guard Channel, the dry sand beach and dunes located on the existing sand spit would evolve into an over-wash terrace.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. The channel will be located to a central location with approximately 200,000 cubic yards used to construct a sand dike across the existing channel and the majority of the material (809,500 cubic yards) stockpiled for eventual transfer to the existing channel. Stockpiling the dredged material on the Emerald Isle sand spit would negatively impact beach and dune communities on the sand spit. Once the stockpiled material is removed from the sand spit, recovery of the beach and dune system could take 1 to 2 years. Since the material removed to construct the new channel would not be used to nourish the portion of the Emerald Isle shoreline included in Phase 3 of the Town's beach nourishment project, offshore borrow material would be used to nourish the 23,831 feet of beach included in Phase 3. Due to the limited fiscal capability of the Town, nourishment of Phase 3 would probably be delayed several years until the Town of Emerald Isle is fiscally capable to undertake the nourishment project. This waiting period for construction of Phase 3 could result in the loss of additional dune and beach habitat along the ocean shoreline of Emerald Isle.

The construction of the sand dike followed by the filling of the existing channel with the stockpiled material is expected to hasten the recovery of the inlet shoreline. A new sand spit is expected to rapidly develop off the west end of Emerald Isle due to a combination of onshore migration of abandoned ebb tide delta material and the longshore movement of material off the western 7,500 feet of ocean shoreline fronting Emerald Isle. This rapid recovery should lead to the development of new sand dunes along the existing eroded inlet shoreline and a rather wide beach fronting the new sand dunes. The recovery of the inlet shoreline and dune system should occur within a 2 year period (see Appendix B). The relocation of the channel is also expected to result in the erosion (approximate loss 17.9 acres) of the western 7,500 feet of Emerald Isle with shoreline recessions ranging from 400 feet near the inlet to around 10 feet at a point 7,500 feet from the inlet over a 10-year adjustment period (see Appendix B). The erosion could remove a portion of the natural dune field that has developed along this section of

the shoreline over the last 15 years. Phase 3 of the Emerald Isle beach nourishment project would probably be constructed in 2007 – 2008 using offshore borrow material.

Some of the predicted erosion on the west end of Emerald Isle would be mitigated by the construction of Phase 3 of the Emerald Isle beach nourishment project. Phase 3 will include placement of some material along the eastern 3,000 feet of the affected shoreline on the west end of Emerald Isle either as part of the main fill or the western taper section. Another mitigating element is the disposal of channel maintenance material on the west end of Emerald Isle by the USACE. Since 1984, the USACE has placed a total of 325,000 cubic yards of channel maintenance material on the western 1,500 feet of Emerald Isle, or an average of 20,300 cubic yards/year. The disposal operations, which have occurred at one to three year intervals with amounts ranging from 15,000 cubic yards to 56,000 cubic yards, are expected to continue.

The beach and dune system on the east end of Bear Island are expected to be positively impacted by the relocation of the channel with shoreline accretion (approximate gain 33.2 acres) ranging from over 500 feet near the inlet to around 100 feet at a point 7,500 feet west of the inlet (see Appendix B). The accretion of the Bear Island shoreline, which could also take 10 years, should result in the development of a much wider dune field along this section of the Bear Island shoreline.

Cumulative Effects. A large portion of Bogue Banks, including the western 23,831 feet of Emerald Isle included in Phase 3, could become part of a 50-year nourishment program sponsored by the Federal Government to reduce storm damages along the island. A draft Environmental Impact Statement for the Federal Bogue Banks storm damage reduction project is scheduled to be released in 2004. Given the time frame normally associated with the implementation of these types of projects, the first beach nourishment under the Federal program may occur as early as 2008 or 2009. Accordingly, there may be some remaining effects of the Phase 3 beach nourishment project on beach and dune communities at the time the Federal project is constructed.

Compatibility with Project Objectives. The dune and beach habitat would be restored along the 700 feet of inlet shoreline presently protected by the sandbag revetment, however, the beach and dune system located along the western 7,500 feet of Emerald Isle could be negatively impacted as the shoreline adjusts to the new channel position (approximate loss 17.9 acres). Phase 3 of the Emerald Isle beach nourishment project will place some material along the eastern 3,000 feet of the shoreline impact area which should mitigate for some of the predicted erosive impacts. Shoreline adjustments along 7,500 feet of the east end of Bear Island may build seaward in response to the new channel location (approximate gain 33.2

acres). The use of offshore borrow material to construct Phase 3 of the Emerald Isle beach nourishment project could result in a higher shell content compared to what naturally exists. Construction of Phase 3 of the Emerald Isle beach nourishment project could be delayed for at least 2 years while the Town of Emerald Isle develops the financial capability to complete the beach nourishment project. Erosion of the 23,831 feet of ocean shoreline included in Phase 3 would probably continue during this interim period.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Construction activities associated with the sand dike could have a temporary negative impact on the beach and dune system on the Emerald Isle sand spit. The sand dike should hasten the development of a new sand spit off the west end of Emerald Isle, however, the time of recovery for the inlet beach and dune system will probably be somewhat longer compared to Alternative E. Material transported onshore from the abandoned portion of the ebb tide delta should migrate onshore over a 2-year period, filling the seaward portions of the existing channel and welding onto the existing beach on the west end of Emerald Isle. This would be followed by the growth of a sand spit off the west end of Emerald Isle. The sand spit, which would develop from a combination of the abandoned ebb tide delta material and material eroded off the west end of Emerald Isle, should merge with the sand dike in approximately 4 to 6 years following the relocation of the channel (see Appendix B). The newly formed sand spit should provide a wide beach area fronting the existing inlet shoreline which could lead to the development of natural dunes. Shoreline adjustments along the west end of Emerald Isle would be the same as with Alternative E, i.e., the loss of beach and dune fields (approximate loss 17.9 acres), and should occur over a 10-year time period.

Most of the material removed to construct the new channel (809,500 cubic yards) would be used to nourish the 23,831 feet of shoreline included in Phase 3 of the Emerald Isle beach nourishment project. The material from the inlet is slightly coarser than but otherwise completely compatible with the native beach material. In this regard, the inlet material contains less than 5% shell and 1.25% fines. Construction of Phase 3 with the inlet material will result in the immediate burial of the existing infauna, however, given its high degree of compatibility of the inlet material with the native material, the recover time for the infauna should be less than 12 months.

The beach and dune system on the east end of Bear Island are expected to be positively impacted by the relocation of the channel with shoreline accretion (approximate gain 33.2 acres) ranging from over 500 feet near the inlet to around 100 feet at a point 7,500 feet west of the inlet (see Appendix B). The accretion of the Bear Island shoreline, which could also take 10 years, should result in the

development of a much wider dune field along this section of the Bear Island shoreline.

Cumulative Effects. The beach and dune system along the inlet shoreline will continue to develop over a period of at least 15 years or as long as the new channel remains in a position well west of its present location. Shoreline adjustments on the west end of Emerald Isle and the east end of Bear Island will probably continue over a 6 to 10-year period (see Appendix B). As with Alternative E, the 23,831 feet of beach included in Phase 3 of the Emerald Isle beach nourishment project may eventually be included in a 50-year Federal storm damage reduction project; however, the direct and indirect impacts of the Phase 3 nourishment project should be minor or nonexistent by the time the Federal project is implemented. Also, construction of Phase 3 will mitigate some of the erosion along the eastern 3,000 feet of the shoreline predicted to be negatively impacted by the relocation of the channel.

Compatibility with Project Objectives. Preferred Alternative F should eventually result in the complete restoration of the 700 feet of inlet shoreline presently protected by the sandbag revetment and dune habitat and would provide highly compatible beach nourishment material for Phase 3 of the Emerald Isle beach nourishment project. Preferred Alternative F fully supports the Town of Emerald Isle's objectives for the project.

5.3.3 **Salt Marsh Communities**

High Salt Marsh

Alternatives A, B, and C should have the same impacts on high salt marsh as described below.

Direct and Indirect Impacts. The south shoreline of Dudley Island and a portion of the Dudley Island shoreline located adjacent to Eastern Channel will probably continue to erode in response to the growth of the Bogue Banks sand spit. Also, the narrow sand area located just north of the existing sand bag revetments which separates old Coast Guard Channel from Bogue Inlet could be breached resulting in the loss of some high marsh lining the old Coast Guard Channel. The new flow and circulation pattern associated with such a breach could result in long-term erosion or transition of some high marsh resources that have developed along this channel well north of the potential breach. Should a breach occur in the Bogue Banks sand spit, the character of the sand spit would eventually evolve to an over-wash terrace which would not only remove the beach and dune system but would destroy the substantial high marsh community that has developed on the sound side of the sand spit. Some of the high marsh could be replaced by low marsh particularly on the back side of the over-washed sand spit.

Cumulative Effects. If erosion continues along the eastern shoulder of Bogue Inlet there may be a loss of high salt marsh habitat. High salt marsh occurs along the east end of the sand spit and along the northern estuarine shoreline of Emerald Isle. If the channel continues to migrate east and erode the shoreline, inlet hydraulics may change and high salt marsh may become inundated or transition to a low salt marsh resource.

Compatibility with Project Objectives. Alternatives A, B, and C would not satisfy the project objective to restore the inlet habitat along the 700 feet of inlet shoreline presently protected by the sandbag revetment and erosion of Dudley Island would contribute to the continued degradation of inlet resources and habitats. A breach of the existing Bogue Banks sand spit would completely alter the character of the sand spit changing it from a dry beach/dune system backed by salt marsh to an over-wash terrace. Some of the high marsh could be replaced by low marsh particularly on the back side of the sand spit.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Erosion of the Dudley Island shoreline and the associated loss of high salt marsh should be diminished for a period of time until the new sand spit develops off the west end of Emerald Isle and merges with the sand dike across the existing channel. Once the spit connects with the sand dike, the northward growth of the sand spit should resume resulting in a resumption of erosion of the south shoreline of Dudley Island. The time period for the spit to merge with the sand dike is approximately two years (see Appendix B). Alternative E should restore the 700 feet of inlet shoreline presently protected by the sandbag revetment and prevent the possible breach of the existing sand spit. This would preserve the character of the sand spit and prevent the possible loss of high salt marsh located on the sound side of the sand spit.

The well-sorted sands, with a low percentage of fines, to be removed from the proposed channel relocation site and deposited in the existing channel to construct the sand dike or stored on the Emerald Isle sand spit and transferred to fill the existing channel are not expected to be transported to areas of the inlet with high salt marsh resources (see Appendix B). High salt marsh communities are located on Dudley Island approximately 1,500 feet from the landward end of the proposed channel and about 3,500 feet east of the proposed channel behind the Emerald Isle sand spit. The short suspension time of these materials combined with the typical elevation of high salt marsh resources (high salt marsh generally above MHW), which is above the zone of bed load transport, will minimize the potential for direct or indirect impacts on high salt marsh resources.

Cumulative Effects. Cumulative effects to high salt marsh communities are not

likely to occur if the channel relocation without beach nourishment alternative is selected. Stockpiling 809,500 cubic yards of channel material on the Emerald Isle sand spit can be done in a manner to prevent the uncontrolled release of this material into the water column until such time that it is mechanically transferred to the existing channel.

Compatibility with Project Objectives. The existing high salt marsh habitat within the inlet complex would be preserved and possibly enhanced. Therefore, the Town's project objective of inlet resource restoration is supported by this alternative.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Erosion of the Dudley Island shoreline and the associated loss of high salt marsh should be diminished for a period of time until the new sand spit develops off the west end of Emerald Isle and merges with the sand dike across the existing channel. Once the spit connects with the sand dike, the northward growth of the sand spit should resume, resulting in a resumption of erosion of the south shoreline of Dudley Island. The time period for the spit to merge with the sand dike under Preferred Alternative F would be approximately four to six years after project completion (see Appendix B). High salt marsh communities are located on Dudley Island approximately 1,500 feet from the landward end of the proposed channel and about 3,500 feet east of the proposed channel behind the Emerald Isle sand spit. Preferred Alternative F should restore the 700 feet of inlet shoreline presently protected by the sandbag revetment and prevent the possible breach of the existing sand spit. This would preserve the character of the sand spit and prevent the possible loss of the high salt marsh located on the sound side of the sand spit.

Cumulative Effects. The high salt marsh located behind the Bogue Banks sand spit would be protected and allowed to continue to function as in the past.

Compatibility with Project Objectives. The existing high salt marsh habitat within the inlet complex would be preserved and possibly enhanced. Therefore, the Town's project objective of inlet resource restoration is supported by this alternative.

Low Salt Marsh

Alternatives A, B, and C would have the same impacts on low salt marsh as described below.

Direct and Indirect Impacts. The south shoreline of Dudley Island and a portion of the Dudley Island shoreline located adjacent to Eastern Channel will probably continue to erode in response to the growth of the Bogue Banks sand spit. Also, the narrow sand area located just north of the existing sand bag revetments which separates old Coast Guard Channel from Bogue Inlet could be breached resulting in the loss of some low marsh lining the old Coast Guard Channel. The new flow and circulation pattern associated with such a breach could result in long-term erosion or transition of some low marsh resources that have developed along this channel well north of the potential breach. Should a breach occur in the Bogue Banks sand spit, the character of the sand spit would eventually evolve to an over-wash terrace which would not only remove the beach and dune system but would destroy some

of the low marsh community that has developed along the sides of the old Coast Guard Channel. Some areas of high salt marsh located on the backside of the sand spit could evolve into low marsh habitat thus replacing some of the low marsh habitat that could be lost if the sand spit is breached at the old Coast Guard Channel.

Cumulative Effects. If erosion continues along the eastern shoulder of Bogue Inlet there may be a loss of low salt marsh habitat. Low salt marsh occurs along the east end of the sand spit and along the northern estuarine shoreline of Emerald Isle. If the channel continues to migrate east and erode the shoreline, inlet hydraulics may change and some of the high salt marsh could become inundated and transition to low salt marsh.

Compatibility with Project Objectives. Alternatives A, B, and C would not satisfy the project objective to restore the inlet habitat along the 700 feet of inlet shoreline presently protected by the sandbag revetment and erosion of Dudley Island would contribute to the continued degradation of inlet resources and habitats. A breach of the existing Bogue Banks sand spit would completely alter the character of the sand spit changing it from a dry beach/dune system backed by salt marsh to an over-wash terrace. Some of the high marsh could be replaced by low marsh particularly on the back side of the sand spit.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Erosion of the Dudley Island shoreline and the associated loss of low salt marsh should be diminished for a period of time until the new sand spit develops off the west end of Emerald Isle and merges with the sand dike across the existing channel. Once the spit connects with the sand dike, the northward growth of the sand spit should resume resulting in a resumption of erosion of the south shoreline of Dudley Island. The time period for the spit to merge with the sand dike is approximately two years (see Appendix B). Alternative E should restore the 700 feet of inlet shoreline presently protected by the sandbag revetment and prevent the possible breach of the existing sand spit. This would preserve the character of the sand spit and prevent the possible loss of low salt marsh located on the sound side of the sand spit.

The well-sorted sands, with a low percentage of fines, to be removed from the proposed channel relocation site and deposited in the existing channel to construct the sand dike or stored on the Emerald Isle sand spit and transferred to fill the existing channel are not expected to be transported to areas of the inlet with low salt marsh resources (see Appendix B). Low salt marsh communities are located on Dudley Island approximately 500 feet from the landward end of the proposed channel and about 3,500 feet east of the proposed channel behind the Emerald Isle sand spit.

Cumulative Effects. Cumulative effects to low salt marsh communities are not likely to occur if the channel relocation without beach nourishment alternative is selected. Stockpiling 809,500 cubic yards of channel material on the Emerald Isle sand spit can be done in a manner to prevent the uncontrolled release of this material into the water column until such time that it is mechanically transferred to the existing channel.

Compatibility with Project Objectives. The existing low salt marsh habitat within the inlet complex should be preserved and possibly enhanced. Therefore, the Town's project objective of inlet resource restoration is supported by this alternative.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Erosion of the Dudley Island shoreline and the associated loss of low salt marsh should be diminished for a period of time until the new sand spit develops off the west end of Emerald Isle and merges with the sand dike across the existing channel. Once the spit connects with the sand dike, the northward growth of the sand spit should resume, resulting in a resumption of erosion of the south shoreline of Dudley Island. The time period for the spit to merge with the sand dike under Preferred Alternative F would be approximately four to six years after project completion (see Appendix B). Low salt marsh communities are located on Dudley Island approximately 500 feet from the landward end of the proposed channel and about 3,500 feet east of the proposed channel behind the Emerald Isle sand spit. Preferred Alternative F would restore the 700 feet of inlet shoreline presently protected by the existing sandbag revetment and prevent the possible breach of the existing sand spit. This would preserve the character of the sand spit and prevent the possible loss of the low salt marsh located on the sound side of the sand spit.

Cumulative Effects. The low salt marsh located behind the Bogue Banks sand spit should be protected allowing it to continue to function as in the past.

Compatibility with Project Objectives. The existing low salt marsh habitat within the inlet complex should be preserved and possibly enhanced. Therefore, the Town's project objective of inlet resource restoration is supported by this alternative.

5.3.4 **Submerged Aquatic Vegetation (SAV) Communities**

Alternatives A, B, and C would have the same impacts on SAV as described below.

Direct and Indirect Impacts. Submerged Aquatic Vegetation (SAV) is most often

found in the sheltered environments of shallow estuarine waters. SAV resources in Bogue Inlet are located in areas behind Bear Island, around Dudley Island and throughout western Bogue Sound. Impacts of Alternatives A, B, and C are expected to be concentrated near the western end of Emerald Isle as the eastern migration of the channel continues.

The USACE Navigation Branch will continue to regularly maintain the navigation channel through Bogue Inlet using U.S. Government sidecast dredges capable of operating in shallow water. Sidecast dredges remove material from the navigation channel using dragarms similar to hopper dredges and discharge the material directly into the open waters of Bogue Inlet off the side of the vessel. Between 1984 and 1999, the average amount of material removed from the channel bottom and discharged into the open waters of Bogue Inlet averaged 151,500 cubic yards/year. Over the last three years (2000 to 2002) maintenance dredging has increased substantially, averaging 514,200 cubic yards/year. The discharge of the dredged material into the open waters of Bogue Inlet has apparently not had a negative impact on SAV farther back in the sound as SAV areas identified by a 1992 survey conducted by NOAA, still exist in 2003. The lack of adverse impact on SAV resulting from maintenance dredging activities is probably due to the low silt content (approximately 1.25%) of the inlet material.

Cumulative Effects. The continuation of the erosion on the Emerald Isle inlet shoreline and the possible overwash and breaching of the Emerald Isle sand spit could create differences in water flux, salinity, and turbidity in areas that were once protected behind the Emerald Isle sand spit. If a breach in the sand spit does occur, the transport distance for suspended sediment from the inlet channel, where maintenance dredging takes place, and the SAV beds located in western Bogue Sound could be shortened substantially. If this changed circulation pattern results in changes in salinity and/or turbidity, cumulative effects on SAV could be negative.

Compatibility with Project Objectives. Alternatives A, B, and C would not restore the inlet habitat including the environment necessary to support SAV's and does not support the Town's objectives for the project.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Dredging to relocate the channel to the middle of the inlet, construction of the sand dike across the existing channel, stockpiling material on the Emerald Isle sand spit, and the mechanical transfer of the stockpiled material to fill the existing channel is expected to temporarily increase the turbidity in the Inlet. However, turbidity should remain below the state standard outside the immediate area of dike construction because the sand in the Inlet is well-sorted and contains a low silt/clay percentage.

Cumulative Effects. Impacts from project construction that may affect SAV, such as increases in turbidity and sedimentation, are expected to be temporary during the construction phase and remain localized. No adverse cumulative impacts to SAV resources should result from the implementation of the channel relocation without beach nourishment alternative.

Compatibility with Project Objectives. SAV resources in the project area are not expected to be significantly impacted by Alternative E. Therefore, inlet habitats including SAV resources should be protected in support of the Town of Emerald Isle's project objectives.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Relocation of the channel and construction of the sand dike are predicted to cause a short term increase in turbidity and sedimentation levels. However, due to the low silt percentage and the well-sorted sands in the Inlet, the turbidity levels are expected to remain below the state standard outside the immediate area of dike construction. The relatively coarse grain size of the inlet material and its relatively low silt content (approximately 1.25%) will limit the movement of the sediment plume during construction to the confluence of the inlet channel with Eastern and Western Channels, that is, the plume is not expected to travel any appreciable distance into the sound (see Appendix B). In this regard, SAV resources are found away from the throat of Bogue Inlet in areas that are protected from sudden changes in water quality such as turbidity. SAV resources may also be impacted by changes in salinity; however, the dimensions of the new channel were selected to maintain the same tidal exchange (including salinity) through the inlet that presently exists (see Appendix B). Therefore, there should not be any SAV impacts due to changes in water quality or sedimentation.

Cumulative Effects. Turbidity levels are predicted to remain localized and below the state standard. Salinity throughout the inlet complex will remain unchanged as Bogue Inlet, with the new channel, will have the same tidal prism or tidal flow as the existing inlet. Therefore, cumulative impacts to SAV under Preferred Alternative F are not expected.

Compatibility with Project Objectives. SAV resources in the project area are not expected to be significantly impacted by Preferred Alternative F. Therefore, inlet habitats including SAV resources should be protected and restored in support of the Town of Emerald Isle's project objectives.

5.4 **THREATENED AND ENDANGERED SPECIES**

5.4.1 **Sea Turtles**

Alternatives A and B would have the same impacts on sea turtles as described below.

Direct and Indirect Impacts. Maintenance dredging activity in Bogue Inlet by the USACE Navigation Branch has not had any known impacts on sea turtles in the inlet; therefore, none is expected during future maintenance activities under Alternatives A and B. Erosion of the inlet shoreline will continue which could negatively impact sea turtle nesting along the 700 feet of inlet shoreline of Emerald Isle presently protected by sandbags. However, due to the relatively small area protected by the sandbags, the propensity of turtles to nest along the ocean shoreline and the rather low density of turtle nests along Bogue Banks, the erosion of the inlet shoreline does not appear to have a significant impact on sea turtle nesting success. Erosion along the eastern 7,500 feet of Bear Island will also likely continue and could have a negative impact on turtle nesting along that section of the island if the erosion is accompanied by vertical scarps. Phase 3 of the Emerald Isle beach nourishment project would be constructed using offshore borrow areas. The 2003 turtle monitoring program has documented nesting in the newly nourished sections of Emerald Isle however since the impacts of the offshore material on sea turtle nesting success has not been completed no definitive conclusion can be made.

Cumulative Effects. As the inlet shoreline continues to migrate to the east, a vertical erosion scarp will probably continually be present which could hamper successful turtle nesting along the inlet shoreline. Given the sea turtle preference to nest along the ocean shoreline of Bogue Banks, the continued erosion of the inlet shoreline is not viewed as a major negative impact on turtle nesting. Nourishment of Phase 3 with material from an offshore borrow area should provide suitable nesting habitat for sea turtles. The possible inclusion of the Phase 3 beach area in a Federal storm damage reduction project should continue to provide suitable nesting habitat in this area for a period of 50 years following initiation of the Federal project. Erosion of the ocean shoreline on Bear Island could continue to negatively impact sea turtle nesting by decreasing the amount of nesting areas available.

Compatibility with Project Objectives. The inlet shoreline would remain in an eroded state, therefore, Alternatives A and B do not support the Town of Emerald Isle's project objectives.

Alternative C – Without Project - Sand Bag Revetments

Direct and Indirect Impacts. Maintenance dredging activity in Bogue Inlet by the USACE Navigation Branch has not had any know impact on sea turtles in the inlet; therefore, none is expected during future maintenance activities under Alternative

C. Construction of a series of sand bag revetments to protect homes once they become threatened should not negatively affect nesting sea turtles along the portion of the inlet shoreline protected by the sandbags since sea turtles tend to avoid highly dynamic inlet beaches. Unlike Alternatives A and B, the vertical erosion scarps that will accompany shoreline migration to the east will be replaced by sand bags. The continued erosion of the inlet shoreline will not have a significant impact on sea turtles since they normally nest along the ocean shoreline and the number of nests along all of Bogue Banks is generally low. Nourishment of Phase 3 of the Emerald Isle beach nourishment project would be accomplished using an offshore borrow source which should provide suitable sea turtle nesting habitat along this section of Emerald Isle. Ocean shoreline erosion on Bear Island will probably continue resulting in potential negative impacts on nesting sea turtles.

Cumulative Effects. Under current North Carolina regulations, sand bags will be removed after they have been in place for a period of two years when protecting homes. After sand bag removal, and loss of the at risk structure, a new sand bag installation will be constructed to protected the next line of threatened homes. Therefore, sandbags could be continually present during the next 10 years if the inlet shoreline continues to erode.

Compatibility with Project Objectives. Alternative C does not support the Town of Emerald Isle's project objectives as inlet shoreline erosion will likely continue to threaten upland development and prevent the reestablishment of access to the inlet shoreline to conditions that existed in the past.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Accounts of sea turtle deaths from dredging activities in Florida, Georgia, and North Carolina have been recorded; however, the majority of these deaths have been attributed to hopper dredges. According to the National Marine Fisheries Service and the USACE, there have been no known turtle takes by cutter-suction pipeline dredges. Since the channel relocation would be accomplished using a cutter-suction pipeline dredge, the potential for take of sea turtle during dredging operations is low. The probability of the direct mortality to sea turtles should be further reduced since all dredging activities are scheduled to occur in the winter to early spring when most sea turtles are outside of inland coastal waters or wintering off the coast of North Carolina.

Alternative E would restore the 700 feet of inlet shoreline of Emerald Isle that is presently protected by sandbags. Since sea turtles normally nest along the ocean shoreline, restoration of the 700-foot shoreline segment should have no significant impact on turtle nesting on Bogue Banks. Erosion on the western 7,500 feet of Emerald Isle (approximate loss 17.9 acres) should be mitigated by accretion along the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres) in response to

the new channel location. Phase 3 of the Emerald Isle beach nourishment project would be accomplished using an offshore borrow source which should provide suitable sea turtle nesting habitat along the nourished beach. Due to financial constraints, the Town of Emerald Isle would likely not be able to complete Phase 3 of the nourishment project until 2007 – 2008 with the 23,831 feet of shoreline included in Phase 3 continuing to erode during the interim period. However, conditions along the Phase 3 shoreline are not so degraded as to prevent turtle nesting so the delay in nourishment should not significantly impact sea turtle nesting success along Bogue Banks. Phase 3 would place material along approximately 3,000 feet of the affected shoreline on the west end of Emerald Isle either as part of the main fill or the west taper section. This should reduce some of the erosive impacts of Alternative E; however, with nourishment delayed until 2007-2008, this section of the shoreline would also experience erosion prior to construction of Phase 3. Continued disposal of navigation maintenance material on the west end of Emerald Isle from the connecting channel should also lessen the erosive impacts of the channel relocation.

Cumulative Effects. The probability for the "take" of sea turtles by dredging activities is expected to be very low because the construction will be accomplished with cutter-suction pipeline dredges working during the winter and early spring when sea turtle presence in the area should be minimal. Therefore, cumulative impacts to sea turtle species is not expected to result from project implementation. Some turtle nesting habitat could be lost along the ocean beach on the west end of Emerald Isle as this shoreline responds to the new channel positions, however, this negative impact should be offset by accretion on the east end of Bear Island (approximate gain 33.2 acres). Completion of Phase 3 of the Emerald Isle beach nourishment project could be delayed until 2007-2008 which would result in the degradation of the beach along the 23,831 feet of shoreline included in Phase 3, but the additional degradation is not expected to significantly impact sea turtle nesting. Construction of the Phase 3 fill should partially offset some of the predicted erosion (approximate loss 17.9 acres) along the 7,500-foot affected shoreline on the west end of Emerald Isle.

Compatibility with Project Objectives. The 700 feet of inlet shoreline presently protected by sandbags should be restored with the implementation of the channel relocation without beach nourishment alternative as the existing channel fills and material accretes along the eastern inlet shoreline. The resulting wide sand beach with possible dune reformation may provide additional nesting habitat within the inlet complex. However, due to the propensity of turtles to nest along the ocean shoreline, the restoration of this relatively small shoreline segment is not expected to have a significant impact on sea turtle nesting success. Phase 3 of the Emerald Isle beach nourishment project could be delayed until 2007 – 2008 resulting in the continued degradation of the ocean beach within the Phase 3 project area.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Accounts of sea turtle deaths from dredging activities in Florida, Georgia, and North Carolina have been recorded; however, the majority of these deaths have been attributed to hopper dredges. Since the channel relocation would be accomplished using a cutter-suction pipeline dredge, the potential for take of sea turtle during dredging operations is low. The probability of the direct mortality to sea turtles should be further reduced since all dredging activities are scheduled to occur in the winter to early spring when most sea turtles are outside of inland coastal waters or wintering off the coast of North Carolina.

Nourishment of Emerald Isle using inlet sands should create a wider beach with characteristics similar to those of the native beach. Sand compatibility analyses of the inlet material demonstrate that the inlet sand is slightly coarser than the native beach material, but otherwise completely compatible with the native beach sands within the Phase 3 project area (see Appendix B).

Erosion on the eastern 7,500 feet of Bear Island should be replaced by accretion while the western 7,500 feet of Emerald Isle is expected to erode in response to the new channel location. However, approximately the eastern 3,000 feet of this affected area would receive some nourishment material as part of the Phase 3 beach nourishment project which should serve to partially mitigate for this predicted erosion. Additional mitigation for the shoreline erosion could come from the continued disposal of navigation maintenance material from the connecting channel on the extreme west end of Emerald Isle by the USACE.

Cumulative Effects. The material that would be removed from Bogue Inlet to nourish the Phase 3 shoreline was derived from the adjacent beaches and is therefore completely compatible with the native beach material. The beach created by the inlet material should have characteristics similar to that of the native beach; therefore, there should not be any negative impacts on turtle nesting within the Phase 3 project area. Erosion of the beach along the western 7,500 feet of Emerald Isle (approximate loss 17.9 acres) in response to the new channel location could negatively impact turtle nesting; however, accretion along the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres) should offset this negative impact. Also, some of the predicted erosion on the west end of Emerald Isle should be mitigated by the inclusion of 3,000 feet of the affected shoreline in the Phase 3 beach nourishment project and the continued disposal of navigation maintenance material on the extreme west end of Emerald Isle.

Compatibility with Project Objectives. Preferred Alternative F is expected to completely restore the 700 feet of inlet shoreline presently protected by the sandbag revetment and would provide quality material to nourish 23,831 feet of ocean shoreline included in the Phase 3 nourishment area. The predicted erosion of

the west end of Emerald Isle should be partially offset by the construction of Phase 3 of the Emerald Isle beach nourishment project that includes 3,000 feet of the affected shoreline and the predicted accretion along the east portion of Bear Island resulting in no net loss of sea turtle nesting habitat. The beach created along the ocean shoreline included in Phase 3 should be compatible with the native beach. Preferred Alternative F completely supports the Town's objectives for the project as they relate to the restoration of the 700 feet of inlet shoreline presently protected by sandbags and along the ocean shorelines.

5.4.2 **Mammals**

Humpback and Right Whales

Alternatives A, B, and C are expected to have the same impacts on Humpback and Right whales as described below.

Direct and Indirect Impacts. Alternatives A, B, and C are not expected to have any direct or indirect impacts on Humpback and Right whales.

Cumulative Effects. Alternatives A, B, and C are not expected to have any cumulative impacts on Humpback and Right whales.

Compatibility with Project Objectives. Listed whale species are not directly associated with the stated project needs or objectives.

Alternatives E and F are expected to have the same impacts on whales as described below.

Direct and Indirect Impacts. Whales are infrequently observed in the nearshore zone of North Carolina and not likely to be found within or adjacent to the shallow waters of the project area. In the event that Federal or State resource protection agencies require that a certified marine mammal observer be stationed on the dredge during project construction, the contractor will be required to provide trained personnel in compliance with the agency directive. Avoidance and activity cessation measures will be implemented to protect marine mammals in the project area.

Cumulative Effects. No cumulative effects to listed whale species or the viability of their populations are expected to result from Alternatives E and F.

Compatibility with Project Objectives. Listed whale species are not directly associated with the stated project needs or objectives.

West Indian Manatee

Alternatives A, B, and C are expected to have the same impact on West Indian Manatee as described below.

Direct and Indirect Impacts. The noise associated with the maintenance dredging activity in Bogue Inlet by the USACE Navigation Branch could discourage West Indian Manatee from entering Bogue Inlet; however, there are no known reports of this type of impact in Bogue Inlet.

Cumulative Effects. No cumulative impacts to manatees are expected to result from Alternatives A, B, and C.

Compatibility with Project Objectives. Manatees are not directly associated with the stated project needs or objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Turbidity levels resulting from dredging operations associated with the channel relocation, dike construction, and filling of the existing channel are predicted to be low and localized. Stockpiling material on the Emerald Isle sand spit should also not have any impact on turbidity. Therefore, SAV resources that manatees rely on as a food should not be affected during project construction. Noise associated with the construction of the new channel, sand dike, and mechanical filling of the existing channel could distract manatees as would the noise associated with the resumption of channel maintenance activities 1 to 2 years following project completion.

Injury to manatees is not likely as project construction will occur in the winter and early spring when ocean and estuary water temperatures are too cold for manatees. In the event that Federal or State resource protection agencies require that a certified marine mammal observer be stationed on the dredge during project construction, the contractor will be required to provide trained personnel in compliance with the agency directive. Avoidance and activity cessation measures will be implemented to protect marine mammals in the project area. Direct and indirect impacts to manatees from Alternative E should be negligible.

Cumulative Effects. Alternative E is not expected to have any impact on SAV; therefore, cumulative impacts on manatee are not anticipated.

Compatibility with Project Objectives. Manatees are not directly associated with the stated project needs or objectives.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Turbidity levels resulting from dredging operations associated with the channel relocation, dike construction, and the disposal of the channel material along the Phase 3 beach nourishment shoreline are predicted to be low and localized and have no significant impact on SAV resources manatees rely on as a food source. Noise associated with the construction of the new channel, sand dike, and beach nourishment could distract manatees as would the noise associated with the resumption of channel maintenance activities 1 to 2 years following project completion.

Injury to manatees is not likely as project construction will occur in the winter and early spring when ocean and estuary water temperatures are too cold for manatees. In the event that Federal or State resource protection agencies require that a certified marine mammal observer be stationed on the dredge during project construction, the contractor will be required to provide trained personnel in compliance with the agency directive. Avoidance and activity cessation measures will be implemented to protect marine mammals in the project area. As a result, direct and indirect impacts to manatees from Preferred Alternative F should be negligible.

Cumulative Effects. Preferred Alternative F is not expected to have any impact on SAV, therefore, cumulative impacts on manatee are not anticipated.

Compatibility with Project Objectives. Manatees are not directly associated with the stated project needs or objectives.

5.4.3 **Birds**

Piping Plover

Alternatives A, B, and C are expected to have similar impacts on piping plovers as described below.

Direct and Indirect Impacts. According to the Federal Register (50C Part 17), the sides of Bogue Inlet, including the inlet shoreline of Emerald Isle, are designated as Critical Habitat for Wintering Piping Plover. Alternatives A and B and to some extent Alternative C will result in the continued erosion of Emerald Isle inlet shoreline which could result in the loss of Critical Habitat for Wintering Piping Plovers. There is some indication that Island 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction (see Appendix B). This westerly migration is expected to continue under Alternatives A, B, and C and could lead to the eventual disappearance of this ephemeral feature. Also, erosion of the ocean shoreline on the east end of Bear Island will likely continue and could impact piping plover use of that end of the island. However, the impacts occurring to the natural system should not have a significant impact on piping plovers as they are well adapted to and seem to thrive in this type of changing environment.

Cumulative Effects. The dynamic nature of Bogue Inlet, which will continue to result in the loss and reformation sand bars and sand islands within the inlet complex, is not expected to have any cumulative impact on piping plover habitat.

Compatibility with Project Objectives. Alternatives A, B, and C would not have any significant impact on the natural evolution of the physical features within Bogue Inlet that are normally associated with piping plover habitat. However, the 700 feet of inlet shoreline presently protected by sandbags would not be restored.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Construction of the relocated channel across the ebb tide delta of Bogue Inlet will remove approximately 47.6 acres of shallow water habitat from the inlet shoal system while construction of the sand dike will create approximately 22.2 acres of shallow water and subtidal habitat. The filling of the

existing channel will also create approximately 127.5 acres of shallow water subtidal and/or intertidal habitat. The new channel location will result in erosion of 7,500 feet of the western shoreline of Emerald Isle (approximate loss 17.9 acres) and accretion along the 7,500 feet of the eastern shoreline of Bear Island (approximate gain 33.2 acres). Noise associated with the channel dredging activity, dike construction, stockpiling of material along the Emerald Isle sand spit, and the mechanical transfer of the stockpiled material onto the existing sand spit may stress Piping Plovers during the projected 3 to 4 month construction period by causing them to spend more time being alert than foraging and resting. Stockpiling material on the Emerald Isle sand spit could negatively impact invertebrates and infauna on which plovers feed. The impact on the invertebrates and infauna could last for 1 to 2 years until the disturbed area are repopulated by invertebrates and infauna from nearby undisturbed areas. There is some indication that Island 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction (see Appendix B). This westerly migration is expected to continue under Alternative E and could lead to the eventual disappearance of this ephemeral feature.

Alternative E could create suitable shallow water foraging habitat for piping plover as a direct result of filling the existing channel or as an indirect result of the development of the sand spit off the west end of Emerald Isle.

Cumulative Effects. Construction of the sand dike followed by the deposition of the stockpiled material into the existing channel should create new intertidal sand flats that could be used as Critical Habitat for Piping Plovers. In addition, intertidal flat resources are anticipated to reform within the inlet complex at a level consistent with historic acreages characteristic of the Inlet. Erosion of 7,500 feet of ocean shoreline on the west end of Emerald Isle (approximate loss 17.9 acres) could damage existing piping plover habitat, however, accretion on the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres) should offset the losses on Emerald Isle and provide the birds with more protected nesting habitat away from human disturbances. Also, the inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project should partially mitigate for some of the predicted erosion; however, construction of Phase 3 could be delayed until 2007-2008 due to funding constrains. The overall cumulative impacts from channel relocation on piping plover should be positive.

Compatibility with Project Objectives. Critical Habitat for Piping Plovers could be created within the Bogue Inlet complex particularly along the Emerald Isle inlet shoreline. Some beach habitat would be lost from the west end of Emerald Isle but this would be offset by the construction of Phase 3 of the Emerald Isle beach nourishment project in 2007-2008 and gains in habitat on the east end of Bear Island. This alternative supports the majority of the Town's project objectives, but does not satisfy the objective of providing high quality beach nourishment material

for Phase 3 of the Emerald Isle beach nourishment project.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Construction of the relocated channel across the ebb tide delta of Bogue Inlet will remove approximately 47.6 acres of shallow water habitat from the inlet shoal system while construction of the sand dike will create approximately 22.2 acres of shallow water and subtidal habitat. Noise associated with the channel dredging activity, dike construction, and beach nourishment may stress Piping Plovers during the projected 3 month construction period by causing them to spend more time being alert than foraging and resting. There is some indication that Island 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction (see Appendix B). This westerly migration is expected to continue under Preferred Alternative F and could lead to the eventual disappearance of this ephemeral feature

Preferred Alternative F should provide foraging habitat for piping plover as a direct result of the dike construction and as an indirect result of the development of the sand spit off the west end of Emerald Isle.

Some potential piping plover habitat on the western 7,500 feet of Emerald Isle could be lost as the shoreline erodes and adjust to the new channel position (approximate loss 17.9 acres). Inclusion of 3,000 feet of this affected shoreline in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. The losses on Emerald Isle should be offset by gains along the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres). Since Bear Island is uninhabited, the beach and dune system that accretes as a result of the new channel should offer good habitat for the piping plovers.

Cumulative Effects. Cumulative impacts to Piping Plovers from Preferred Alternative F should compare to cumulative impacts from Alternative E. Reformation of intertidal flats, intertidal areas near the sand dike, and beach habitat with compatible beach sand, are expected to be available for foraging, nesting, and roosting Piping Plovers. Therefore, cumulative impacts resulting from this alternative are anticipated to be minimal, but possibly positive due to new available habitat.

Compatibility with Project Objectives. Critical Habitat for Piping Plovers could be created within the Bogue Inlet complex particularly along the Emerald Isle inlet shoreline. Some beach habitat would be lost from the west end of Emerald Isle but this would be offset by the construction of Phase 3 of the Emerald Isle beach nourishment project and gains in habitat on the east end of Bear Island. This alternative fully supports the Town of Emerald Isle's objectives for the project.

Critical Habitat for Wintering Piping Plover

Alternatives A, B, and C are expected to have similar impacts on piping plovers as described below.

Direct and Indirect Impacts. According to the Federal Register (50C Part 17), the sides of Bogue Inlet, including the inlet shoreline of Emerald Isle, are designated as Critical Habitat for Wintering Piping Plover. Alternatives A and B and to some extent Alternative C will result in the continued erosion of Emerald Isle inlet shoreline which could result in the loss of Critical Habitat for Wintering Piping Plovers. Recent aerial mapping and modeling results as stated in Appendix B (Section 3.20) give some indication that Island No. 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction. This westerly migration is expected to continue under Alternatives A, B, and C and could lead to the eventual disappearance of this ephemeral feature. Also, erosion of the ocean shoreline on the east end of Bear Island will likely continue and could impact piping plover use of that end of the island. However, the impacts occurring to the natural system should not have a significant impact on piping plovers as they are well adapted to and seem to thrive in this type of changing environment.

Cumulative Effects. The dynamic nature of Bogue Inlet, which will continue to result in the loss and reformation of sand bars and sand islands within the inlet complex, is not expected to have any cumulative negative impact on piping plover habitat.

Compatibility with Project Objectives. Alternatives A, B, and C would not have any significant impact on the natural evolution of the physical features within Bogue Inlet that are normally associated with piping plover habitat. However, the 700 feet of inlet shoreline presently protected by sandbags would not be restored.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Construction of the relocated channel across the ebb tide delta of Bogue Inlet will remove approximately 47.6 acres of shallow water habitat from the inlet shoal system while construction of the sand dike will create approximately 22.2 acres of shallow water and subtidal habitat. The filling of the existing channel will also create approximately 127.5 acres of shallow water and subtidal habitat. The new channel location will result in erosion of 7,500 feet of the western shoreline of Emerald Isle (approximate loss 17.9 acres) and accretion along the 7,500 feet of the eastern shoreline of Bear Island (approximate gain 33.2 acres). Noise associated with the channel dredging activity, dike construction, stockpiling of material along the Emerald Isle sand spit, and the mechanical transfer of the stockpiled material into the existing may stress Piping Plovers during the

projected 3 to 4 month construction period by causing them to spend more time being alert than foraging and resting. Stockpiling material on the Emerald Isle sand spit could negatively impact invertebrates and infauna on which plovers feed. The impact on the invertebrates and infauna could last for 1 to 2 years until the disturbed area are repopulated by invertebrates and infauna from nearby undisturbed areas. There is some indication that Island No. 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction (see Appendix B). This westerly migration is expected to continue under Alternative E and could lead to the eventual disappearance of this ephemeral feature.

Alternative E could create suitable shallow water foraging habitat for piping plover as a direct result of filling the existing channel or as an indirect result of the development of the sand spit off the west end of Emerald Isle.

Cumulative Effects. Construction of the sand dike followed by the deposition of the stockpiled material into the existing channel should create new intertidal sand flats that can be used as Critical Habitat for Piping Plovers. In addition, intertidal flat resources are anticipated to reform within the inlet complex at a level consistent with historic acreages characteristic of the Inlet. Erosion of 7,500 feet of ocean shoreline on the west end of Emerald Isle (approximate loss 17.9 acres) could damage existing piping plover habitat, however, accretion on the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres) should offset the losses on Emerald Isle and provide the birds with more protected nesting habitat away from human disturbances. Also, the inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project would partially mitigate for some of the predicted erosion; however, construction of Phase 3 could be delayed until 2007-2008 due to funding constraints. Once Phase 3 beach nourishment is completed, negative impacts to piping plovers could potentially result from increases in disturbances from predator and human activity. However, if the new area is properly managed, the overall cumulative impacts from channel relocation on piping plover should be minimal, but possibly positive due to additional habitat.

Compatibility with Project Objectives. Critical Habitat for Piping Plovers could be created within the Bogue Inlet complex particularly along the Emerald Isle inlet shoreline. Some beach habitat would be lost from the west end of Emerald Isle but this would be offset by the construction of Phase 3 of the Emerald Isle beach nourishment project in 2007-2008 and gains in habitat on the east end of Bear Island. This alternative supports the majority of the Town's project objectives, but does not satisfy the objective of providing high quality beach nourishment material for Phase 3 of the Emerald Isle beach nourishment project.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Construction of the relocated channel across the ebb tide delta of Bogue Inlet will remove approximately 47.6 acres of shallow water habitat from the inlet shoal system while construction of the sand dike will create approximately 22.2 acres of shallow water and subtidal habitat. Noise associated with the channel dredging activity, dike construction, and beach nourishment may stress Piping Plovers during the projected 3 month construction period by causing them to spend more time being alert than foraging and resting. There is some indication that Island No. 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction (see Appendix B). This westerly migration is expected to continue under Preferred Alternative F and could lead to the eventual disappearance of this ephemeral feature

Preferred Alternative F could create suitable shallow water foraging habitat for piping plover as a direct result of the dike construction and as an indirect result of the development of the sand spit off the west end of Emerald Isle.

Some potential piping plover habitat on the western 7,500 feet of Emerald Isle could be lost as the shoreline erodes (approximate loss 17.9 acres) and adjust to the new channel position. Inclusion of 3,000 feet of this affected shoreline in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. The losses on Emerald Isle should be offset by gains along the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres). Since Bear Island is uninhabited, the beach and dune system created as a result of the new channel should offer better habitat for the piping plovers.

Cumulative Effects. Cumulative impacts to Piping Plovers from Preferred Alternative F should compare to cumulative impacts from Alternative E. Reformation of intertidal flats, intertidal areas near the sand dike, and beach habitat with compatible beach sand, are expected to be available for foraging, nesting, and roosting Piping Plovers. However, after the construction of the sand dike and the existing channel is filled, isolated inlet piping plover habitats will be more accessible and thus, be more susceptible to increases in predator and human affects. With the implementation of a bird management plan, cumulative impacts resulting from this alternative should be positive.

Compatibility with Project Objectives. Critical Habitat for Piping Plovers could be created within the Bogue Inlet complex particularly along the Emerald Isle inlet shoreline. Some beach habitat would be lost from the west end of Emerald Isle but this would be offset by the construction of Phase 3 of the Emerald Isle beach nourishment project and gains in habitat on the east end of Bear Island. This alternative fully supports the Town of Emerald Isle's objectives for the project.

Roseate Tern

Direct and Indirect Impacts. Alternatives A and B and to some extent Alternative C would allow the continued erosion of the Emerald Isle inlet shoreline which could result in the loss of roseate tern habitat. Recent aerial mapping and modeling results as stated in Appendix B (Section 3.20) give some indication that Island No. 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction. This westerly migration is expected to continue with Alternatives A, B, and C and could lead to the eventual disappearance of this ephemeral feature. Also, erosion of the ocean shoreline on the east end of Bear Island will likely continue and could affect roseate tern use of that end of the island.

Cumulative Effects. Cumulative effects to roseate tern habitat are similar to impacts to piping plover.

Compatibility with Project Objectives. The inlet habitats and resources including those used by roseate terns, would not be restored or maintained under the no action alternative which does not support the project objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Construction of the relocated channel across the ebb tide delta of Bogue Inlet will remove approximately 47.6 acres of shallow water habitat from the inlet shoal system while construction of the sand dike will create approximately 22.2 acres of shallow water and subtidal habitat. The filling of the existing channel will also create approximately 127.5 acres of shallow water and subtidal habitat. The new channel location will result in erosion of 7,500 feet of the western shoreline of Emerald Isle (approximate loss 17.9 acres) and accretion along the 7,500 feet of the eastern shoreline of Bear Island (approximate gain 33.2 acres). Noise associated with the channel dredging activity, dike construction, stockpiling of material along the Emerald Isle sand spit, and the mechanical transfer of the stockpiled material into the existing may stress roseate tern during the projected 3 to 4 month construction period by causing them to spend more time being alert than foraging and resting. Stockpiling material on the Emerald Isle sand spit could negatively impact invertebrates and infauna on which roseate terns feed. The impact on the invertebrates and infauna could last for 1 to 2 years until the disturbed area are repopulated by invertebrates and infauna from nearby undisturbed areas. There is some indication that Island No. 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction (see Appendix B). This westerly migration is expected to continue under Alternative E and could lead to the eventual disappearance of this ephemeral feature.

Alternative E could create suitable shallow water foraging habitat for roseate terns as a direct result of filling the existing channel or as an indirect result of the development of the sand spit off the west end of Emerald Isle.

Cumulative Effects. Construction of the sand dike followed by the deposition of the stockpiled material into the existing channel should create new intertidal sand flats that could be used by roseate terns. In addition, intertidal flat resources are anticipated to reform within the inlet complex at a level consistent with historic acreages characteristic of the Inlet. Erosion of 7,500 feet of ocean shoreline on the west end of Emerald Isle (approximate loss 17.9 acres) could damage existing roseate tern habitat, however, accretion on the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres) should offset the losses on Emerald Isle and provide the birds with more protected nesting habitat away from human disturbances. Also, the inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project would partially mitigate for some of the predicted erosion; however, construction of Phase 3 could be delayed until 2007-2008 due to funding constrains. Beach nourishment may increase the potential for predator and human affects to roseate terns and their resources. However, with the implementation of an effective bird management plan, the overall cumulative impacts from channel relocation on roseate terns should be minimal.

Compatibility with Project Objectives. Habitat for roseate terns could be created within the Bogue Inlet complex particularly along the Emerald Isle inlet shoreline. Some beach habitat would be lost from the west end of Emerald Isle but this should be offset by the construction of Phase 3 of the Emerald Isle beach nourishment project in 2007-2008 and gains in habitat on the east end of Bear Island. This alternative supports the majority of the Town's project objectives, but does not satisfy the objective of providing high quality beach nourishment material for Phase 3 of the Emerald Isle beach nourishment project.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Construction of the relocated channel across the ebb tide delta of Bogue Inlet will remove approximately 47.6 acres of shallow water habitat from the inlet shoal system while construction of the sand dike will create approximately 22.2 acres of shallow water and subtidal habitat. Noise associated with the channel dredging activity, dike construction, and beach nourishment may stress roseate terns during the projected 3 month construction period by causing them to spend more time being alert than foraging and resting. There is some indication that Island No. 2, located between Bogue Banks and Bear Island just west of the existing channel, is migrating in a westerly direction (see Appendix B). This westerly migration is expected to continue under Preferred Alternative F and could lead to the eventual disappearance of this ephemeral feature.

Preferred Alternative F could create suitable shallow water foraging habitat for roseate terns as a direct result of the dike construction and as an indirect result of the development of the sand spit off the west end of Emerald Isle.

Some potential roseate tern habitat on the western 7,500 feet of Emerald Isle could be lost as the shoreline erodes (approximate loss 17.9 acres) and adjust to the new channel position. Inclusion of 3,000 feet of this affected shoreline in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. The losses on Emerald Isle should be offset by gains along the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres). Since Bear Island is uninhabited, the beach and dune system created as a result of the new channel should offer better habitat for the roseate terns.

Cumulative Effects. Cumulative impacts to roseate terns from Preferred Alternative F should compare to cumulative impacts from Alternative E. Reformation of intertidal flats, intertidal areas near the sand dike, and beach habitat with compatible beach sand, are expected to be available for foraging, nesting, and roosting roseate terns. However, after the reformation of these habitats, isolated roseate tern habitat will be more susceptible to increases in predator and human affects. With the implementation of an effective bird management plan, cumulative impacts resulting from this alternative should be minimal.

Compatibility with Project Objectives. Habitat for roseate terns could be created within the Bogue Inlet complex particularly along the Emerald Isle inlet shoreline. Some beach habitat would be lost from the west end of Emerald Isle but this would be offset by the construction of Phase 3 of the Emerald Isle beach nourishment project and gains in habitat on the east end of Bear Island. This alternative fully supports the Town of Emerald Isle's objectives for the project.

5.4.4 **Seabeach Amaranth**

Alternatives A, B, and C would have similar impacts on seabeach amaranth as described below.

Direct and Indirect Impacts. Erosion of the inlet shoreline of Emerald Isle and the south shoreline of Dudley Island that lies adjacent to Eastern Channel would likely continue under Alternatives A, B, and C, as would the erosion along the west end of Bear Island. This erosion could result in the loss of seabeach amaranth habitat. The nourishment of the Phase 3 shoreline with material from offshore borrow areas could provide additional seabeach amaranth habitat. In this regard, monitoring of the completed sections of the Bogue Bank Beach Nourishment project has found higher seabeach amaranth counts post-construction compared to pre-construction

counts.

Cumulative Effects. Continued erosion of the project area shorelines resulting from Alternatives A, B, and C may contribute to the loss of additional seabeach amaranth habitat and resources.

Compatibility with Project Objectives. Alternatives A, B, and C do not support the Town's objectives for the project and does not support the restoration of critical seabeach amaranth resources.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Direct and indirect impacts to seabeach amaranth from channel relocation would include the loss of potential habitat along the beach and dune system on the western 7,500 feet of Emerald Isle (approximate loss 17.9 acres), a similar gain in beach and dune system habitat on the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres), and the eventual restoration of potential habitat along 23,831 feet of ocean shoreline associated with the construction of Phase 3 of the Emerald Isle beach nourishment project. Erosion of the south shoreline of Dudley Island should be curtailed until the sand spit reforms and merges with the sand dike. Construction of Phase 3 of the Emerald Isle beach nourishment project would be accomplished using offshore borrow areas which has proven to have a positive impact on the number of seabeach amaranth plants observed on Bogue Banks. However, due to the limited fiscal capability of the Town of Emerald Isle, construction of Phase 3 could be delayed several years until the Town is financially able to support the project. This could result in the continued erosion of the ocean shoreline included in Phase 3 of the beach nourishment project resulting in the loss of seabeach amaranth resources.

Cumulative Effects. Construction of Phase 3 of the Emerald Isle beach nourishment project would probably occur in 2007-2008 using material from offshore borrow areas. Beach nourishment has been shown to be positive for the growth of seabeach amaranth and thus, the nourishment to Emerald Isle from offshore borrow areas would provide more beach habitat for seabeach amaranth once the project was constructed.

Compatibility with Project Objectives. The 700 feet of inlet shoreline habitat fronting the existing sandbag revetment should be restored which could make it suitable for the propagation of seabeach amaranth. The nourishment of Bogue Banks with an offshore sand source has had a positive impact on the number of seabeach amaranth plants found along the entire length of Bogue Banks and therefore should have the same impact within the Phase 3 nourishment area for Emerald Isle. However, if the channel is relocated without beach nourishment, the Town of Emerald Isle would not be immediately able to financially support a separate beach nourishment project for Phase 3, and the project could be delayed several years.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Nourishment of Phase 3 of the Emerald Isle beach nourishment project would be accomplished simultaneously with the relocation of the inlet channel resulting in the immediate restoration of 23,831 feet of ocean shoreline with high quality beach material. This should provide immediate habitat opportunities for seabeach amaranth along Emerald Isle. Shoreline adjustments on

the western 7,500 feet of Emerald Isle (approximate loss 17.9 acres) could result in the loss of some seabeach amaranth habitat while a gain in habitat could occur on the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres). Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts.

Cumulative Effects. With project implementation and construction of the sand dike across the existing channel, sediment deposition in the abandoned channel may result in the formation of intertidal flats. The sand flats may eventually accrete to a point where they become emergent and transition to a supratidal resource with beach and dune characteristics that allow for the establishment of seabeach amaranth. Therefore, this alternative should provide potential habitat for seabeach amaranth and have a positive cumulative effect on seabeach amaranth resources.

Compatibility with Project Objectives. Preferred Alternative F is predicted restore the habitat along the 700 feet of inlet shoreline presently protected by sandbags and ocean shorelines of Emerald Isle and fully supports the project objectives.

5.5 MARINE RESOURCES

5.5.1 Inlet Resources

Benthic Infaunal Community

Alternatives A and B would have the same impacts on benthic infaunal communities as described below.

Direct and Indirect Impacts. Erosion is predicted to continue along western Emerald Isle in association with the eastward movement of the navigation channel. Dredging of the existing channel in Bogue Inlet and the connecting channel leading from the Atlantic Intracoastal Waterway (AIWW) to the inlet by the USACE Navigation Branch will continue to impact benthic communities located in the approximate 20 acre channel prism area. The disposal of the dredged material from the inlet channel off to the side of the vessel will continue to affect benthic communities located adjacent to the channel area. However, recolonization and repopulation of disturbed habitats is expected to occur as organisms move to the channel area from adjacent undisturbed habitat.

Cumulative Effects. No significant or additional loss of benthic organisms or the habitat they utilize is anticipated to result from Alternatives A and B.

Compatibility with Project Objectives. The Town of Emerald Isle's objectives for

the project are not supported by these alternatives.

Alternative C – Without Project - Sand Bag Revetments

Direct and Indirect Impacts. Construction of sand bag revetments are expected to reduce erosion along the shoreline of Emerald Isle, however, maintenance of the navigation channels will still be conducted by the USACE Navigation Branch. Therefore, direct and indirect impacts to benthic organisms from the sand bag revetment alternative should be comparable to the direct and indirect impacts to benthic organisms from Alternatives A and B.

Cumulative Effects. The cumulative effects to benthic infaunal populations resulting from this alternative are comparable to Alternatives A and B.

Compatibility with Project Objectives. The Town of Emerald Isle's objectives for the project are not supported by this alternative.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Direct impacts to 47.6 acres of subtidal habitat will occur during channel construction which will likely destroy benthic organisms located in the channel area. Approximately 22.2 acres of channel bottom are expected to be directly impacted by the construction of the sand dike and an additional 127.5 acres of channel bottom filled with the transfer of the stockpiled material to the existing channel. The new channel location will result in erosion of 7,500 feet of the western shoreline of Emerald Isle (approximate loss 17.9 acres) and accretion along the 7,500 feet of the eastern shoreline of Bear Island (approximate gain 33.2 acres). However, recolonization and repopulation of disturbed habitats is expected to occur as organisms move to the project area from adjacent undisturbed habitat. In addition, temporary impacts may occur from increases in sedimentation and turbidity levels, such as direct burial of benthic organisms and lower dissolved oxygen in the waters surrounding benthic communities.

Cumulative Effects. Because benthic organisms can recolonize disturbed areas within 1 to 2 years and the water quality impacts are anticipated to be minimal and temporary, cumulative impacts to benthic organisms from the channel relocation without beach nourishment alternative are not likely to occur.

Compatibility with Project Objectives. The project objectives, with the exception of the use of the inlet material for beach nourishment are supported by this alternative.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Direct impacts to 47.6 acres of subtidal habitat will occur during channel construction which will destroy benthic organisms located in the channel area. Approximately 22.2 acres of channel bottom are expected to be directly impacted by the construction of the sand dike. Over a period of 4 to 6 years, 127.5 acres of the existing channel will fill with littoral material from the abandoned portion of the ebb tide delta lying off the west end of Emerald Isle and the erosion of material from the western end of the Emerald Isle ocean shoreline. The new channel location will result in erosion of 7,500 feet of the western shoreline of Emerald Isle (approximate loss 17.9 acres) and accretion along the 7,500 feet of the eastern shoreline of Bear Island (approximate gain 33.2 acres). However, recolonization and repopulation of disturbed habitats is expected to occur as organisms move to the project area from adjacent undisturbed habitat. In addition, temporary impacts may occur from increases in sedimentation and turbidity levels, such as direct burial of benthic organisms and lower dissolved oxygen in the waters surrounding benthic communities.

Cumulative Effects. The existing channel located seaward of the sand dike is expected to gradually fill with the influx of littoral sediment off the west end of Emerald Isle and the onshore movement of the abandoned ebb tide delta material situated off the west end of Emerald Isle. Benthic communities located in the existing channel could be overtaken by the influx of littoral sediment, however, cumulative impacts to benthic communities are not likely to occur from the channel relocation with beach nourishment because benthic organisms can quickly recolonize disturbed areas and water quality impacts are expected to be minimal and temporary.

Compatibility with Project Objectives. The project objectives are supported by this alternative.

Shellfish

Alternatives A, B, and C would have the same impacts on shellfish as described below.

Direct and Indirect Impacts. If the easterly migration of the inlet channel continues, the sand spit separating the Coast Guard Channel from the inlet could be breached. The altered flow patterns in the estuary could introduce higher salinity ocean water into shellfish resources. Under Alternatives A, B, and C, the USACE Navigation Branch would continue to use sidecast dredges to maintain the navigation channel with the dredged material being discharged directly into the water column of Bogue Inlet. There is no indication that previous maintenance dredging activities in Bogue Inlet have caused adverse direct or indirect impacts to shellfish resources.

Cumulative Effects. If the sand spit breaches and a direct exchange of oceanic

water through the Coast Guard Channel occurs, shellfish resources could be cumulatively affected by the alteration of tidal flows and water quality in the estuary.

Compatibility with Project Objectives. The Town of Emerald Isle's objectives for the project are not supported by this alternative.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Increases in turbidity are anticipated from the dredging of the new channel, construction of the sand dike, and the mechanical transfer of the stockpiled material to fill the existing channel. However, turbidity is not expected to exceed the State standard outside the area of construction. Shellfish are susceptible to impacts from increases in turbidity that can lead to adverse respiratory and feeding affects. The low silt percentage and low suspension time of the sediment is expected to result in minimal and temporary impacts within the project area, but shellfish resources are not expected to be adversely influenced by project construction since the closest shell fish area is located in the western end of Bogue Sound approximately 700 feet from the landward end of the proposed channel.

Cumulative Effects. No cumulative impacts to shellfish are anticipated to occur from the channel relocation because water quality changes are expected to be temporary and minimal.

Compatibility with Project Objectives. The project objectives, with the exception of the use of the inlet material for beach nourishment are supported by this alternative.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Increases in turbidity are anticipated from the dredging of the new channel and construction of the sand dike. However, turbidity is not expected to exceed the State standard outside the area of construction. Shellfish are susceptible to impacts from increases in turbidity that can lead to adverse respiratory and feeding affects. The low silt percentage and low suspension time of the sediment is expected to result in minimal and temporary impacts within the project area, but shellfish resources are not expected to be adversely influenced by project construction since the closest shell fish area is located in the western end of Bogue Sound approximately 700 feet from the landward end of the proposed channel.

Cumulative Effects. No cumulative impacts to shellfish should occur from the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Finfish

An Essential Fish Habitat (EFH) assessment has been prepared for the Bogue Inlet Channel Erosion Response Project. This assessment identifies the fish species that are likely or expected to occur in the project area, their management designation associated habitat, and effects determination. The EFH identifies several mitigation and avoidance measures to prevent and limit permanent impacts to Essential Fish Habitat and Habitat Areas of Particular Concern. Additional aerial photography will be used to supplement ground-truth investigations to identify any impacts from the project. A copy of the EFH is included in the FEIS (Appendix E).

Alternatives A, B, and C would have the same impacts on finfish as described below.

Direct and Indirect Impacts. No direct or indirect impacts to finfish species are anticipated to result from Alternatives A, B, and C.

Cumulative Effects. No cumulative effects are expected to result from the Alternatives A, B, and C.

Compatibility with Project Objectives. Alternatives A, B, and C do not support the project objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. The proposed channel dimensions were designed to reflect existing dimensions and not to alter tidal volumes. However, the loss of infaunal prey for finfish may result from the stockpiling of sand from the inlet onto land areas and the transfer of the stockpiled material to fill the seaward portion of the existing channel. However, impacts are expected to be temporary and minimal during project construction with infaunal community loss restricted to the immediate channel area and dike construction area. Turbidity impacts are predicted to be minimal because of the low silt/clay percentage and low suspension time of the sediment.

Cumulative Effects. No cumulative effects to finfish species are expected to occur as a result of this alternative.

Compatibility with Project Objectives. This alternative is compatible with most of the project objectives.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Direct and indirect impacts from Preferred Alternative F within the inlet system should be similar to those impacts to finfish from the channel relocation without beach nourishment.

Cumulative Effects. Cumulative impacts to finfish are not likely to occur from the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Marine Mammals - Dolphins

Alternatives A, B, and C would have the same impact on dolphins as described below.

Direct and Indirect Impacts. Dolphin activity could be disrupted by the noise associated with the routine maintenance dredging of the Bogue Inlet channel, however, dolphins are expected to continue to access the resources of Bogue Inlet.

Cumulative Effects. No cumulative effects to dolphins are expected to result from Alternatives A, B, and C.

Compatibility with Project Objectives. Dolphins are not directly associated with the stated project needs or objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Noise from construction activities associated with the dredging of the new channel, construction of the sand dike, stockpiling of material, mechanical transfer of the stockpiled material to the existing channel, and eventual resumption of the routine channel maintenance by the USACE may temporarily affect dolphins that may be present around Bogue Inlet. This impact is expected to be minimal and temporary as dolphins can easily move to other areas outside of the influences from project construction noise.

Cumulative Effects. No cumulative impacts to dolphins are expected to occur from Alternative E.

Compatibility with Project Objectives. Dolphins are not directly associated with the stated project needs or objectives.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Noise from construction activities associated with the dredging of the new channel and construction of the sand dike, and the eventual resumption of routine channel maintenance by the USACE may temporarily affect dolphins that may be present around Bogue Inlet. This impact is expected to be minimal and temporary as dolphins can easily move to other areas outside of the influences from project construction noise.

Cumulative Effects. No cumulative impacts to dolphins are expected to occur from Preferred Alternative F.

Compatibility with Project Objectives. Dolphins are not directly associated with the stated project needs or objectives.

Intertidal Flats and Shoals

Alternatives A, B, and C would have the same impacts on intertidal flats and shoals as described below.

Direct and Indirect Impacts. The continued erosion of the Pointe area of Emerald Isle will convert upland areas to intertidal shoals and sand flats with the material eroded from the upland area being redistributed to the sound shoals and sand flats as well as to the outer portions of the Bogue Inlet ebb tide delta. Maintenance dredging of the inlet bar channel will continue to deposit material to the side of the channel while maintenance of the channel connecting Bogue Inlet with the AIWW will remove material from the inlet complex and deposit it on the extreme west end of Emerald Isle. The dredging activities may have some impact on the formation of new intertidal shoals and sand flats, particularly along the areas adjacent to the connecting channel.

Cumulative Effects. The shoal system of Bogue Inlet is very dynamic with areas being submerged during part of the year and well above mean high water at other times. Therefore, the continued erosion of western Emerald Isle and the maintenance dredging of the channel are not expected to result in any cumulative impacts to the intertidal flats.

Compatibility with Project Objectives. Conservation of existing intertidal flats and shoals will be accomplished under the no action alternative.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Construction of the new channel will result in the direct loss of 47.6 acres of subtidal shoals while construction of the sand dike would create 22.2 acres of shallow water and subtidal habitat. The stockpiling of the dredged material for eventual transfer to the existing channel would involve

22.8 acres of storage area on the Emerald Isle sand spit. The mechanical transfer of the stockpiled material from the Emerald Isle sand spit to the existing channel should eventually result in the creation of 127.5 acres of supratidal and subtidal habit as the new sand spit builds off the west end of Emerald Isle and merges with the sand dike. The new channel location will result in erosion of 7,500 feet of the western shoreline of Emerald Isle (approximate loss 17.9 acres) and accretion along the 7,500 feet of the eastern shoreline of Bear Island (approximate gain 33.2 acres). Over time, the subtidal and intertidal features will likely assume characteristics of the natural system.

Cumulative Effects. Cumulative effects to intertidal flats and shoals from the realignment of the inlet channel without beach nourishment are expected to be offset. The losses associated with the new channel should partially replace the sand dike and should eventually offset the development of the sand spit off the west end of Emerald Isle.

Compatibility with Project Objectives. Intertidal flats and shoal resources should be restored through the construction of the sand dike and filling of the existing channel either directly with the stockpiled material or indirectly by the development of the new sand spit off the west end of Emerald Isle. This alternative would satisfy the project objective to restore the 700 feet of inlet shoreline presently protected by sandbags.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. The construction of the new channel would remove 47.6 acres of subtidal shoals while the construction of the sand dike would partially restore 22.2 acres. The seaward portion of the existing channel should eventually fill with the influx of littoral sediment off the west end of Emerald Isle and the onshore movement of the abandoned ebb tide delta material, however, the time required for the existing channel to fill could range from 4 to 6 years. The gradual filling of the existing channel associated with the spit development should eventually create 127.5 acres of new supratidal and subtidal habitat. The new channel location will result in erosion of 7,500 feet of the western shoreline of Emerald Isle (approximate loss 17.9 acres) and accretion along the 7,500 feet of the eastern shoreline of Bear Island (approximate gain 33.2 acres).

Cumulative Effects. Because the intertidal sand flat system is projected to reach equilibrium rapidly, cumulative effects should be minimal from the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

5.5.2 **Beach Resources**

Supratidal Beach and Dune Communities

Alternatives A and B are expected to have the same impacts on supratidal beach and dune communities as described below.

Direct and Indirect Impacts. The continued eastward migration of the inlet channel and the associated erosion on the west end of Emerald Isle could result in extensive damage to supratidal beach and dune communities. Ocean shoreline erosion and the associated loss of supratidal beach and dune communities are also likely to continue on the eastern 7,500 feet of Bear Island.

Cumulative Effects. Dunes are important to the North Carolina coast by providing protection from large storm surges and hurricanes, in addition to providing habitat for flora and fauna. In some places along western Emerald Isle, dune ridges reach elevations of 4 to 5 m (13 to 16.4 ft) above NGVD. With the continuation of the eastern migration of the inlet channel over the next 10 years, beach and dune communities located up to 600 feet east of Bogue Inlet may be lost, resulting in less protection from hurricanes and less habitat for floral and faunal species. The potential for the reformation of beach and dune habitat along western Emerald Isle could not occur, as the area would be lost due to erosion and overwash. Losses would also continue on Bear Island as the east end of the island would become more exposed to wave attack with the eastward movement of the channel and ebb tide delta. Therefore, negative cumulative impacts to beach and dune communities on Bogue Banks and Bear Island could result from Alternatives A and B due to the extensive loss of a section of the essential dune ridge and the loss of the potential for formation of beach and dune communities in the area.

Compatibility with Project Objectives. The continuing loss of supratidal beach and dune communities associated with the eastward migration of the inlet shoreline would not preserve the tax base of the town and county as the loss of these communities would include the loss of homes, roads and associated infrastructure in the Pointe subdivision. The inlet habitat would continue to deteriorate and access to the inlet shoreline could not be restored to historic conditions. Material to nourish Phase 3 of the Emerald Isle beach nourishment project would be obtained from an offshore borrow area. As a result, the ocean front supratidal beach and dune communities may differ in character from the native setting due to a higher concentration of shell and shell hash in the offshore material.

Alternative C – Without Project - Sand Bag Revetments

Direct and Indirect Impacts. The construction of sand bag revetments to protect threatened homes and roads over the course of 10 years would tend to slow the

advance of the inlet shoreline to the east. Once the existing 700-foot long revetment protecting seven homes is removed, the shoreline should quickly erode resulting in the loss of those seven homes and threatening others located immediately to the east. A new line of sand bags would be constructed to protect the newly threatened homes, but again, this new line of sand bags can only remain in place, under North Carolina law, for 2 years after which they must be removed. This scenario would continue resulting in the loss of dune and supratidal habitat over the 10-year impact period. The use of interim sand bags to protect threatened structures should limit the shoreline migration to 360 feet compared to 600 feet for Alternatives A and B. The impacts on the supratidal beach and dune communities on Bear Island would be similar to Alternatives A and B as the eastward migration of the inlet channel and ebb tide delta would expose the east end of Bear Island to direct wave attack.

Cumulative Effects. Supratidal and dune habitat would likely be lost during the 10 year impact period; however, the magnitude of the loss would be somewhat less than Alternatives A and B. With the installation of the sand bag revetments, the eastward migration of the shoreline should be limited to around 360 feet compared to 600 feet projected for the no action alternative.

Compatibility with Project Objectives. The continuing loss of supratidal beach and dune communities associated with the eastward migration of the inlet shoreline would not preserve the tax base of the town and county as the loss of these communities would include the loss of homes, roads and associated infrastructure in the Pointe subdivision. The inlet habitat would continue to deteriorate and would be constantly disturbed by the construction and removal of the temporary sand bag revetments. Access to the inlet shoreline could not be restored to the extent desired by the Town as the shoreline would continue to migrate to the east albeit at a slower rate. Material to nourish Phase 3 of the Emerald Isle beach nourishment project would be obtained from an offshore borrow area which is known to contain higher concentrations of shell and shell hash. As a result, the ocean front supratidal beach and dune communities would differ if character from the native setting.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. The relocation of the inlet channel to a more central position between Bogue Banks and Bear Island combined with the construction of the sand dike and infilling of the existing channel with stockpiled dredged material should significantly reduce the erosion of the inlet shoreline and initiate a fairly rapid recovery of the inlet supratidal beach and dune communities along the 700 feet of inlet shoreline presently protected by sandbags. The nearly complete filling of the existing channel would hasten the development of the sand spit off the west end of Emerald Isle which should contribute to the restoration of the inlet habitat.

In this regard, the sand spit is expected to merge with the sand dike in about 2 years (see Appendix B). Material to nourish Phase 3 of the Emerald Isle beach nourishment project would be obtained from an offshore borrow area which is known to contain high concentrations of shell and shell hash. As a result, the ocean front supratidal beach and dune communities would differ in character from the native setting. Due to the financial constraints on the Town of Emerald Isle, construction of Phase 3 could be delayed for several years resulting in the continued loss of ocean front supratidal beach and dune communities during this interim period.

The shoreline erosion on the western 7,500 feet of Emerald Isle expected to accompany the relocation of the channel would result in the loss of existing supratidal beach and dune communities within this zone (approximate total loss 17.9 acres). Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. Shoreline adjustments on Bear Island associated with the new channel location should result in the creation of additional supratidal beach and dune communities (approximate gain 33.2 acres) along the eastern 7,500 feet of that island.

Cumulative Effects. The inlet shoreline should gradually take on natural characteristics as the sand spit builds into the inlet and merges with the sand dike. The wide dry sand beach that could be created west of the existing inlet shoreline, is expected to eventually reach approximately 127.5 acres, would provide ample quantities of wind blown sand to support the development of a dune system on the extreme western end of Emerald Isle. The gains in supratidal beach and dune communities would be partially offset by the erosion of similar communities along the western 7,500 feet of Emerald Isle (approximate loss 17.9 acres) as the shoreline adjust to the new channel location. The adjustments on the west end of Emerald Isle could take 10 years. Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. New supratidal beach and dune communities would also be created on the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres) as that shoreline would build seaward in response to the new channel location.

Compatibility with Project Objectives. Alternative E should significantly reduce erosion of the inlet shoreline for at least 15 years and possibly 35 years depending on migratory behavior of the new channel. As a result, Alternative E should provide protection to the seven homes presently threatened by the inlet shoreline erosion and should prevent the additional loss of homes and infrastructure thus preserving the tax base of the town and county for the foreseeable future. The

inlet shoreline habitat should eventually be restored to conditions existing in the mid 1970 to early 1980's which would allow the restoration of public access to the inlet shoreline to past conditions. Material removed to construct the new channel would be used to fill the existing channel, and would not be available for Phase 3 of the Emerald Isle beach nourishment project. Nourishment of Phase 3, which would be delayed for several years due to financial constraints on the Town of Emerald Isle, would be accomplished using offshore borrow areas. Material from the offshore borrow areas is known to contain higher concentrations of shell and shell hash. As a result, the ocean front supratidal beach and dune communities within Phase 3 of the Emerald Isle beach nourishment project may differ in character from the native setting.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. The relocation of the inlet channel to a more central position between Bogue Banks and Bear Island combined with the construction of the sand dike should significantly reduce the erosion of the inlet shoreline and initiate a fairly rapid recovery of the inlet supratidal beach and dune communities. The recovery of the inlet shoreline will not be as rapid as under Alternative E since most of the material removed to construct the new channel would be used to nourish Phase 3 of the Emerald Isle beach nourishment project. Therefore, filling of the existing channel would rely on the migration of the abandoned ebb tide delta and material eroded off the west end of Emerald Isle. The development of the sand spit off the west end of Emerald Isle should be rather substantial after four years and essentially complete after six years as the spit merges with the sand dike across the existing channel (see Appendix B). During this interim 4 to 6 year period, residual currents along the inlet shoreline could pose some erosion potential; therefore, the existing sand bag revetment should be allowed to remain for at least 2 years following the channel relocation. If the inlet shoreline recovers more rapidly, the sand bag revetment would be removed earlier.

The supratidal beach and dune communities located within Phase 3 of the Emerald Isle beach nourishment project would be restored using the highly compatible inlet material (see Appendix B) which should lead to the rapid recovery of the biological communities that are located within the supratidal beach and dune systems.

The shoreline adjustments on the western 7,500 feet of Emerald Isle expected to accompany the relocation of the channel may result in the loss of existing supratidal beach and dune communities within this zone (approximate total loss 17.9 acres). Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of connecting channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. Shoreline adjustments on Bear

Island associated with the new channel location should result in the creation of additional supratidal beach and dune communities (approximate gain 33.2 acres) along the eastern 7,500 feet of that island.

Cumulative Effects. The inlet shoreline should gradually take on natural characteristics as the sand spit builds into the inlet and merges with the sand dike. The wide dry sand beach that would be created west of the existing inlet shoreline would provide ample quantities of wind blown sand to support the development of a dune system on the extreme western end of Emerald Isle. The gains in supratidal beach and dune communities would be partially offset by the loss of similar communities along the western 7,500 feet of Emerald Isle (approximate loss 17.9 acres) as the shoreline adjusts to the new channel location. The adjustments on the west end of Emerald Isle could take 10 years. Inclusion of 3,000 feet of the affected shoreline on the west end of Emerald Isle in the Phase 3 beach nourishment project and the continued disposal of channel maintenance material on the extreme west end of Emerald Isle should partially offset these erosive impacts. New supratidal beach and dune communities should also be created on the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres) as that shoreline would likely build seaward in response to the new channel location. The use of the inlet material to construct the beach fill along the 23,831 feet of beach included in Phase 3 of the Emerald Isle beach nourishment project should result in the rapid recovery of the biological communities within the supratidal beach and dune system. As a result, full recovery of the biological communities should occur long before the initiation of the Federal storm damage reduction project.

Compatibility with Project Objectives. Preferred Alternative F should substantially reduce erosion of the inlet shoreline for at least 15 years and possibly 35 years depending on migratory behavior of the new channel. As a result, Preferred Alternative F would provide protection to the seven homes presently threatened by the inlet shoreline erosion and would prevent the additional loss of homes and infrastructure thus preserving the tax base of the town and county for the foreseeable future. The 700 feet of inlet shoreline presently protected by sandbags should eventually be restored to conditions existing in the mid 1970 to early 1980's which would allow the restoration of public access to the inlet shoreline to past conditions. Preferred Alternative F would also satisfy the objective of obtaining highly compatible material for nourishing Phase 3 of the Emerald Isle beach nourishment project which should enhance the recreational opportunities along the ocean shoreline. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Intertidal Beach

Alternatives A and B would have the same impact on the intertidal beach as described below.

Direct and Indirect Impacts. Phase 3 of the Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Nourishment of the beach will likely result in the burial of all intertidal infauna within the project area. The abundance and diversity of infauna could be low for a period of 12 months or longer which could negatively impact various shorebirds and waterbirds that feed on the infauna. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Once in place, the shell material tends to accumulate in the swash zone, i.e., the zone between mean low water and the crest of the beach berm. If concentrations are too high, beach use could be impacted due to the discomfort swimmers and other beach users encounter when walking across the shell deposits.

The intertidal beach along the inlet shoreline and at least 600 feet of ocean shoreline on the west end of Emerald Isle is predicted to be impacted by the eastward migration of the inlet channel and shoreline over the next 10 years.

Cumulative Effects. Phase 3 of the Emerald Isle beach nourishment project would be accomplished using offshore borrow areas. The offshore sand sources have been found to contain higher concentrations of shell and shell hash compared to the native beach materials. The higher shell content may or may not impact the recovery rate of the infauna that populate the intertidal beach, however, the concentration of shell near the waterline could negatively impact human beach use. The Phase 3 shoreline may eventually be included in a federal long-term storm damage reduction project which could be implemented sometime after 2008.

Compatibility with Project Objectives. Alternatives A and B would not provide highly compatible material for nourishing Phase 3 of the Emerald Isle beach nourishment project. The habitat along the inlet shoreline would be continually disturbed as the channel migrates to the east.

Alternative C – Without Project - Sand Bag Revetments

Direct and Indirect Impacts. Phase 3 of the Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Nourishment of the beach will likely result in the burial of all intertidal infauna within the project area. The abundance and diversity of infauna could be low for a period of 12 months or longer which could negatively impact various shorebirds and waterbirds that feed on the infauna. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Once in place, the shell material tends to accumulate in the swash zone, i.e., the zone between mean low water and the crest of the beach berm. If concentrations are too high, beach use could be impacted due to the discomfort swimmers and other beach users encounter when walking across the shell deposits.

The intertidal beach along the inlet shoreline and at least 360 feet of ocean shoreline on the west end of Emerald Isle is predicted to be impacted by the eastward migration of the inlet channel and shoreline over the next 10 years. Also, the installation of future sandbag revetments below the mean high water line will negatively impact the intertidal beach along the inlet shoreline.

Cumulative Effects. The cumulative impacts for Alternative C would be the similar to Alternatives A and B.

Compatibility with Project Objectives. Alternative C would not provide highly

compatible material for nourishing Phase 3 of the Emerald Isle beach nourishment project. The habitat along the inlet shoreline would be continually disturbed by the construction of sandbag revetments as the channel migrates to the east. The eastward migration of the inlet channel could also impact 360 feet of ocean shoreline over a 10-year period.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Phase 3 of the Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Once in place, the shell material tends to accumulated in the swash zone, i.e., the zone between mean low water and the crest of the beach berm. If concentrations are too high, human beach use could be impacted due to the discomfort swimmers and other beach users encounter when walking across the shell deposits.

Cumulative Effects. Alternative E would have similar cumulative impacts on the intertidal beach along the ocean shoreline as Alternatives A, B, and C.

Compatibility with Project Objectives. Alternative E would not provide highly compatible material for nourishing Phase 3 of the Emerald Isle beach nourishment project. The habitat along the inlet shoreline is predicted to be restored as a result of the direct filling of the existing channel and development of the sand spit off the west end of Emerald Isle

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Material derived from the relocation of the inlet channel is highly compatible with the native beach sands found along the 23,831 feet of beach included in Phase 3 of the Emerald Isle beach nourishment project. Even though the material is completely compatible, nourishment of the beach will likely result in the burial of all intertidal infauna within the project area. The abundance and diversity of infauna could be low for a period of 12 months which could negatively impact various shorebirds and waterbirds that feed on the infauna. Given the compatibility of the inlet material with the native sands, infauna should experience almost complete recovery within 12 months. The intertidal beach communities along the 700 feet of inlet shoreline presently protected by the sandbag revetment should also be positively impacted with the elimination of the inlet shoreline erosion and the relatively rapid development of the sand spit off the west end of Emerald Isle.

Cumulative Effects. The intertidal zone is widely used by birds and finfish as

foraging grounds. The use of the highly compatible inlet material to construct the Phase 3 beach fill should result in additional intertidal beach habitat and prey resources for foraging birds and finfish within 12 months following the completion of the beach nourishment. Since future beach nourishment in this area under a Federal storm damage reduction project would not occur for at least four and possibly 6 years, there should be no remaining effects of the Phase 3 nourishment project on the intertidal beach communities.

Compatibility with Project Objectives. The inlet channel material, having been derived from the adjacent beaches, in completely compatible with the native beach material found along the 23,831 feet of beach located within Phase 3 of the Emerald Isle each nourishment project (see Appendix B). Accordingly, Preferred Alternative F satisfies the project objective of obtaining compatible material for beach nourishment. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Nearshore Soft Bottom (Unconsolidated Sediment) Communities

Alternatives A, B, C, and E would have the same impacts on nearshore soft bottoms as described below.

Direct and Indirect Impacts. The unvegetated, oceanic nearshore soft bottom (unconsolidated sediment) communities located directly offshore of Emerald Isle may be directly and indirectly affected by the placement of fill material from offshore borrow sites along the 23,831 feet of ocean shoreline of Emerald Isle. Construction of the beach fill will result in the direct deposition of material from the toe of the dune seaward to approximately the 10-foot NGVD depth contour. Over time, the slope of the fill will adjust with material being transported seaward to approximately the 20-foot NGVD depth contour. Therefore, softbottom habitats located landward of the 20-foot NGVD depth contour will be directly or indirectly impacted by the construction of the beach fill. Offshore sediments may be higher in carbonate material (shells), which may inhibit the burrowing ability of soft bottom beach infauna. However, monitoring of Phase 1 of the Bogue Banks beach nourishment project, which was completed in 2001 with material from the offshore borrow areas and covered the shoreline from Pine Knoll Shores to Indian Beach, has shown almost complete recovery of the beach benthic communities.

Cumulative Effects. As a nourished beach area erodes over time, the fill material moves into adjacent aquatic habitats both near and offshore. Changes in the content of the sandy soft bottom habitat can affect the composition of the micro and macrofauna living within or on the sandy substrate. Changes to the benthic community in the soft bottom areas can have cumulative effects on the other organisms such as birds and fish that feed upon them. Therefore, changes in the

nearshore soft bottom communities may have cumulative effects on the food chain.

Compatibility with Project Objectives. Alternatives A, B, C, and E would nourish the Phase 3 shoreline with material from an offshore borrow area which has higher concentrations of shell and shell hash. Therefore, these alternatives do not completely satisfy the objective of nourishing Phase 3 with highly compatible material.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Channel relocation with beach nourishment involves the use of fill material dredged from the new inlet to construct a sand dike across the existing channel and to nourish 23,831 feet of the Emerald Isle ocean shoreline. Construction of the beach fill will involve the direct disposal of material from the toe of the dune seaward to approximately the 10-foot NGVD depth contour. Over time, the slope of the fill will adjust with material being transported seaward to approximately the 20-foot NGVD depth contour. Therefore, softbottom habitats located landward of the 20-foot NGVD depth contour will be directly or indirectly impacted by the construction of the beach fill.

Cumulative Effects. Comparison of the fill material and the native beach on Emerald Isle indicate that the fill material is slightly coarser but otherwise compatible with the natural beach (see Appendix B). A study by Van Dolah et al. (1994) found that the use of fill sediments that closely matched the native sediments showed an ecological recovery of infaunal species within 8 months. Thus, the use of inlet sediment, which closely approximates the composition of the natural sediment on Emerald Isle, should prevent any negative cumulative impacts to the nearshore soft bottom communities due to differences in sediment composition. Construction of the new channel could alter the sediment transport patterns, and thus, may affect the areas of erosion and accretion. The eventual accretion along Bear Island is expected which would lead to a loss of existing nearshore soft bottom habitat, however, due to the relatively slow rate of accretion, new softbottom habitats should evolve as the shoreline builds seaward. The western 7,500 feet of Emerald Isle is expected to erode in response to the new channel location, however, this should not negatively impact the nearshore softbottom communities.

Compatibility with Project Objectives. The channel relocation with beach nourishment alternative is compatible with the project objectives.

Offshore Soft Bottom (Unconsolidated Sediment) Communities

Alternatives A, B, C, and E would have the same impacts on offshore soft bottom

communities as described below.

Direct and Indirect Impacts. The placement of the beach fill along the 23,831 feet of shoreline included in Phase 3 of the Emerald Isle beach nourishment project will probably only directly or indirectly impact softbottom resources located landward of the 20-foot NGVD depth contour. However, some of the material could eventually move farther seaward, particularly during severe storm events. The use of offshore borrow areas would directly impact softbottom communities within the borrow sites. In this regard, permits for the use of the offshore borrow areas limit the depth of the dredge cut to 4 feet. In order to obtain the 913,400 cubic yards needed to construct Phase 3, approximately 141.5 acres of ocean bottom lying off the west end of Emerald Isle would be directly disturbed by the dredging activity. Increased turbidity and sedimentation due to dredging may also indirectly affect other soft bottom communities in areas located near the borrow sites by burying organisms or affecting their ability to filter feed.

Cumulative Effects. A study conducted in 2001 by Rakocinski noted that the offshore soft bottom community, in Perdido Key, Florida, is less resilient to dredge and fill projects than those near shore. A decrease in density and species richness was noted during the study. Thus, it is possible that similar conclusions may result with the offshore dredging. In addition, changes to the soft bottom community may be realized by vertebrate consumers higher in the food chain.

Compatibility with Project Objectives. The material obtained from the offshore borrow areas contains higher concentrations of shell and shell hash than the native beach material. The shell material may accumulate along the intertidal zone of the beach which could impact human beach use. Therefore, Alternatives A, B, C, and E would not satisfy the project objectives to obtain high quality beach nourishment material for Phase 3.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Channel relocation with beach nourishment involves the use of dredged material from Bogue Inlet as beach fill which would avoid the direct disturbance of approximately 141.5 acres of offshore softbottom communities. The impacts associated with the direct placement and eventual offshore transport of material from the beach fill area would be similar to the other alternatives.

Cumulative Effects. No cumulative effects to offshore soft bottom resources are expected to result from the implementation of the channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. The channel relocation with beach

nourishment alternative is compatible with the project objectives.

Benthic Infaunal Community

Alternatives A, B, C, and E would have similar impacts on the ocean beach benthic infaunal community as described below.

Direct and Indirect Impacts. Phase 3 of the Emerald Isle beach nourishment project would be accomplished using material from offshore borrow areas. Most of the material in the offshore borrow areas has a relatively high shell content and it is unlikely that selective dredging of the borrow areas could substantially reduce the shell content along the nourished beach. Disposal of the material along the beach would directly cover the area from the toe of the exiting dune seaward to a depth of approximately 10 feet below NGVD. The thickness of the fill would range from a maximum of about 6 feet near the existing 0-foot NGVD contour and decrease to 0 at the -10-foot NGVD contour. Following the initial placement, the fill material will gradually adjust with some of the material migrating to approximately the 20-foot NGVD depth contour on the active beach profile. The initial disposal would likely have a direct negative impact on benthic communities located in the nearshore placement area; however, monitoring of Phase 1 of the Bogue Banks beach nourishment project, which was completed in 2001 with material from the offshore borrow areas and covered the shoreline from Pine Knoll Shores to Indian Beach, has shown almost complete recovery of the beach benthic infaunal communities. The offshore migration of the fill material following the initial placement should be slow enough to allow the benthic communities to adapt to the new material.

Cumulative Effects. The offshore migration of the beach fill material should occur within the first 6 months following placement resulting in no long-lasting impacts on the benthic communities. The benthic communities impacted by the Phase 3 fill should be fully recovered by the time the Federal storm damage reduction project is initiated except in the case of Alternative E which could involve the construction of Phase 3 in 2007-2008. Physical disturbances, such as, fishing with bottom-dwelling gear, deposition of organics onto the community (Thompson et al., 1999), changes in dissolved oxygen content, high water temperatures, decrease in food supply, and stagnant water conditions can alter benthic infaunal communities. Alternatives A, B, C, and E are not expected to alter any of the conditions affecting the beach resource benthic community and thus, no cumulative impacts are anticipated.

Compatibility with Project Objectives. The material from the offshore borrow areas, which contains higher concentrations of shell and shell hash compared to that of the native beach material, does not completely satisfy the objective to provide high quality beach nourishment material.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Both direct and indirect impacts to the beach benthic infaunal resources are expected from beach nourishment activities. The project will likely result in mortality of individuals located in the beach nourishment area. While the inlet material is highly compatible with the native beach material found along the 23,831 feet of shoreline included in Phase 3 of the Emerald Isle beach nourishment project, the direct impacts on the benthic communities would be the same as Alternatives A, B, C, and E. Since the inlet material is essentially of the same quality as the native beach, the recovery time for the benthic infaunal communities could be slightly less than that associated with the offshore borrow material.

Cumulative Effects. The offshore migration of the beach fill material should occur within the first 6 months following placement resulting in no long-lasting impacts on the benthic communities. The benthic communities impacted by the Phase 3 fill should be fully recovered by the time the Federal storm damage reduction project is initiated.

Compatibility with Project Objectives. The use of the inlet material to construct Phase 3 would satisfy the project objective of using compatible beach material to nourish the 23,831 feet of shoreline. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

Finfish (Beach Resources)

Alternatives A, B, and C would have the same impacts on ocean finfish as described below.

Direct and Indirect Impacts. The nourishment of Phase 3 of the Emerald Isle beach nourishment project using the offshore borrow areas would result in temporary periods of increased turbidity in the immediate disposal area. Typically, high turbidity diminishes within one to two tidal cycles once the dredge pipe moves to another disposal location. The increased turbidity in the immediate disposal zone could impact the ability of finfish to see prey. More than likely, finfish will migrate out of the high turbidity zone so no significant impacts are expected.

Cumulative Effects. No cumulative impacts to finfish from Alternatives A, B, and C are anticipated.

Compatibility with Project Objectives. Alternatives A, B, and C do not satisfy the objective of acquiring high quality material for beach nourishment.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Construction activities should be contained centrally in the Inlet, and thus, finfish residing in areas close to shore just seaward of the inlet are expected to only be minimally impacted by the channel relocation, sand dike construction, and filling of the existing channel with stockpiled material. The turbidity and suspended sediment plume generated from the project is predicted to be contained between the confluence of the inlet bar channel and Eastern Channel and the seaward edge of the existing inlet bar channel (see Appendix B) and should not impact finfish in the nearshore intertidal areas near the inlet due to the low turbidity levels and low concentrations of suspended sediment.

Nourishment of Phase 3 of the Emerald Isle beach nourishment project using offshore borrow material would have the same impacts as described for Alternatives A, B, and C.

Cumulative Effects. No cumulative impacts to finfish should result from Alternative E.

Compatibility with Project Objectives. The channel relocation without beach nourishment alternative does not satisfy the objective of acquiring high quality material for beach nourishment.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Construction activities should be contained centrally in the Inlet, and thus, finfish residing in areas close to shore just seaward of the inlet are expected to only be minimally impacted by the channel relocation and sand dike construction. The turbidity and suspended sediment plume generated from the project is predicted to be contained between the confluence of the inlet bar channel and Eastern Channel and the seaward edge of the existing inlet bar channel (see Appendix B) and should not impact finfish in the nearshore intertidal areas near the inlet due to the low turbidity levels and low concentrations of suspended sediment.

In the beach nourishment area turbidity levels should be low due to the low silt content of the inlet material. However, some increase in turbidity in the immediate disposal area is to be expected.

Cumulative Effects. Cumulative impacts to finfish from this alternative should not occur.

Compatibility with Project Objectives. The inlet material is highly compatible with the native beach sand located within Phase 3 of the Emerald Isle beach nourishment project. This alternative fully supports the project objectives as established by the Town of Emerald Isle.

5.6 **TURTLE RESOURCES**

5.6.1 **Diamondback Terrapin**

Alternatives A, B, C, E, and F would have the same impacts on diamondback terrapin as described below.

Direct and Indirect Impacts. The Carolina diamondback terrapin (*Malaclemys terrapin centrata*) is commonly found within the inshore waters of North Carolina. During the winter months, Carolina diamondback terrapins hibernate in the muddy

burrows along the embankments of tidal creeks. They remain buried until mid to late February when they emerge to mate (K. Hart, pers. comm.). Twenty-five to thirty-five diamondback terrapins have been documented in the project area during an unknown period of time (K. Hart, pers. Comm.). Therefore it is possible that direct and indirect impacts to diamondback terrapins could occur since the diamondback terrapins may be found in the inlet water column in mid February which coincides with the time of project construction activities.

Cumulative Effects. No cumulative effects to terrapins should result from Alternatives A, B, C, E, and F.

Compatibility with Project Objectives. Diamondback terrapins have been documented in the project area in the past and thus may be present during the time of project activities or regular maintenance dredging. Monitoring of terrapin activity in the area during project dredging should prevent contact with any turtles found close to the dredge. Due to the possible contact with turtles in the project area alternatives A, B, C, E, and F are not completely consistent with the project objectives.

5.6.2 **Nearshore Sea Turtle Habitat**

Alternatives A, B, and C would have the same impact on sea turtle nesting habitat along the ocean beach as described below.

Direct and Indirect Impacts. Erosion of the ocean beach on the west end of Emerald Isle due to the eastward migration of the inlet channel is likely to continue resulting in the erosion of 600 feet of ocean shoreline in the case of Alternatives A and B and 360 feet of ocean shoreline for Alternative C. The loss of these relatively small areas as potential sea turtle nesting habitat would not have any significant impact on the sustainability of the species.

Nourishment of Phase 3 of the Emerald Isle beach nourishment project would be accomplished using offshore borrow areas. Beach nourishment operations for Bogue Banks completed in 2001 and 2002 included the use of hopper dredges which resulted in the taking of several turtles even though the operations were carried out during times when turtles are not normally present. The risk of additional turtle takes could continue if hopper dredges are used in the offshore borrow areas.

The construction of a beach fill with material that has characteristics different from that of the native material can result in differences in compaction, water content, gas diffusion, and thermal properties which can negatively impact the embryonic development of hatchling sea turtles. The material obtained from the offshore borrow areas contain higher concentrations of shell than the native beach. An

increase in shell hash may alter characteristics of the natural beach which could possibly result in differences in compaction, moisture, gas diffusion and temperature within the nest. Changes in these variables have negative impacts on hatching success (Ernest and Martin, 1999; Steinitz et al., 1998). Therefore the material obtained from the offshore borrow area may effect hatchling success. A better understanding of material impacts on nesting and nesting success is needed before a definitive conclusion can be made.

A major concern with any beach nourishment project is the potential for scarp formation. With regard to the potential for scarp formation, the design template for Phase 3 includes a maximum berm elevation of 7.0 feet above NGVD which is the same as the natural beach along Bogue Banks. Monitoring of the physical performance of the previous fills along Bogue Banks, which also had a maximum berm elevation of 7.0 feet NGVD, has not detected a high propensity for scarp development. The same type of behavior would be expected for the Phase 3 fill.

The construction of the Phase 3 fill with offshore borrow material would provide a relatively wide beach that would be suitable for turtle nesting. However, the condition of the beach within the Phase 3 nourishment area is not so degraded as to prevent turtle nesting; therefore, the additional beach width should only have a minimal positive impact on turtle nesting along Bogue Banks.

Cumulative Impacts. If the inlet channel continues to migrate to the east over the next 10 years, 600 feet of ocean shoreline would be lost to erosion under Alternatives A and B and approximately 360 feet under Alternative C. The loss of these relatively small areas is not expected to have a significant impact of the sustainability of the species. Erosion is also expected to continue on the eastern 7,500 feet of Bear Island. If this erosion results in the formation of erosion scarps, turtle nesting could be negatively impacted in this localized area.

The offshore borrow material contains higher concentrations of shell and shell hash, however, 22 turtle nests have been document on Emerald Isle during the 2003 nesting season with many of the nests located in the recently nourished section of Emerald Isle. Shell material may negatively impact beach use, however, studies of the impact of the material on turtle nesting have not been completed; therefore, no definitive conclusion can be made regarding the effects of the material on turtles.

Compatibility with Project Objectives. The offshore borrow material used for Phase 1 and 2 of the Bogue Banks beach nourishment project, which would also be used to construct Phase 3 under Alternatives A, B, and C, contain higher concentrations of shell and shell hash that tends to accumulate on the foreshore of the beach between mean low water and mean high water. While the shell material may negatively impact beach use, studies of the impact of the material on turtle nesting

have not been completed, therefore, no definitive conclusion can be made regarding the effects of the material on turtles.

Direct and Indirect Impacts. Alternative E is predicted to cause erosion along the western 7,500 feet of Emerald Isle and accretion along the eastern 7,500 feet of Bear Island. If the predicted erosion along the west end of Emerald Isle (approximate loss 17.9 acres) is accompanied by vertical erosion scarps, turtle nesting in this localized area could be impacted. However, given the low density of turtle nest along Bogue Banks, the erosion of this localized area is not expected to significantly impact turtle nesting success. The predicted accretion on Bear Island (approximate gain 33.2 acres) could have a positive impact on turtle nesting by eliminating vertical erosion scarps along the eastern 7,500 feet of this island.

Direct and indirect impacts of Alterative E, which would also involve the use of offshore borrow areas to construct the Phase 3 beach fill, would be the same as that described for Alternatives A, B, and C.

Cumulative Impacts. The cumulative impacts of Alternative E on sea turtle nesting habitat would be similar to Alternatives A, B, and C.

Compatibility with Project Objectives. The offshore borrow material used for Phase 1 and 2 of the Bogue Banks beach nourishment project, which would also be used to construct Phase 3, contain higher concentrations of shell and shell hash that tends to accumulate on the foreshore of the beach between mean low water and mean high water. While the shell material may negatively impact beach use, studies of the impact of the material on turtle nesting have not been completed; therefore, no definitive conclusion can be made regarding the effects of the material on turtles.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. The material dredged from Bogue Inlet and deposited directly along the Phase 3 shoreline is slightly coarser but otherwise compatible with the native beach material. The inlet material has a low shell content (less than 5%) and a low silt content (1.25%). Following a period of adjustment that could last 6 months, the beach within Phase 3 should be indistinguishable from the native beach. Therefore, turtles should use this beach in much the same manner as they use other areas along Bogue Banks. The use of a cutter-suction pipeline dredge to construct the new channel combined with the winter to early spring construction period should greatly reduce the possibility of turtle takes.

Cumulative Impacts. The construction of the Phase 3 fill with the inlet channel material would provide a relative wide beach that would be suitable for turtle nesting. However, the condition of the beach within the Phase 3 nourishment area

is not so degraded as to prevent turtle nesting; therefore, the additional beach width should only have a minimal impact on turtle nesting along Bogue Banks. Erosion of the western 7,500 feet of Emerald Isle could negatively impact sea turtle nesting (approximate loss 17.9 acres), particularly if the erosion is accompanied by vertical scarps; however, this should be offset by the accretion of the eastern 7,500 feet of ocean shoreline on Bear Island (approximate gain 33.2 acres). The erosive impacts on the west end of Emerald Isle associated with the channel relocation would be partially offset by the inclusion of the eastern 3,000 feet of the beach impact area in the Phase 3 beach nourishment project and the continued disposal of navigation maintenance material on the extreme west end of Emerald Isle.

Compatibility with Project Objectives. The inlet channel material that would be used to construct the Phase 3 fill would be compatible with the native material and should provide suitable nesting habitat for turtles.

5.6.3 **Offshore Sea Turtle Habitat**

Alternatives A, B, C, and E would have the same impact on offshore sea turtle habitat as described below.

Direct and Indirect Impacts. The use of offshore borrow areas would disturb approximately 141.5 acres of ocean bottom. While construction would occur during the winter and early spring, past operations during these same seasons have resulted in turtle takes which delayed the dredging operation or resulted in its cessation. The use of the offshore borrow areas to construct the Phase 3 would experience the same risks.

Cumulative Effects. Dredging in the offshore borrow areas is limited to a maximum depth of cut of 4 feet. This rather shallow cut should result in the rapid recovery of the area, however, the recovery time could still take 1 to 2 years. This could impact food sources used by turtles.

Compatibility with Project Objectives. Offshore sea turtle resources are outside the scope of the project objectives.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Preferred Alternative F would avoid the disturbance of 141.5 acres of offshore turtle habitat. Construction activities will be restricted to the middle of Bogue Inlet and along western Emerald Isle. Therefore, impacts to offshore sea turtle habitats are not expected from dredging activities.

Cumulative Effects. No cumulative impacts are predicted to occur from the

channel relocation with beach nourishment alternative.

Compatibility with Project Objectives. Although offshore sea turtle resources are outside the scope of the project objectives, the use of the inlet material for beach nourishment would preserve offshore sea turtle habitat.

5.7 **RESIDENT AND MIGRATORY BIRD RESOURCES**

5.7.1 **Shorebirds**

Alternatives A, B, and C would have the same impacts on shorebirds as described below.

Direct and Indirect Impacts. Erosion of the Emerald Isle Inlet shoreline, including the sand spit north of the Pointe subdivision and southern Dudley Island could potentially result in the loss of foraging, roosting, and nesting habitat. However, inlets are typically dynamic environments that are subjected to a continual state of change to which shorebirds can readily adapt. Erosion in one section of Emerald Isle is offset by accretion in other areas and birds will move within the inlet complex in response to these changes. For example, with the erosion on the western end of Emerald Isle, there is also accretion on the beach east of the sandbags and the development of the large spit at The Point. Therefore, the continuation of the inlet shoreline erosion associated with Alternatives A, B, and C should not result in any significant impact on shorebirds.

Nourishment of Phase 3 of the Emerald Isle beach nourishment project would be accomplished using offshore borrow areas which may change the character of the beach. Erosion of the eastern 7,500 feet of Bear Island could also continue resulting in the loss of shorebird habitat on this island.

Cumulative Effects. If erosion of the inlet shoreline continues over a period of 10 years, the character of the inlet shoreline is predicted to change with the loss of upland areas in the Pointe subdivision, erosion of ocean beach resources along the west end of Emerald Isle, and the possible evolution of the Emerald Isle sand spit to an overwash terrace. Since these changes occur in most natural inlet systems, they should not have a significant impact on shorebirds or shorebird habitat. Erosion of the east end of Bear Island could also result in the loss of shorebird habitat.

Compatibility with Project Objectives. Alternatives A, B, and C do not address the project objectives, however, no significant negative impacts on shorebirds are expected.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. The realignment of the channel to a central location may remove some of the inlet shorebird's prey base from the intertidal flats and shoals of the inlet. Also, following a brief respite period associated with the development of the sand spit off the west end of Emerald Isle, erosion of the south shoreline of Dudley Island is likely to continue. The stockpiling of the channel

material on the Emerald Isle sand spit will temporarily disturb foraging, resting, and loafing areas. However, infauna should recruit and repopulate from undisturbed areas within 1 to 2 years. Construction of the sand dike and filling of the existing channel will immediately replace a portion of the lost resting and loafing habitat used by shorebirds, and this area will be available for foraging activities once benthic infaunal populations have recolonized the area. In addition, construction activities and noise associated with these activities may disturb shorebirds by causing them to spend more time being alert than foraging and resting.

Shoreline adjustments that would accompany the relocation of the inlet channel could result in erosion along the western 7,500 feet of Emerald Isle (approximate loss 17.9 acres) and accretion along the eastern 7,500 feet of Bear Island (approximate gain 33.2 acres). The erosive impacts of relocating the channel on the west end of Emerald Isle would be partially offset by the inclusion of the eastern 3,000 feet of the shoreline impact in the Phase 3 beach nourishment project and the continued disposal of navigation maintenance material on the extreme west end of Emerald Isle. The predicted shoreline adjustments should result in no net change in shorebird habitat.

The restoration of the inlet shoreline that is predicted to occur due to the filling of the existing channel and the formation of the sand spit off the west end of Emerald Isle would reestablish public access to the inlet shoreline to a condition that existed in the past. An increase in pedestrian and vehicular access to the inlet shoreline, particularly during nesting season, could negatively impact shorebirds.

Cumulative Effects. Sand dike construction and the filling of the existing channel are predicted to lead to the formation of supratidal and intertidal habitat. The newly established habitat can be used by shorebirds for foraging, nesting, and roosting. Once the sand dike has been constructed and the existing channel filled, access to isolated inlet shorebird habitats will be established which could increase the potential for predator and human affects to inlet shorebird resources. Implementation of an effective bird management plan should offset most of the negative impacts due to increased access.

Erosion of the western 7,500 feet of Emerald Isle should occur over at least a 10-year period which could impact shorebird resources in this area (approximate loss 17.9 acres). This erosive impact will be partially offset by the construction of Phase 3 of the Emerald Isle beach nourishment project which will include the eastern 3,000 feet of the shoreline impact area. Accretion of the 7,500 feet of shoreline on the east end of Bear Island over a similar 10-year period should provide additional shorebird habitat (approximate gain 33.2 acres).

Compatibility with Project Objectives. The channel relocation without beach nourishment alternative supports all of the objectives of the project except the

provision of highly compatible beach nourishment material for Phase 3 of the Emerald Isle beach nourishment project.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Intertidal sand flats are typically found in Bogue Inlet and are commonly used by shorebirds. These shoals are part of a dynamic system that shorebirds have adapted their behaviors to use. The realignment of the channel to a central location may remove some of the inlet shorebird's prey base from the intertidal flats and shoals of the inlet. However, infauna should recruit and repopulate from undisturbed areas within 1 to 2 years. Construction of the sand dike could immediately replace a portion of the lost resting and loafing habitat used by shorebirds, and this area could be available for foraging activities once benthic infaunal populations have recolonized the area. In addition, construction activities and noise associated with these activities may disturb shorebirds by causing them to spend more time being alert than foraging and resting.

Erosion of the western 7,500 feet of Emerald Isle could occur over at least a 10-year period which could impact shorebird resources in this area (approximate loss 17.9 acres). This erosive impact should be partially offset by the construction of Phase 3 of the Emerald Isle beach nourishment project which will include the eastern 3,000 feet of the shoreline impact area. Accretion of the 7,500 feet of shoreline on the east end of Bear Island over a similar 10-year period should provide additional shorebird habitat (approximate gain 33.2 acres).

The restoration of the inlet shoreline that is predicted to occur due to the filling of the construction of the sand dike and the formation of the sand spit off the west end of Emerald Isle should reestablish public access to the inlet shoreline to a condition that existed in the past. An increase in pedestrian and vehicular access to the inlet shoreline, particularly during nesting season, could negatively impact shorebirds. However, a bird management plan is currently being developed to provide additional protection. This plan is expected to minimize any impacts that may occur. Additionally, bird monitoring will continue for three years post-construction to monitor the status of the birds.

Cumulative Effects. Sand dike construction is predicted to lead to the formation of intertidal habitat as the existing channel fills in and equilibration occurs. The newly established habitat could be used by shorebirds for foraging, nesting, and roosting. Once the sand dike has been constructed, access to isolated inlet shorebird habitats will be established which could increase the potential for predator and human affects to inlet shorebird resources. Implementation of an effective bird management plan should offset most of the negative impacts resulting from increased access.

The beach habitat created from the immediate beach nourishment should provide additional habitat for shorebirds and thus, positive cumulative impacts may result. Furthermore, the expected accretion along Bear Island should also provide

additional habitat for shorebird resources, however, gains on Bear Island could be offset by similar losses on the west end of Emerald Isle. Some of the predicted shoreline losses on the west end of Emerald Isle would be offset by the inclusion of the eastern 3,000 feet of the shoreline impact area in the Phase 3 beach nourishment project.

Compatibility with Project Objectives. The channel relocation with beach nourishment alternative supports the objectives of the project.

5.7.2 **Colonial Waterbirds**

Alternatives A, B, and C are expected to have the same impact on colonial waterbirds as described below.

Direct and Indirect Impacts. Colonial waterbirds are known to congregate and forage in areas of western Emerald Isle and throughout the permit area. Under Alternatives A, B, and C, the inlet area is expected to continue to evolve with the loss of some areas, such as the existing Emerald Isle sand spit, that would be replaced by the natural formation of other upland or supratidal areas within the inlet complex. Ocean shoreline habitat will also likely be lost to erosion, however, colonial waterbirds should be able to adapt to these changing conditions and utilize alternative sites. As a result, no direct or indirect negative impacts on colonial waterbirds are expected from Alternatives A, B, and C.

Cumulative Effects. The continued evolution of the inlet environment expected to accompany Alternatives A, B, and C and the erosion of Bear Island are not expected to have any negative cumulative impacts on colonial waterbirds

Compatibility with Project Objectives. Alternatives A, B, and C do not address most of the stated project objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Colonial waterbirds are known to congregate in large colonies on the intertidal flats of Bogue Inlet, including Islands Nos. 1 and 2. With the relocation of the channel to a central location, loss of intertidal flat resources will occur. For example, Island No.1, which is a marginal ebb channel shoal, will likely disappear from its present location but be reformed adjacent to the relocated channel. The shoal system of Bogue Inlet is dynamic and the loss and reformation of sand flats is a common occurrence. Temporary direct impacts to colonial waterbirds may result from disturbance to individuals during construction activities which may result in the waterbirds spending more time being alert than foraging.

Most colonial waterbirds feed mainly on finfish and not on benthic infauna as shorebirds do. Temporary and minimal impacts to finfish are expected with the loss of infaunal prey of finfish being restricted to the immediate channel area and dike construction area. With decreases in finfish being localized in the channel and dike construction areas, colonial waterbirds can easily move to other suitable areas around Bogue Inlet, such as marsh habitats, to forage.

Stockpiling of the 809,500 cubic yards of material on the Emerald Isle sand spit may have direct and indirect impacts to colonial waterbirds by burying roosting habitat and smothering the infaunal community which is fed upon by finfish (most colonial waterbird's prey). The removal of the stockpiled material and deposition of the material in the existing channel could create nesting and roosting habitat for colonial waterbirds and return finfish numbers to normal levels as benthic infauna move in from adjacent areas.

The west end of Emerald Isle is expected to erode in response to the new channel location, however, these negative impacts on colonial waterbirds should be offset by accretion on the east end of Bear Island.

Cumulative Effects. Construction of the sand dike and the filling of the existing channel with the stockpiled material should result in the rapid transition of these areas to subtidal, intertidal, or supratidal habitats which should provide suitable nesting, roosting, and foraging habitat for colonial waterbirds. The restoration of the inlet shoreline that is predicted to occur due to the filling of the existing channel and the formation of the sand spit off the west end of Emerald Isle would reestablish public access to the inlet shoreline to a condition that existed in the past. An increase in pedestrian and vehicular access to the inlet shoreline, particularly during nesting season, could negatively impact colonial waterbirds. Implementation of an effective bird management plan should offset most of the negative impacts due to increased access.

The erosion of the west end of Emerald Isle (approximate loss 17.9 acres) and accretion on the east end of Bear Island (approximate gain 33.2 acres) will tend to have offsetting impacts on colonial waterbirds. The predicted erosion on the western 7,500 feet of Emerald Isle could be partially offset by the inclusion of the eastern 3,000 feet of the shoreline impact area in the Phase 3 beach nourishment project.

Compatibility with Project Objectives. The channel relocation without beach nourishment alternative satisfies all project objectives as they relate to inlet resources and the protection of upland properties. With this alternative, the Town of Emerald Isle will still be required to finance and implement the Phase 3 beach nourishment project using an offshore sand source.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Colonial waterbirds are known to congregate in large colonies on the intertidal flats of Bogue Inlet, including Islands Nos. 1 and 2. With the relocation of the channel to a central location, loss of intertidal flat resources will occur. For example, Island No.1, which is a marginal ebb channel shoal, will likely disappear from its present location but be reformed adjacent to the relocated channel. The shoal system of Bogue Inlet is dynamic and the loss and reformation of sand flats is a common occurrence. Temporary direct impacts to colonial waterbirds may result from disturbance to individuals during construction activities which may result in the waterbirds spending more time being alert than foraging.

Other impacts may come from a decrease in finfish numbers as a loss of benthic infauna from the intertidal flats may result due to the relocation of the sand from and intertidal / subtidal location to subtidal / supratidal condition at the sand dike. Long-term effects to benthic infaunal prey species is not expected to result from project construction as these species have been shown to repopulate disturbed habitats quickly, and thus, long-term effects to colonial waterbird prey (finfish) species are not expected.

The erosion of the west end of Emerald Isle (approximate loss 17.9 acres) and accretion on the east end of Bear Island could tend to have offsetting impacts on colonial waterbirds (approximate gain 33.2 acres). The predicted erosion on the western 7,500 feet of Emerald Isle should be partially offset by the inclusion of the eastern 3,000 feet of the shoreline impact area in the Phase 3 beach nourishment project.

Cumulative Effects. Construction of the sand dike is predicted to result in the equilibration and filling of the abandoned channel and transition of the subtidal resources to intertidal or supratidal habitats depending upon location which should provide additional habitat for inlet colonial waterbirds. In addition, the dynamic shoal system will likely reform sand flats that waterbirds can use for foraging, nesting, and related activities which should result in positive cumulative impacts for colonial waterbirds.

The restoration of the inlet shoreline that is predicted to occur due to the filling of the existing channel and the formation of the sand spit off the west end of Emerald Isle would reestablish public access to the inlet shoreline to a condition that existed historically. An increase in pedestrian and vehicular access to the inlet shoreline, particularly during nesting season, could negatively impact colonial waterbirds. Implementation of an effective bird management plan should offset most of the negative impacts due to increased access.

Compatibility with Project Objectives. This alternative is compatible with all of the

project objectives.

5.7.3 **Other Waterbirds**

Alternatives A, B, and C are expected to have the same impact on other waterbirds as described below.

Direct and Indirect Impacts. Inlet habitats, such as western Emerald Isle are utilized by other species of waterbirds, such as loons, mergansers, and ospreys, as foraging and roosting grounds. Under Alternatives A, B, and C, the inlet area is expected to continue to evolve with the loss of some areas, such as the existing Emerald Isle sand spit, that would be replace by the natural formation of other upland or supratidal areas within the inlet complex. Alternatives A, B, and C will likely cause the loss of potential roosting and foraging habitat on west end of Emerald Isle as inlet shoreline continues to migrate to the east. Losses of habitat could also continue to occur with erosion of the east end of Bear Island. Most of these species have adapted to using a variety of inlet ocean habitats and should find acceptable alternative sites. Many species, such as rails, will utilize marsh habitat around the Inlet. As a result, no direct or indirect negative impacts on other waterbirds are expected from Alternatives A, B, and C.

Cumulative Effects. The continued evolution of the inlet environment expected to accompany Alternatives A, B, and C are not expected to have any negative cumulative impacts on other waterbirds.

Compatibility with Project Objectives. Alternatives A, B, and C do not support the project objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. The realignment of the channel to a central location may decrease the levels of other waterbird's prey base (finfish) from areas near the intertidal flats and shoals of the inlet due to the possible removal of benthic infauna on which finfish forage. However, infauna should recruit and repopulate from undisturbed areas within 1 to 2 years and thus, decrease in finfish levels should be short-term. Construction of the sand dike and filling of the existing channel could immediately replace a portion of the lost resting and loafing habitat used by waterbirds, and this area will be available for foraging activities once benthic infaunal populations (and finfish) have recolonized the area. In addition, construction equipment and activities may disturb waterbirds by causing them to spend more time being alert than foraging and resting. However, other areas around Bogue Inlet, away from direct influences of construction activities, are preferred by other waterbirds. For example, other waterbirds, such as rails, prefer marsh habitats as foraging and roosting grounds as these areas can provide significant amounts of prey resources which should result in temporary and minimal direct and indirect impacts to other waterbirds.

Stockpiling of the 809,500 cubic yards of material on the Emerald Isle sand spit is not expected to have direct or indirect impacts to other waterbirds since the waterbirds primarily utilize areas outside of beach habitats (ie., inlet and marsh habitats) for foraging and loafing sites.

The use of offshore borrow material to construct the Phase 3 beach fill should not have a significant impact on other waterbirds.

Cumulative Effects. Sand dike construction and the filling of the existing channel with the stockpiled material are predicted to lead to the formation of intertidal habitat. The newly established habitat could be used by other waterbirds for foraging, nesting, and roosting. Once the sand dike has been constructed and the existing channel filled, access to the isolated inlet shorebird habitats will be established which could increase the potential for predator and human affects to inlet shorebird resources. Implementation of an effective bird management plan should offset most of the negative impacts due to increased access.

Compatibility with Project Objectives. The channel relocation without beach nourishment alternative supports the objectives of the project.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Intertidal sand flats are typically found in Bogue Inlet and are commonly used by other waterbirds. These shoals are part of a dynamic system that waterbirds have adapted their behaviors to use. The realignment of the channel to a central location may decrease the levels of other waterbird's prey base (finfish) from areas near the intertidal flats and shoals of the inlet due to the possibly removal of benthic infauna on which finfish forage. However, infauna should recruit and repopulate from undisturbed areas within 1 to 2 years and thus, decrease in finfish levels should be short-term. Construction of the sand dike could immediately replace a portion of the lost resting and loafing habitat used by other waterbirds, and this area should be available for foraging activities once benthic infaunal populations (and finfish) have recolonized the area. In addition, construction equipment and activities may disturb shorebirds by causing them to spend more time being alert than foraging and resting. However, other areas around Bogue Inlet, away from direct influences of construction activities, are preferred by other waterbirds. For example, other waterbirds, such as rails, prefer marsh habitats as foraging and roosting grounds as these areas can provide significant amounts of prey resources which should result in temporary and minimal direct and indirect impacts to other waterbirds.

Cumulative Effects. Sand dike construction is predicted to lead to the formation of intertidal habitat as the existing channel fills in and equilibration occurs. The newly established habitat could be used by waterbirds for foraging and roosting activities. Once the sand dike has been constructed, access to the isolated inlet shorebird habitats will be established which could increase the potential for predator and human affects to inlet shorebird resources. Implementation of an effective bird management plan should offset most of the negative impacts due to increased access.

While the inlet material is more compatible than the material contained in offshore borrow areas, the use of the inlet material to construct the Phase 3 beach fill should have the same impacts on colonial waterbirds as the offshore material.

Compatibility with Project Objectives. The channel relocation without beach nourishment alternative supports the objectives of the project.

5.8 **WATER QUALITY**

5.8.1 **Turbidity**

Alternatives A, B, and C will have similar impacts on turbidity as described below.

Direct and Indirect Impacts. The USACE Navigation Branch would continue to maintain the Bogue Inlet navigation channel using sidecast dredges. Maintenance dredging in Bogue Inlet in normally carried out during 3 to 4 week periods separated by several months. The inlet material is composed of medium to fine grained quartz sand with minimal shell and silt content. As a result of the time separation between operations and the quality of the dredged material, the impacts of each maintenance operation on turbidity appear to be minimal.

The Town of Emerald Isle will probably proceed with construction of the Phase 3 beach nourishment project using sand from an offshore borrow site. Selection of an appropriate offshore borrow area with a low silt/clay component is important to assure that turbidity levels are in compliance with the State of North Carolina water quality standards. In this regard, sampling of the offshore borrow material used to construct Phases 1 and 2 of the Bogue Banks beach nourishment project indicated that the sediment contained 0.5% silt. As a result, beach nourishment with the offshore borrow material should result in minimal and temporary increases in turbidity at the offshore borrow and shoreline fill sites. Increases in turbidity associated with beach nourishment projects is known to dissipate to ambient conditions within one to two tidal cycles following cessation of the activity in a particular area.

Cumulative Effects. Due to the low silt/clay content of the material dredged during channel maintenance operations cumulative impacts due to high levels of turbidity are not expected to occur from Alternatives A, B, and C. Similarly, construction of the beach fill using offshore sand sources should not result in adverse cumulative effects to water quality.

Compatibility with Project Objectives. Alternatives A, B, and C do not support the project objectives to protect the Emerald Isle inlet shoreline properties from erosion or provide for the nourishment of the Phase 3 using a high quality sand source.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. Excavation of the new channel and construction of the sand dike across the existing channel are expected to result in temporary increases in suspended sediment and turbidity in the immediate area of construction activity. Computations of the suspended sediment plume associated with the dike construction found that suspended sediment concentrations of 6 ppm could occur between the dike and the confluence of the inlet channel with Eastern Channel. Similarly, suspended sediment concentration seaward of the dike would be around 4 ppm between the dike and the seaward limit of the existing inlet channel. While there is no direct correlation between suspended sediment and turbidity, the low suspended sediment concentration combined with the low silt content of the inlet material (1.25%) resulted in the conclusion that turbidity should remain below the state standard outside the immediate construction or disposal area (see Appendix B). Any increase in turbidity associated with the excavation of the channel, stockpiling of material on the Emerald Isle sand spit, construction of the sand dike, or the mechanical transfer of the stockpiled material to the existing channel should be of short duration.

The Town of Emerald Isle will probably proceed with construction of the Phase 3 beach nourishment project using sand from an offshore borrow site. Selection of an appropriate offshore borrow area with a low silt/clay component is important to assure that turbidity levels are in compliance with the State of North Carolina water quality standards. In this regard, sampling of the offshore borrow material used to construct Phases 1 and 2 of the Bogue Banks beach nourishment project indicated that the sediment contained 0.5% silt. As a result, beach nourishment with the offshore borrow material should result in minimal and temporary increases in turbidity at the offshore borrow and shoreline fill sites. Increases in turbidity associated with beach nourishment projects is known to dissipate to ambient conditions within one to two tidal cycles following cessation of the activity in a particular area.

Cumulative Effects. No cumulative effects are expected to result from project implementation since turbidity levels should not exceed the state standard and suspension time is expected to be minimal.

Compatibility with Project Objectives. Alternative E satisfies all of the project objectives except the use of high quality fill material for Phase 3.

Preferred Alternative F – Channel Relocation with Beach Nourishment

Direct and Indirect Impacts. Construction of the sand dike across the existing channel could result in the suspension of the silt and clay material with this material being transported toward the sound and the ocean during the flood and

ebb phases of the tide respectively. The low silt/clay content of the inlet material should result in relatively low concentrations of suspended sediment outside the immediate area deposition. Estimates of the travel distance and concentrations of suspended sediment during the dike construction (see Figure 6.1 in Appendix B) found that suspended sediment should average around 6 parts per million (ppm) from the dike area to the confluence of the inlet channel with the Eastern Channel and average 4 ppm seaward of the dike. While there is no direct correlation between suspended sediment concentrations and turbidity, the low concentration of suspended sediment indicates that turbidities are likely to remain low during dike construction.

Cumulative Effects. No cumulative impacts on turbidity are expected due to the low suspended sediment concentrations and low silt content of the inlet material. Any increases in turbidity should be limited to the immediate construction area and would be of relatively short duration.

Compatibility with Project Objectives. This alternative supports the project objectives.

5.8.2 **Salinity**

Alternatives A, B, and C are expected to have the same impacts on salinity as described below.

Direct and Indirect Impacts. Maintenance dredging of the Bogue Inlet channel conducted by the USACE Navigation Branch is not expected to change salinity levels in the area since this activity does not change the hydrodynamics of the inlet.

Cumulative Effects. No cumulative effects on salinity are expected to result from Alternatives A, B, and C.

Compatibility with Project Objectives. Alternatives A, B, and C do not address any of the project objectives.

Alternative E – Channel Relocation without Beach Nourishment

Direct and Indirect Impacts. During the year, Bogue Inlet has natural fluctuations in salinity ranging from high, transitional, to low depending on tide conditions and antecedent rainfall/runoff conditions. The dimensions of the new channel were selected based on the ability of the new channel to capture the majority of the tidal flow through Bogue Inlet. The minimum cross-sectional area of Bogue Inlet would be slightly less than its historic equilibrium size immediately following construction