Natural Resource Summary Report

US 701 Bridge Replacement Project Over the Great Pee Dee River, Pee Dee River Overflow, and Yauhannah Lake Horry and Georgetown Counties, South Carolina

August 28, 2009

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Natural Resource Summary Report for the U.S. 701 Bridge Replacement Project Over the Great Pee Dee River, Pee Dee Overflow, and Yauhannah Lake in Horry/ Georgetown Counties, South Carolina

1.0 INTRODUCTION / PROJECT DESCRIPTION

The US 701 Bridge Replacement project consists of the replacement and realignment of an approximately two mile long section of US 701 located in Georgetown and Horry Counties. The project involves the replacement of three bridges on US 701 through rural, undeveloped, light residential and light commercial portions of Horry and Georgetown Counties. The project involves replacing the three existing US 701 bridges over Yauhannah Lake, the Great Pee Dee River, and the Great Pee Dee River Overflow, as indicated on the location maps included as Figure 1, Figure 2 and Figure 3. The study area consists of a corridor that is approximately two miles long, 300 feet wide, and is centered on the existing US 701 alignment from a point near the US 701 / Lucas Bay Road intersection in Horry County, to a point near the US 701 / Trinity Road intersection in Georgetown County. The project involves the bridge replacements as well as the construction of new roadway approach alignment. The project corridor crosses the referenced water bodies, as well as extensive floodplain forested wetlands. The Waccamaw National Wildlife Refuge occupies much of the project corridor study area.

The existing bridges were built in the early 1950s replacing the older bridges constructed circa 1920. The existing bridges have been inspected by the Department and have been rated structurally deficient and are in need of replacement for public safety reasons. The periodic addition of asphalt or other highway surfacing materials to the bridge structures causes additional strain and settling of the structures. The purpose of the project is to replace the structurally deteriorated and functionally obsolete existing US 701 bridges and maintain the principal direct rural connection between the larger towns of Conway and Georgetown, as well as the smaller communities such as Bucksport and Yauhannah in between.

Location and design alternatives have been considered in the planning process. The “no-build” alternative, which consists of making no improvements, was considered as a baseline for comparison; however, the “no-build” alternative would not improve the safety and structural characteristics of the bridge / highway system. Therefore, this alternative is not considered acceptable.

Alternatives to the northwest side of the existing route, to the southeast side of the existing route, and a combination of sides were initially considered in the development of the recommended project alignment. Four alternative alignments were included for an in-depth evaluation as part of this study. Alternatives 1 and 2 are located 72 feet and 55 feet, respectively, northwest of the existing alignment. Alternatives 3 and 4 are located 55 and 72 feet, respectively, southeast of the existing alignment. Based on a review of potential environmental impacts and other considerations, Alternative 3 has been identified as the preferred alternative.

2.0 NATURAL RESOURCES IN THE PROJECT CORRIDOR

This natural resources summary is a summary of natural resource information collected during the initial phase of project research in 2005 and as the project was put on hold for an extended period of time, also includes information collected since project re-start.

Based on observations made during corridor reconnaissance, the two mile section of the US 701 corridor is very rural and is dominated by the water bodies and wooded floodplain landscape that the three bridges traverse. The Waccamaw National Wildlife Refuge occupies much of the project corridor study area. The project corridor consists primarily of two types of habitat. The predominant habitat is palustrine forested floodplain wetland, consisting of bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa* biflora), red maple (*Acer rubrum*), river birch (*Betula nigra*), titi (*Cyrilla racemiflora*), willow oak (*Quercus phellos*), and laurel oak (*Quercus laurifolia*). At either end of the corridor, the habitat becomes a drier, sandy upland with loblolly pine (*Pinus taeda*), water oak (*Quercus nigra*), and other similar species.

2.1 Threatened or Endangered Species

Pursuant to Section 7 of the Endangered Species Act (ESA) a field survey was conducted on the proposed study area. The lists of endangered (E) and threatened (T) species were obtained from the U. S. Fish and Wildlife Service (USFWS) and NOAA Fisheries. The information was originally obtained in 2004 from agency websites. USFWS also followed up in May of 2005 with a letter which included the county listings. In order to update the county listings after project restart, the available listings were again obtained from the USFWS (USFWS Charleston Ecological Services Website, 2009) and NOAA Fisheries (NOAA Fisheries Website, 2009) websites in April of 2009

The project area was examined by reconnaissance methods in January, March and June of 2005. Species ecological requirements were researched and the SCDNR Heritage Trust Rare, Threatened and Endangered Species Inventory was reviewed in January 2005, May 2008, and April 2009 (SCDNR Heritage Trust Program, 2005, 2008, 2009). No occurrences of the listed species in the immediate project corridor area were noted in the reviews of the Heritage Trust Inventory information.

The blue whale (*Balaenoptera musculus*), the finback whale (*Balaenoptera physalus*), the humpback whale (*Megaptera novaeangliae*), the North Atlantic right whale (*Eubalaena glacialis*), the sei whale (*Balaenoptera borealis*), and the sperm whale

(*Physeter macrocephalus*) are marine mammals and are listed for South Carolina as endangered species (NOAA Fisheries, 2009). These species are oceanic species and would not be expected to occur in the action area and the project would not affect these species (NOAA Fisheries, 2009).

The green sea turtle (*Chelonia mydas*) and the loggerhead sea turtle (*Caretta caretta*) are marine turtles listed as threatened for South Carolina. The hawksbill sea turtle (*Eretmochelys imbricata*), the Kemp's ridley sea turtle (*Lepidochelys kempii*), and the leatherback sea turtle (*Dermochelys coriacea*) are marine turtles listed as endangered for South Carolina (NOAA Fisheries, 2009). These species are marine species, primarily occurring in the near shore and off-shore environment. Nesting for each of these species has occurred along South Carolina beaches; however, none of these species would be expected to occur this far inland in the action area and the project would not affect these species (NOAA Fisheries, 2009).

The West Indian manatee (*Trichechus manatus)* is listed as an endangered species for Horry and Georgetown Counties. According to manatee sighting information on the SCDNR website (SCDNR Website, 2005/2009), there have been no known sightnings of manatees this far inland in the Great Pee Dee River. Based on the sightings information, manatees would not be expected to occur this far from the marine/estuarine environment.

The shortnose sturgeon (*Acipenser brevirostrum*) is known to exist in the Great Pee Dee River. Dr. Mark Collins, with the South Carolina Department of Natural Resources (SCDNR), has indicated that the shortnose sturgeon makes a spawing migration past the US 701 bridge over the Great Pee Dee River from January to mid-April (Collins, SCDNR, personal communication, 2005). It has been recommended that no blasting, pile driving or other activities that may disrupt the sturgeon migration be conducted during this time frame. In the past, the SCDOT and NOAA Fisheries have entered into agreements regarding seasonal construction moratoriums for similar projects.

The refuge manager has indicated that there have been reports of a pair of bald eagles (*Haliaeetus leucocephalus*) in the Yauhannah Lake area; however, he has not been able to confirm the location (Sasser, USFWS, personal communication, 2005). The bald eagle is no longer considered threatened under the ESA; however, protection is afforded this species under the Bald and Golden Eagle Protection Act. The project corridor area is considered to be potential foraging habitat for the bald eagle, with major water bodies and large trees suitable for perching. However, no bald eagles were observed during reconnaissance of the project corridor area. Additonally, no occurrences of the bald eagle were indicated on the SCDNR Heritage Trust inventory of threatened and endangered species.

No red cockaded woodpecker (*Picoides borealis*) cavity trees were found within a half-mile of the project. Additionally, the refuge manager provided a map of known occurrences of several bird species in the area (Sasser, 2005). Based on this information, the closest known red cockaded woodpecker colony is located approximately 4.5 miles southeast of the project.

No wood storks (*Mycteria americana*) have been observed during reconnaissance of the project corridor area. The refuge manager has previously

indicated that wood storks are known to use the Waccamaw National Wildlife Refuge, but not in the project corridor area, (Sasser, USFWS, personal communication, 2005). No occurrences of the wood stork in the project corridor area were documented in the SCDNR Heritage Trust inventory of threatened and endangered species.

The Piping Plover (*Charadrius melodus*) is not considered likely in the project area due to the absence of coastal beach and dune habitat (USFWS Ecological Services Website, 2005).

The Kirtland's warbler (*Dendroica kirtlandii*) is a neo-tropical migratory bird species, and is considered a possible part time resident of Horry and Georgetown Counties. The species is a transient migrant and is not likely to be in the project area for a significant period of time as it migrates between the breeding grounds in Michigan, Wisconsin and Ontario and the wintering grounds in the Bahamas (USFWS, 1998; Mayfield, 1988).

Sea-beach Amaranth (*Amaranthus pumilus*) is not considered likely in the project area due to the absence of coastal beach and dune habitat (USFWS Website, 2005).

Pondberry (*Lindera melissifolia*) was not observed in the project corridor area during reconnaissance efforts. The habitat observed is not considered suitable for this species, as the species prefers sandy sinks and pond margins, and is more commonly found associated with karst topography in South Carolina. (Devall, M., 2001). No occurrences of this species in this area was documented in the SCDNR Heritage Trust inventory of threatened and endangered species.

Canby's dropwort (*Oxypolis canbyi*) was also not observed during reconnaissance of the project corridor. The project corridor area is not considered to contain likely habitat for this species, as the wet margins of the forested wetland areas are predominantly overshadowed by dense forest canopy and are not similar to the more typical pond cypress savannahs the plant prefers. (Center for Plant Conservation Website, 2005). No occurrences of this species in this area was documented in the SCDNR Heritage Trust inventory of threatened and endangered species.

American chaffseed (*Schwalbea americana*) was not observed during reconnaissance of the project corridor. The plant is not considered likely to be present due to the lack of suitable habitat, such as significant fire maintained areas. (USFWS, *Schwalbea americana*, 2005).

A general Biological Assessment report for the project and a separate Biological Assessment report specific to the shortnose sturgeon have also been prepared as separate documents.

2.2 Water Quality

The project will involve work within the Great Pee Dee River, Yauhannah Lake and the forested wetlands associated with these water bodies, as well as the wetlands associated with the Great Pee Dee Overflow. The wetlands located in the project corridor were field delineated in January 2005. Information pertaining to the wetland study is provided in the wetlands section of this report. At the time of the 2005 data

collection for this project information for this portion of the Pee Dee River watershed was collected from the SCDHEC Bureau of Water website (2005). At that time this portion of the Pee Dee River was included in SCDHEC hydrologic unit #03040201-170, which included primarily the Pee Dee River and its tributraries from the Little Pee Dee River to Winyah Bay. Since that time a re-designation by SCDHEC has incorporated a larger regional watershed, designated the Great Pee Dee River / Winyah Bay watershed. This watershed unit is now designated #03040207-02 and was formerly #s 03040201-170, 03040201-160, and a portion of 03040207-040 (SCDHEC Water Quality Standards and Water Shed Planning Section; SCDHEC Bureau of Water, 2005/2009).

At the US 701 Bridge crossing, the water is classified as FW (Freshwater), which is defined as freshwater suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with SCDHEC requirements. These waters are also typically suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora (SCDHEC definition of “FW”).

The Great Pee Dee River above the US 701 bridge is listed by SCDHEC as a State impaired water for purposes of fish consumption due to mercury contamination under Section 303(d) of the Clean Water Act (2004 and 2008 listing). At the time of the 2005 research, the SCDHEC water shed data for what was then hydrologic unit #03040201-170 also indicated that aquatic life uses are not supported in the Great Pee Dee River at the US 701 bridge due to occurrences of zinc in excess of the aquatic life acute standards. However, the recent data, for what is now unit #03040207-02, shows that aquatic life uses are fully supported (SCDHEC Water Quality Standards and Water Shed Planning Section; SCDHEC Bureau of Water, 2005/2009).

The 303(d) listing is due to a fish consumption advisory for mercury contamination. Except in isolated cases mercury contamination is predominantly associated with deposition from the atmosphere, mainly through rainfall, with the primary sources being coal fired power plants, chemical plants, waste incineration, and metal processing, and not typically through vehicle related road runoff (USGS Fact Sheet FS-216-95).

During construction activities, temporary siltation may occur in these water bodies and erosion will be of a greater degree than presently occurring on existing terrain. It is recommended that the contractor minimize this impact through implementation of construction best management practices, reflecting policies contained in 23 CFR 650 B and S.C. Code of Regulations 72-400. The SCDOT has also issued an Engineering Directive Memorandum (Number 23), dated March 10, 2009, regarding Department procedures to be followed in order to ensure compliance with S.C. Code of 72-400, Standards for Stormwater Management and Sediment Reduction. Exposed areas may be stabilized by following the Department’s Supplemental Technical Specification for Seeding (SCDOT Designation SC-M-810 (11-08).

2.3 Wetlands

The wetlands located in the project corridor were field delineated in January 2005. The wetlands were delineated pursuant to the US Army Corps of Engineers 1987 Wetland Delineation Manual (US Army Corps of Engineers, 1987). Based on field observations at the time of the delineation, as well as the information on the NWI map, the wetlands are considered to be palustrine forested floodplain wetlands, located within the floodplain of the Great Pee Dee River and overflow areas. Based on a review of aerial photography, USGS quad mapping, NWI Mapping, and soil survey information this type of of floodplain wetland habitat continues upstream and downstream, relatively uninterrupted for miles. A sandy upland, often as a bluff is located on the northeastern and southwestern sides of the floodplain forest. Regionally the floodplain wetland habitat contains occasional drier, upland hummocks, or occasional deeper water habitats, which appear to be old river channel oxbows (see Figures and aerial photographs in Appendix C).

Based on field observations during the wetland delineation, vegetation located in the the forested floodplain wetland of the project corridor area, consists of such species as bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa* biflora), red maple (*Acer rubrum*), river birch (*Betula nigra*), titi (*Cyrilla racemiflora*), willow oak (*Quercus phellos*), and laurel oak (*Quercus laurifolia*). At either end of the corridor, the habitat becomes a drier, sandy upland with loblolly pine (*Pinus taeda*), water oak (*Quercus nigra*), and other similar species. Representative photographs of the forested floodplain wetland habitat, taken at the time of the field delineation, are included in Appendix C.

Based on available aerial photography and regional mapping, this type of habitat appears to be extensive both upstream and downstream of the US 701 bridge. A cleared electrical transmission line right of way is located approximately 200 plus feet to the northwest of the existing US 701 alignment. Based on a review of available aerial photography and field observations, the transmission line right of way and the existing causeways for US 701 represent the only significant breaks in this wetland habitat for miles upstream and downstream from US 701. (see NWI mapping, USGS map, and soil survey map in Appendix C). The Great Pee Dee River has been designated a State Scenic River from the US 378 Bridge to the US 17 Bridge, a distance of approximately 70 miles (SCDNR State Scenic Rivers Website, 2005). According to information on the SCDNR website page for State Scenic Rivers Program, most of this stretch of the Great Pee Dee River is bordered by floodplain forest which is relatively uninterrupted except for the US 701 Bridge and one railroad bridge.

On the Georgetown County side, there are two mapped soil types within the project corridor study area. The upland bluff area adjacent to the southwest of Lake Yauhannah is mapped as Chisolm Sand, which is a well drained, nearly level to gently sloping soil on uplands and stream terraces on the lower coastal plain (Georgetown County Soil Survey, 1980). The other mapped soil unit is Chastain silty clay loam, a hydric soil that is a typically poorly drained, nearly level soil on broad inland flood plains of the Santee and Pee Dee Rivers (Georgetown County Soil Survey, 1980). Based on the soil survey mapping, the Chastain silty clay loam is present throughout the

Georgetown County side of the floodplain forested wetland both in the study area and regionally for several miles upstream and downstream from the US 701 bridge (Georgetown County Soil Survey, 1980).

On the Horry County side, there are two mapped soil types within the project corridor study area. The upland area adjacent to the northeast of the floodplain forested wetland is mapped as Lakeland Sand, which consists of excessively drained nearly level to steep soils on coastal plain uplands. (Horry County Soil Survey, 1983). The other mapped soil unit on the Horry County side is Johnston Loam, a hydric soil that is typically a very poorly drained soil on nearly level flood plains of the coastal plain (Horry County Soil Survey, 1983). Based on the soil survey mapping, the Johnston Loam is present throughout the Horry County side of the floodplain forested wetland both in the study area and regionally for several miles upstream and downstream from the US 701 bridge (Horry County Soil Survey, 1983).

Based on field observations, the wetland delineation is consistent with the mapped units of hydric soils. The soil survey mapping also shows a significant regional presence of these hydric soils associated with the floodplain of the Great Pee Dee River.

At the time of the 2005 data collection for this project information for this portion of the Pee Dee River watershed was collected from the SCDHEC Bureau of Water website (2005). At that time this portion of the Pee Dee River was included in SCDHEC hydrologic unit #03040201-170, which included primarily the Pee Dee River and its tributraries from the Little Pee Dee River to Winyah Bay. According to this information, as well as a review of the USGS 7.5 minute Yauhannah Quadrangle, this section of the Pee Dee River recveives drainage from its upper reaches, as wells as many tributaries such as Conch Creek, Bradley Branch, Yauhannah Creek (Tupelo Bay), and Bull Creek (Cowford Swamp, Horsepen Branch). These tributaries either feed directly into the Pee Dee River or feed into the vast forested floodplain swamp adjacent to the Pee Dee River, and then through sheet flow would eventually feed into the river. Hydrologically, the Pee Dee River in this area appears to be fed by a large water shed draining into and through the Pee Dee Swamp as evident on area maps and the SCDHEC hydrologic unit information. The river at this location is also subject to tidal ebb and flow (NOAA Tides and Currents Website).

Forested floodplain wetlands provide several beneficial functions and values including temporary floodwater storage and moderation of peak flows, water quality maintenance, groundwater recharge and erosion prevention (Rose, 2005). Riparian ecosytems typically function as nutrient sinks as materials flow in from adjacent uplands and as transformers of nutrients as far as export of materials from the watershed (Mitsch & Gosselink, 1986). Productivity and diversity are typically very high and these ecosystems are also often used by wildlife for refuge, plant diversity, available water, and as a migration corridor (Mitsch & Gosselink, 1986).

One method of assessing the value and function of wetlands is in terms of wildlife habitat. The U.S. Fish and Wildlife Service (USFWS) Resource Category criteria are outlined in the USFWS Mitigation Policy, 46 CFR 7644-7663. Resource categories and mitigation planning techniques are assigned based on the following criteria:

- Category 1 - Communities of one-of-a-kind high value to wildlife, unique and irreplaceable on a national or eco-regional basis, habitat is not replaceable in kind based on present-day scientific and engineering skills within a reasonable time frame.

- Category 2 - Communities of high value to wildlife, which are relatively scarce or are becoming scarce on a national, or eco-regional basis, habitat, can be replaced in kind within a reasonable time frame based on present-day scientific and engineering skills.

- Category 3 - Community types of high to medium wildlife value which are relatively abundant on a national basis, out-of-kind replacement is allowable if a tradeoff analysis demonstrates equivalency of substituted habitat type and/or habitat values. These sites are often in conjunction with a replenishing source.

- Category 4 - Community types of low to medium wildlife value, generally losses will not have a substantial adverse effect on important fish and wildlife resources. These sites have often been affected by the present roadway or human disturbances and are usually isolated.

Based on the extensive presence of this type of wetland upstream and downstream of US 701, as well as the significant presence of other stretches of floodplain forested wetland along other drainages in the South Carolina coastal plain, this type of wetland would fit into Resource Category 3. As it is recognized that these forested floodplain wetlands are part of an important and valuable ecosystem wetland impacts will be minimized with longer bridge spanning, best management practices (BMPs) and utilizing to the degree practicable the existing US 701 causeway fill. Due to the linear nature of the project, and the homogeneity of the habitats, wetland impacts would be similar for all build alternatives considered; however, Alternative 3 (55 feet downstream of existing alignment) would result in the least amount of wetland impacts and is the preferred alternative. Once wetland impacts have been minimized by alternatives analysis, compensatory mitigation from an approved SCDOT wetland mitigation bank will be utilized to offset local losses in functions and values of this wetland. Additionally, although wetland impacts for the project are unavoidable, based on the extensive floodplain wetland habitat in this area, the similarity of the project to the existing bridge / causeway system, and the steps taken to minimize impacts to the remaining wetlands in this floodplain system, the project should not significantly reduce this systems ability to continue to provide the functions and values on a local and regional basis. Additionally, with longer bridging and the removal of some of the existing causeway fill, it is expected that flow conditions would also improve.

Alternative 1

Alternative 1 involves constructing new alignment approximately 72 feet northwest (upstream) of the centerline of the existing alignment. Alternative 1 has the greatest wetland impacts, primarily due to the additional relocation of the boat landing access road. Approximate wetland impacts for this alternative are 6.67 acres for the roadway and 2.18 acres for the boat landing access road.

Alternative 2

Alternative 2 involves constructing new alignment approximately 55 feet northwest (upstream) of the centerline of the existing alignment. Alternative 2 would result in fewer wetland impacts than Alternative 1; however, wetland impacts would still be incurred from the relocation of the boat landing access road. Approximate wetland impacts for this alternative are 5.41 acres for the roadway and 1.79 acres for the boat landing access road.

Alternative 3

Alternative 3 involves constructing new alignment approximately 55 feet southeast (downstream) of the centerline of the existing alignment. Alternative 3 generally positions the new alignment along the same alignment as the original US 701 bridge constructed circa 1920s. Alternative 3 would result in the least amount of wetland impacts, including impact for an improved access road to the boat landing. Approximate wetland impacts for this alternative are 4.79 acres for the roadway and 1.04 acres for the improvements to the boat landing access road.

Alternative 4

Alternative 4 involves constructing new alignment approximately 72 feet southeast (downstream) of the centerline of the existing alignment. Alternative 4 would result in a slightly higher amount of wetland impacts than Alternative 3, including impact for an improved access road to the boat landing. Alternative 4 would also position the new alignment closer to Cowford Lake than Alternative 3. Approximate wetland impacts for this alternative are 6.05 acres for the roadway and 1.04 acres for the improvements to the boat landing access road.

Preferred Alternative

Alternative 3 has been selected as the preferred alternative due to the various design criteria, as well as minimized impacts to the wetlands and the fewest relocations and property impacts. The proposed project will require an individual Corps of Engineers Section 404 permit, Section 401 water quality certification, and an Ocean and Coastal Resource Management (OCRM) coastal zone consistency certification.

2.4 Terrestrial and Aquatic Wildlife

The predominant habitat within the project corridor consists of palustrine forested floodplain wetland which includes such tree species as bald cypress, swamp tupelo, red maple, river birch, titi, willow oak, and laurel oak (wetland delineation conducted 2005 by ARM Environmental Services, personal observations, NWI mapping). Upon review of project information, comments from SCDNR indicate that the most of the project “falls within the Waccamaw National Wildlife Refuge, an expansive portion of floodplain wetland” (Rose, 2005). Forested floodplains and riparian ecosystems generally provide a valuable habitat for a number of animal species and are an example of an ecotonal, or edge, habitat between the river and uplands (Mitsch & Gosselink, 1986). The SCDNR description of the 70 mile stretch of the Pee Dee River corridor designated as scenic indicates that this river corridor habitat includes over 120 species of fish, species such as the American alligator, red cockaded woodpecker, bald eagle, swallow tailed kite, 17 species of duck, several species of wading birds and

fur bearers, and typical South Carolina game species, such as whitetailed deer and turkeys (SCDNR State Scenic Rivers Website, 2005).

As is common in wooded areas of South Carolina, mammals such as white tailed deer, raccoons, skunks, and squirrels occupy the area. Mature hardwood trees are preferred nesting sites for cavity nesters such as owls, wood peckers and squirrels. Several duck species, including resident wood ducks and several migratory waterfowl species utilize the swamp and riverine habitat of the Waccamaw National Wildlife refuge (USFWS Waccamaw NWR Brochure , 2002). At either end of the corridor, the habitat becomes a drier, sandy upland with loblolly pine, water oak, and other typical upland tree species (personal observations, Horry and Georgetown County Soil Surveys). The riverine and deepwater habitats of the Great Pee Dee River and Yauhannah Lake include many species of fish (SCDNR State Scenic Rivers Website, 2005), freshwater turtles and other reptiles, and other water dependent animals.

The Rafinesque's big eared bat (*Corynorhinus rafinesquii*) has been known to occur beneath the Pee Dee Overflow bridge and the Yauhannah Lake bridge (SCDNR Heritage Trust Inventory). At a May 2, 2008 meeting with SCDOT in Columbia, South Carolina, Craig Sasser, the refuge manager also provided information, in the form of his e-mail communications with Susan Loeb at Clemson University, that two groups of bats were observed beneath the Yauhannah Lake bridge in 2002, one of which was a maternal colony of 21 individuals and the bats used the bridge again in 2003 (Sasser/Loeb, 2008). These e-mails are provided in Appendix D. According to this information two groups of bats were observed under the Yauhannah Lake bridge in June 2002, and one of these was a maternity colony of 21 individuals. The maternity colony was observed again at this location in June and July of 2003, and both adults and young were observed.

Data available from the SCDNR Heritage Trust program also indicated that bats have previously been observed using these bridges. The Heritage Trust Inventory listings for the big eared bat are provided in Appendix D. The Rafinesque's big eared bat is not a Federally listed threatened or endangered species; however, the bat is rare in South Carolina and is considered a State endangered species (SCDNR Heritage Trust Inventory). The USFWS and the SCDNR have both expressed a concern for the big eared bat.

Artificial and natural structures can be used as day and night roosts for the bats throughout the year (Bennett, et al., 2008). However, studies have shown that big eared bats rarely use bridges during winter (Bennett, 2005). Removal of the existing bridges will remove this roosting structure; however, the existing bridges will not be removed until the new bridges are constructed, and the new bridges will provide new roosting structure. The bats prefer large, concrete-girder bridges and avoid flat bottomed slab bridges (Bennett, et al., 2008). The proposed bridges over the Pee Dee Overflow and Yauhannah Lake will be of concrete girder construction and will have longer spans than the existing bridges providing more roosting habitat than currently.

Construction of the new bridges may create a temporary disturbance to the bats utilizing the existing structures; however, according to information from Bat Conservation International (BCI), bats roosting in bridges become accustomed to vibrations and sounds associated with normal traffic, and structural maintenance only has an effect if the bats are exposed or if foreign materials are introduced (Keely and

Tuttle, 1999). During field surveys, BCI researchers have observed crews working working on and around bat occupied structures with no apparent effects (Keely and Tuttle, 1999.)

It is also understood that USFWS may be researching opportunities to provide alternative roost sites for the big eared bat (Ertel/Bayless, 2008). As indicated above, the design of the new bridge will be conducive to roosting and therefore impacts to roosting habitat will be temporary. Demolition of the existing structures should take place at a time of year that maternal roosting is not occurring. Pre-demolition inspections may also be warranted.

The swallow tailed kite (*Elanoides forficatus*) is a federal species of concern and State endangered species, that is also known to exist in the vicinity of the project corridor. According to information provided by the refuge manager, the kite is known to use the wooded swamp around Cowford Lake (to the southeast of the existing US 701 alignment) as a nesting area. Additional information provided by the refuge manager has indicated various kite sightings in the vicinity of the existing US 701 alignment as well as being scattered throughout the refuge area (Sasser, 2005, 2008 – See maps in Appendix D). The kite was not observed in the project corridor area during reconnaissance efforts; however, on the southeastern side of the existing US 701 alignment the kite is known to use the wooded swamp around the southeastern side of Cowford Lake (see Sasser provided maps in Appendix D). The 55' downstream alternative has been selected as the preferred alternative due to the various design criteria, as well as minimized impacts to wetlands and the fewest relocations and property impacts. The 55' downstream alternative would keep the new alignment closer to the existing alignment, and thus further from the known kite nesting sites, than the 72' downstream alignment. Two occurrences of kite nesting have been documented further to the northwest of the existing alignment. The closest of these occurrences is located approximately 3,000 feet northwest of the existing alignment. Although the preferred alternative is on the Cowford Lake side, by keeping the proposed alignment closer to the existing alignment, potential impacts to the kite habitat will be minimized.

No other bridging is located over the Great Pee Dee River system in this area except for the US 378 bridge, located approximately 24 miles to the northwest, the US 378 bridge over the Little Pee Dee River, located approximately 13 miles northwest, or the US 17 bridge over the Waccamaw River, located approximately 21 miles to the south-southwest. Except for the existing US 701 bridging and causeways and the electrical transmission line, the bottomland forest and swamp habitat continues relatively uninterrupted for miles upstream and downstream, providing habitat for a number of species (see NWI mapping, USGS map, and soil survey map in Appendix C). The potential impacts to the shortnose sturgeon have been discussed in the threatened or endangered species section. No other significant impacts to wildlife are expected.

The bridge over the Great Pee Dee River will be at least 800 feet longer than the existing bridge and furthermore, the bridge spans for all three bridges will be generally longer than the existing bridge spans. This longer bridging, combined with removal of some of the existing causeway fill will permit greater opportunity for wildlife passage.

As indicated in the water quality section, during construction activities, temporary siltation may occur in these water bodies and erosion will be of a greater degree than presently occurring on existing terrain. It is recommended that the contractor minimize

this impact through implementation of construction best management practices, reflecting policies contained in 23 CFR 650 B and S.C. Code of Regulations 72-400. The SCDOT has also issued an Engineering Directive Memorandum (Number 23), dated March 10, 2009, regarding Department procedures to be followed in order to ensure compliance with S.C. Code of 72-400, Standards for Stormwater Management and Sediment Reduction. Exposed areas may be stabilized by following the Department's Supplemental Technical Specification for Seeding (SCDOT Designation SC-M-810 (11-08). Through the use of the required BMPs erosion control methods necessary to curtail runoff during construction, and the use of SCDOT designated seeding techniques, there should be no substantially increased impact on water quality in the area as a result of this project. Therefore, significantly adverse impacts to aquatic wildlife are not expected.

2.5 Floodplains

Based on a study of the Flood Insurance Rate Maps (FIRM) for the areas adjacent to the project, published by the Federal Emergency Management Agency (FEMA), the project would involve construction within the 100-year floodplain (Map #45051C0645 H, 1999; Map #450085 0075 D, 1989). The Flood Insurance Rate Maps designate this area as a Special Flood Hazard Area Zone A. As a designated Zone A area, the floodplain limits shown on the maps are determined by approximate methods. Due to potential impacts of the proposed project on the floodplain, a detailed hydraulic study of the bridge crossing will be performed as part of the project. The hydraulic study will include a one-dimensional and two-dimensional hydraulic analysis, based on guidelines provided in the SCDOT Requirements for Hydraulic Design Studies (latest edition) as well as applicable FEMA and SCDNR guidelines. The one-dimensional hydraulic analysis will be included as an attachment to the EA.

The one-dimensional hydraulic model was developed for the natural, existing, and proposed conditions to measure the potential impacts from the project. A hydrological analysis of the watershed was completed to estimate design flows and project surveys and mapping were used to develop the hydraulic model. The existing conditions include a total of 4,363' of total bridge length including a 1,603' bridge at the Great Pee Dee River. The proposed bridge configuration includes a total bridge length of 5,250' including a 2,435' bridge at the Great Pee Dee River. The proposed bridges will also include longer spans which reduces future obstructions within the floodplain. The increase in bridge length, removal of some existing causeway, as well as the increased efficiency in bridge spans will reduce backwater for the proposed conditions. The one-dimensional hydraulic study resulted in a proposed condition 100-year backwater of less than 1.0' for the 100-year flood, therefore satisfying FEMA and SCDOT criteria. As the project design is completed, a two-dimensional analysis will be developed to further study the impacts of the project as well as provide necessary design data for the project.

The project will not be a significant or longitudinal encroachment as defined under 23 CFR 650A, nor is it expected to have an appreciable environmental impact on this base floodplain as documented in the hydraulic analysis report. According to U.S. Department of Transportation (DOT) Order 5650.2, Floodplain Management and Protection, "Expansion of a facility already located within a floodplain usually would not be considered a significant encroachment." The US DOT Order 5650.2 further defines a significant encroachment as involving one or more of the following impacts:

1. A considerable probability of loss of human life,
2. Likely future damage associated with the encroachment that could be substantial in cost or extent, including interruption of service on or loss of a vital transportation facility, and
3. A notable adverse impact on natural and beneficial floodplain values.

As documented in the study, the level of risk associated with the probable area of flooding and its consequences attributed to this encroachment is not any greater than that associated with the present roadway. The proposed alternative increases the total bridged area within the floodplain, thus reducing the backwater from the existing roadway and bridge conditions.

2.6 Air Quality

The project is located in portions of Horry and Georgetown Counties. Both of these counties are currently in attainment with all National Ambient Air Quality Standards (NAAQS) according to data from the South Carolina Department of Health and Environmental Control. Given the attainment status there is no requirement for transportation control measures or conformity to maintain the area's air quality at this time.

In addition to the criteria air pollutants for which there are National Ambient Air Quality Standards (NAAQS), EPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries).

Mobile Source Air Toxics (MSATs) are a subset of the 188 air toxics defined by the Clean Air Act. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

The EPA is the lead Federal Agency for administering the Clean Air Act and has certain responsibilities regarding the health effects of MSATs. The EPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources. 66 FR 17229 (March 29, 2001). This rule was issued under the authority in Section 202 of the Clean Air Act. In its rule, EPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline (RFG) program, its national low emission vehicle (NLEV) standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, FHWA projects that even with a 64 percent increase in VMT, these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and will reduce on-highway diesel PM emissions by 87 percent, as shown in the following graph.

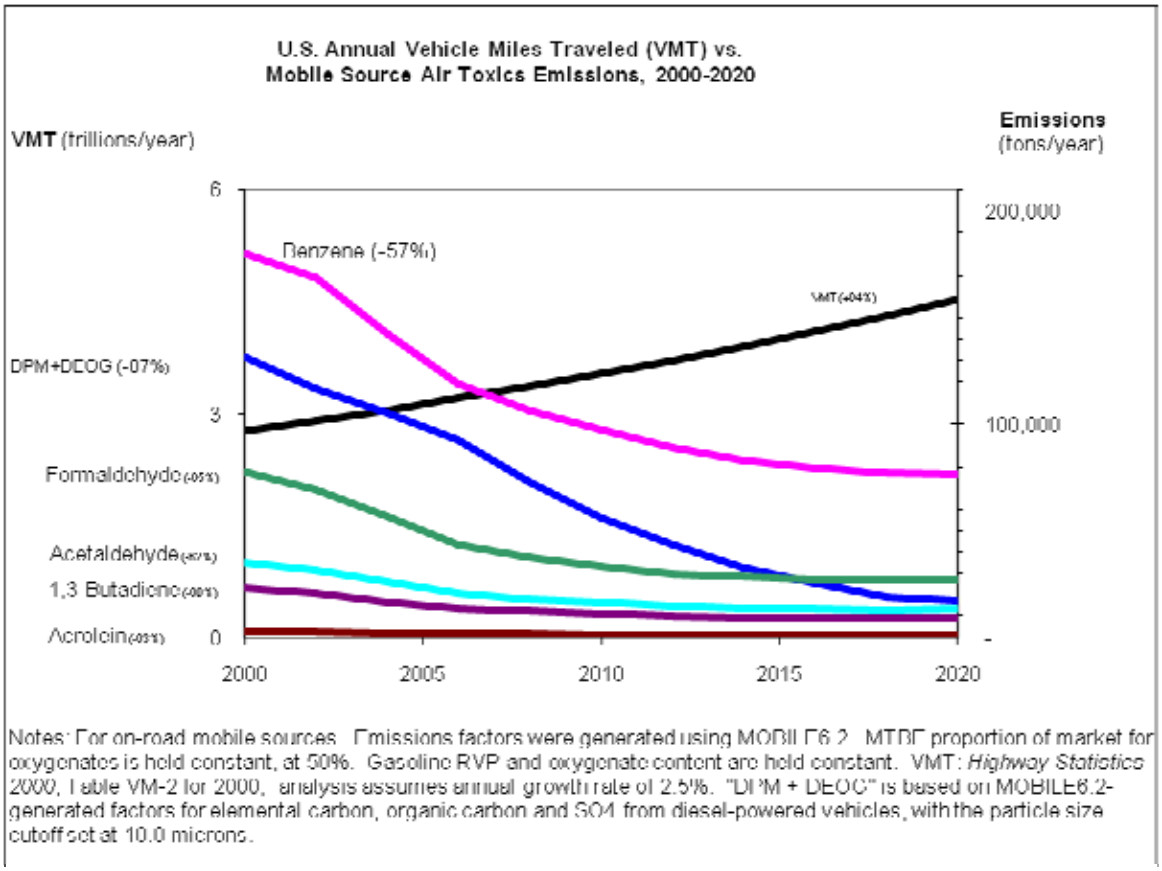

FIGURE 1: VMT VS. MOBILE SOURCE AIR TOXICS

The purpose of this project is to replace the existing and functionally deficient bridges. The project will be built on a slightly new alignment; however, the project will not result in any meaningful changes in traffic volumes, vehicle mix, location of the existing facility, or any other factor that would cause an increase in emissions impacts relative to the no-build alternative. As such, it is expected that the project will generate minimal air quality impacts for Clean Air Act criteria pollutants and the project has not been linked with any special MSAT concerns. Consequently, the project should be exempt from analysis for MSATS.

Moreover, the referenced EPA regulations for vehicle engines and fuels will cause overall MSATs to decline significantly over the next twenty years. Even after accounting for a 64 percent increase in VMT, FHWA predicts MSATs will decline in the range of 57 percent to 87 percent, from 2000 to 2020, based on regulations now in effect, even with a projected 64 percent increase in VMT. This will both reduce the background level of MSATs as well as the possibility of even minor MSAT emissions from this project.

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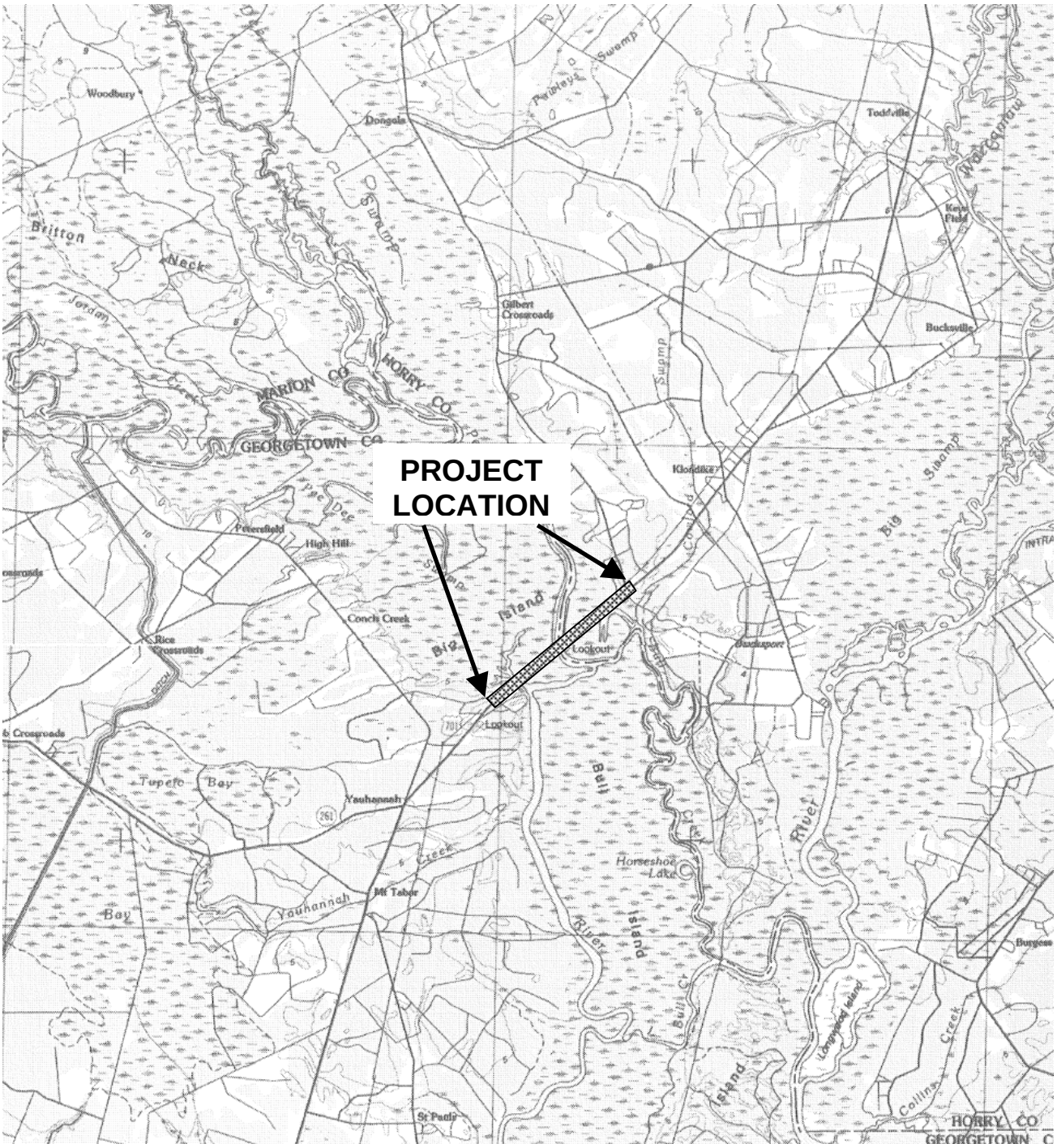

Shaded Area Indicates County Location in SC

FIGURE 1
U.S. 701 BRIDGE REPLACEMENT PROJECT
HORRY AND GEORGETOWN COUNTIES, S.C.

SCALE 0 2 MILE

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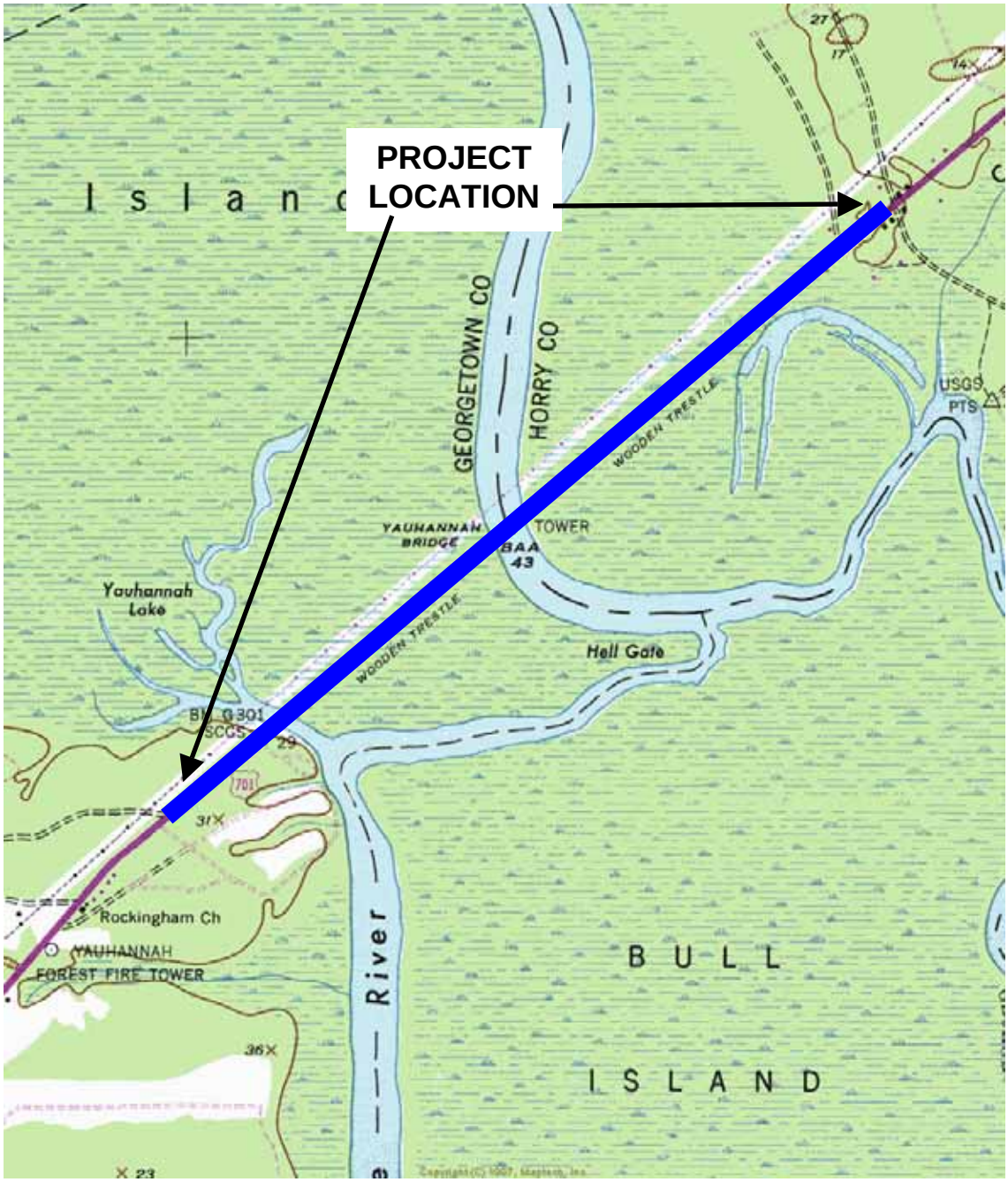

USGS 7.5 Minute Yauhannah Quad

Shaded Area Indicates County Location in SC

FIGURE 2
U.S. 701 BRIDGE REPLACEMENT PROJECT
HORRY AND GEORGETOWN COUNTIES, S.C.

NO SCALE

N

Appendix A

Threatened / Endangered Species

τβα Tuhin Basu & Associates, Inc.
7921 Jones Branch Dr., Suite 545
McLean, Virginia 22102

703-918-9870
FAX: 703-918-9878

FAX TRANSMITTAL

To:	**Richard Ciccolella**	**Firm:**	ARM Environmental Services, Inc.
From:	Harry Parrish	**Date:**	May 13, 2005
Fax:	803-783-2587	**Phone:**	803-783-3314
Pages:	7 **(including cover)**	**CC:**	
RE:	Fish & Wildlife Letter		

NOTES:

Attached for your records is a copy of a letter from the Fish & Wildlife Service as a follow-up to the agency field meeting.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
176 Croghan Spur Road, Suite 200
Charleston, South Carolina 29407

May 9, 2005

Mr. Tuhin K. Basu, PE
Tuhin Basu and Associates, Inc.
7921 Jones Branch Drive, Suite 545
McLean, VA 22102

Re: U.S. Route 701 Bridges over Great Pee Dee River, Horry and Georgetown Counties, SC

Dear Mr. Basu:

The U.S. Fish and Wildlife Service (Service) has prepared the following comments based upon our recent onsite, multi-agency field visit of April 28 ,2005, concerning the proposed replacement of three separate bridges along US Hwy 701 spanning the Great Pee Dee River between Georgetown and Conway, SC. This project entails constructing three new bridges and two causeways adjacent and parallel to the older bridges and causeways.

Two replacement alternatives were proposed for the Hwy. 701 bridges over the Great Pee Dee River, one on either side of the existing corridor. The centerline for both of the proposals are planned to be 45 feet from the existing centerline incorporating a significant portion of the existing fill into the new design. The proposed bridges will be constructed at a higher elevation than the existing bridges and, therefore, span a greater length over the river and associated floodplain.

Please find attached a list of threatened and endangered (T&E) species known to occur in Georgetown County. This list includes species of state and federal concern. SCDOT's reconnaissance efforts for the Hwy 701 project's biological assessment must include a search for the federally listed T&E species. We also recommend SCDOT include the state listed species in its biological/ecological review. A preliminary review by Service personnel has found that at least two species of concern, the Rafinesque's big-eared bat, *Corynorhinus rafinesquii*, and Swallow-tailed kite, *Elanoides forficatus*, occur in the area. With the planned removal of the existing bridges we recommend SCDOT incorporate design features into the bridge that will encourage bat use as well as consider potential impacts to the kite. Please contact the S.C. Department of Natural Resources for further information on these species and their habitat requirements.

The Service is concerned with the continuing habitat fragmentation consequent to the causeways' initial construction. Our commitment to conserve, protect and enhance our natural resources drives us to seek opportunities such as this to re-establish, to the maximum extent possible, the historical floodplain habitat of the Great Pee Dee River To this end we implore SCDOT consider bridging the entire length of the Great Pee Dee River and its floodplain. If bridging the entire area is not feasible, we recommend the integration of multiple floodplain culverts and wildlife passages into the new causeway in an attempt to provide a measure of restoration. Service personnel would be happy to assist SCDOT is determining the best location and design for these structures.

Irrespective of the final structural design, the Service favors the northwestern alternative for Hwy. 701. This side of the roadway has been previously impacted through the placement of a transmission line and Cowford Lake, a sensitive aquatic area, is located on the opposite, southeastern side. Finally, SCDOT should review its agreement with the Waccamaw National Wildlife Refuge regarding the US Hwy. 701 right of way and its impact upon the Refuge's proposed Environmental Education center.

The Service appreciates the opportunity to comment on this project early in the planning phase and look forward to working closely with you in the future. If you have any questions on Service comments please contact Mark Caldwell of this office at (843) 727-4707 ext. 215.

Sincerely,

Timothy N. Hall
Field Supervisor

INH/MAC

cc:
Mr. Berry Still, SCDOT, Columbia, SC
Mr. Craig Sasser, Manager, Waccamaw National Wildlife Refuge, Georgetown, SC

South Carolina Distribution Records of
Endangered, Threatened, Candidate and Species of Concern
March, 2005

E Federally endangered
T Federally threatened
P Proposed in the Federal Register
CH Critical Habitat
C The U.S Fish and Wildlife Service or the National Marine Fisheries Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list these species
S/A Federally protected due to similarity of appearance to a listed species
SC Federal Species of concern. These species are rare or limited in distribution but are not currently legally protected under the Endangered Species Act.
* Contact the National Marine Fisheries Service for more information on this species

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated continually and may be different from the following.

County	Common Name	Scientific Name	Status	Occurrence
Georgetown				
	West Indian manatee	Trichechus manutus	E	Known
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Red-cockaded woodpecker	Picoides borealis	E	Known
	Wood stork	Mycteria americana	E	Known
	Piping plover	Charadrius melodus	T, CH	Known
	Kemp's ridley sea turtle	Lepidochelys kempii*	E	Known
	Leatherback sea turtle	Dermochelys coriacea*	E	Known
	Loggerhead sea turtle	Caretta caretta	T	Known
	Green sea turtle	Chelonia mydas*	T	Known
	Shortnose sturgeon	Acipenser brevirostrum*	E	Known
	Sea-beach amaranth	Amaranthus pumilus	T	Known
	Pondberry	Lindera melissifolia	E	Possible
	Canby's dropwort	Oxypolis canbyi	E	Possible
	Chaffseed	Schwalbea americana	E	Possible
	Southern Dusky Salamander	Desmognathus auriculatus	SC	Possible

	Georgia lead-plant	Amorpha georgiana var. georgiana	SC	Known
	One-flower balduina	Balduina uniflora	SC	Known
	Venus' fly-trap	Dionaea muscipula	SC	Known
	Southern bog-button	Lachnocaulon beyrichianum	SC	Known
	Pondspice	Litsea aestivalis	SC	Known
	Carolina bogmint	Macbridea caroliniana	SC	Known
	Savannah or Piedmont cowbane	Oxypolis ternata	SC	Known
	Carolina grass-of-parnassus	Parnassia caroliniana	SC	Known
	Pineland plantain	Plantago sparsiflora	SC	Known
	Awned meadowbeauty	Rhexia aristosa	SC	Known
	Wire-leaved dropseed	Sporobolus teretifolius	SC	Known
	Reclined meadow-rue	Thalictrum subrotundum	SC	Known
	Kirtland's Warbler	Dendroica kirtlandii	E	Possible
	Dune bluecurls	Trichostema sp 1	SC	Known
	Bachman's sparrow	Aimophia aestivalis	SC	Known
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	Red knot	Calidris canutus	SC	Possible
	Black-throated green warbler	Dendroica virens	SC	Possible
	Swallow-tailed kite	Elanoides forficatus forficatus	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	American oystercatcher	Haematopus palliatus	SC	Known
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Black rail	Laterallus jamaicensis	SC	Possible
	Swainson's warbler	Limnothlypis swainsonii	SC	Known
	Painted bunting	Passerina ciris ciris	SC	Possible
	Gull-billed tern	Sterna nilotica	SC	Known
	Carolina pygmy sunfish	Elassoma boehlkei	SC	Known
	Rafinesque's big-eared bat	Corynorhinus rafinesquii	SC	Known
	Southern hognose snake	Heterodon simus	SC	Possible
	Pine or Gopher snake	Pituophis melanoleucus melanoleucus	SC	Known

Horry				
	West Indian manatee	Trichechus manutus	E	Known
	Red-cockaded woodpecker	Picoides borealis	E	Known
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Wood stork	Mycteria americana	E	Known
	Piping plover	Charadrius melodus	T, CH	Known
	Kemp's ridley sea turtle	Lepidochelys kempii*	E	Known
	Leatherback sea turtle	Dermochelys coriacea*	E	Known
	Loggerhead sea turtle	Caretta caretta	T	Known
	Green sea turtle	Chelonia mydas*	T	Possible
	Shortnose sturgeon	Acipenser brevirostrum*	E	Known
	Sea-beach amaranth	Amaranthus pumilus	T	Known
	Pondberry	Lindera melissifolia	E	Possible
	Canby's dropwort	Oxypolis canbyi	E	Possible
	Chaff-seed	Schwalbea americana	E	Known
	Southern Dusky Salamander	Desmognathus auriculatus	SC	Possible
	Georgia lead-plant	Amorpha georgiana var. georgiana	SC	Known
	One-flower balduina	Balduina uniflora	SC	Known
	Ciliate-leaf tickseed	Coreopsis integrifolia	SC	Known
	Venus' fly-trap	Dionaea muscipula	SC	Known
	Dwarf burhead	Echinodorus parvalus	SC	Known
	Harper's fimbristylis	Fimbristylis perpusilla	SC	Known
	Southern bog-button	Lachnocaulon beyrichianum	SC	Known
	Pondspice	Litsea astivalis	SC	Known
	Carolina bogmint	Macbridea caroliniana	SC	Known
	Piedmont cowbane	Oxypolis ternata	SC	Known
	Carolina grass-of-parnassus	Parnassia caroliniana	SC	Known
	Pineland plantain	Plantago sparsiflora	SC	Known
	Crested fringed orchid	Pteroglossaspis ecristata	SC	Known
	Well's Pyxie Moss	Pyxidanthera barbulata var barbulata	SC	Known
	Wire-leaved dropseed	Sporobolus teretifolius	SC	Known

	Pickering's morning-glory	Stylisma pickerngii var. pickeringii	SC	Known
	White false-asphodel	Tofieldia glabra	SC	Known
	Kirtland's Warbler	Dendroica kirtlandii	E	Possible
	Bachman's sparrow	Aimophia aestivalis	SC	Known
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	Red knot	Calidris canutus	SC	Possible
	Swallow-tailed kite	Elanoides forficatus forficatus	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	American oystercatcher	Haematopus palliatus	SC	Known
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Painted bunting	Passerina ciris ciris	SC	Possible
	Gull-billed tern	Sterna nilotica	SC	Known
	Southern hognose snake	Heterodon simus	SC	Possible
	Northern pine snake	Pituophis melanoleucus melanoleucus	SC	Known
	Rafinesque's big-eared bat	Corynorhinus rafinesquii	SC	Known

http://www.fws.gov/charleston/docs/county_lists.htm#Listed%20Species%20in%20Horry%20County
4-8-09

Listed Species in Horry County				
Species	**Federal Status**	**State Status**	**Habitat**	**Threats**
Mammals				
West Indian manatee *Trichechus manatus*	E	E	coastal waters, estuaries, and warm water outfalls	initial decreases probably due to overharvesting for meat, oil and leather; current mortality due to collisions with boats and barges; decline also related to coastal development and loss of suitable habitat, particularly destruction of seagrass beds
Birds				
Red-cockaded woodpecker *Picoides borealis*	E	E	nest in mature pine with low understory vegetation (<1.5m); forage in pine and pine hardwood stands > 30 years of age, preferably > 10" dbh	reduction of older age pine stands and to encroachment of hardwood midstory in older age pine stands due to fire suppression
Bald eagle *Haliaeetus leucocephalus*	BGEPA	BGEPA	coastlines, rivers, large lakes or streams which provide adequate feeding grounds; typically nest in SC between late October and late May; tend to return year after year to the same nest tree, once they have successfully established a nest	human activities that can cause them to abandon nest, or to not properly incubate eggs, or care for young
Wood stork *Mycteria americana*	E	E	primarily feed in fresh and brackish wetlands and nest in cypress or other wooded swamps	decline due primarily to loss of suitable feeding habitat; other factors include loss of nesting habitat, prolonged

				drought/flooding, racoon predation on nests, and human disturbance of rookeries
Piping plover *Charadrius melodus*	T	T	winters on SC coast; prefers areas with expansive sand or mudflats (for foraging) in close proximity to a sand beach (for roosting)	habitat alteration and destruction and human disturbance in nesting colonies; recreational and commercial development have contributed greatly to loss of breeding habitat
Reptiles				
Kemp's ridley sea turtle *Lepidochelys kempii*	E	E	outside of nesting season, primarily found in the nearshore and inshore waters of the Gulf of Mexico, although immatures have been observed along the Atlantic as far north as Massachusetts	overharvesting of eggs and adults for food and skins, drowning when caught in shrimp nets
Leatherback sea turtle *Dermochelys coriacea*	E	E	rarely nests in SC, visits often coincide with periodic abundance of cannonball jellyfish; distributed worldwide in tropical and temperate waters of the Atlantic, Pacific and Indian Oceans; most pelagic of the sea turtles	loss or degradation of nesting habitat due to coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; and incidental take from channel dredging and commercial trawling
Loggerhead sea turtle *Caretta caretta*	T	T	nests on SC ocean beaches, forages primarily on mollusks and crustaceans in shallow ocean waters and stream channels, widely distributed throughout the world	loss or degradation of nesting habitat due to coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; and incidental take from channel dredging and commercial

				trawling
Green sea turtle *Chelonia mydas*	T	T	rarely nests in SC, generally found in fairly shallow waters (except when migrating) inside reefs, bays and inlets	exploitation for food, high levels of predation, loss of nesting habitat due to human encroachment, hatchling disorientation due to artificial lights on beaches, and drowning when trapped in fishing and shrimping nets
Fishes				
Shortnose sturgeon *Acipenser brevirostrum*	E	E	occur in most major river systems along the eastern seaboard	habitat alterations from discharges, dredging or disposal of material into rivers, or related development activities involving estuarine/riverine mudflats and marshes; commercial exploitation up until the 1950s
Plants				
Sea-beach amaranth *Amaranthus pumilus*	T	T	Atlantic coast barrier island beaches, on overwash flats at accreting ends of islands and lower foredunes of non-eroding beaches	beach-armoring, construction of other beach-stabilization structures, beach grooming, insect herbivory, off-road vehicles
Pondberry *Lindera melissifolia*	E	E	found in swamp and pond margins, sandy sinks, swampy depressions or wet flats that are subject to drying but the roots are submerged at times	drainage ditching and subsequent conversion of habitat to other uses, lack of seedling production

Canby's dropwort *Oxypolis canbyi*	E	E	found in pond-cypress savannahs in Carolina Bay formations dominated by grasses and sedges or ditches next to bays; prefer borders and shallows of cypress-pond pine ponds and sloughs	loss or alteration of wetland habitats
American chaffseed *Schwalbea americana*	E	E	found in various sandy soil areas on the coastal plain; plants are usually found on margins of savannas and cypress ponds that are seasonally wet; best managed by prescribed fire	fire suppression, habitat conversion, and incompatible agriculture and forestry practices

http://www.fws.gov/charleston/docs/county_lists.htm#Listed%20Species%20in%20Georgetown%20County
4-8-09

Listed Species in Georgetown County				
Species	**Federal Status**	**State Status**	**Habitat**	**Threats**
Mammals				
West Indian manatee *Trichechus manatus*	E	E	coastal waters, estuaries, and warm water outfalls	initial decreases probably due to overharvesting for meat, oil and leather; current mortality due to collisions with boats and barges; decline also related to coastal development and loss of suitable habitat, particularly destruction of seagrass beds
Birds				
Bald eagle *Haliaeetus*	BGEPA	BGEPA	coastlines, rivers, large lakes or streams which provide adequate feeding	human activities that can cause them to abandon nest, or to not

leucocephalus			grounds; typically nest in SC between late October and late May; tend to return year after year to the same nest tree, once they have successfully established a nest	properly incubate eggs, or care for young
Red-cockaded woodpecker *Picoides borealis*	E	E	nest in mature pine with low understory vegetation (<1.5m); forage in pine and pine hardwood stands > 30 years of age, preferably > 10" dbh	reduction of older age pine stands and to encroachment of hardwood midstory in older age pine stands due to fire suppression
Wood stork *Mycteria americana*	E	E	primarily feed in fresh and brackish wetlands and nest in cypress or other wooded swamps	decline due primarily to loss of suitable feeding habitat; other factors include loss of nesting habitat, prolonged drought/flooding, racoon predation on nests, and human disturbance of rookeries
Piping plover *Charadrius melodus*	T	T	winters on SC coast; prefers areas with expansive sand or mudflats (for foraging) in close proximity to a sand beach (for roosting)	habitat alteration and destruction and human disturbance in nesting colonies; recreational and commercial development have contributed greatly to loss of breeding habitat
Reptiles				
Kemp's ridley sea turtle *Lepidochelys kempii*	E	E	outside of nesting season, primarily found in the nearshore and inshore waters of the Gulf of Mexico, although immatures have been observed along the Atlantic as far north as Massachusetts	overharvesting of eggs and adults for food and skins, drowning when caught in shrimp nets

Leatherback sea turtle *Dermochelys coriacea*	E	E	rarely nests in SC, visits often coincide with periodic abundance of cannonball jellyfish; distributed worldwide in tropical and temperate waters of the Atlantic, Pacific and Indian Oceans; most pelagic of the sea turtles	loss or degradation of nesting habitat due to coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; and incidental take from channel dredging and commercial trawling
Loggerhead sea turtle *Caretta caretta*	T	T	nests on SC ocean beaches, forages primarily on mollusks and crustaceans in shallow ocean waters and stream channels, widely distributed throughout the world	loss or degradation of nesting habitat due to coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; and incidental take from channel dredging and commercial trawling
Green sea turtle *Chelonia mydas*	T	T	rarely nests in SC, generally found in fairly shallow waters (except when migrating) inside reefs, bays and inlets	exploitation for food, high levels of predation, loss of nesting habitat due to human encroachment, hatchling disorientation due to artificial lights on beaches, and drowning when trapped in fishing and shrimping nets
Fishes				
Shortnose sturgeon *Acipenser brevirostrum*	E	E	occur in most major river systems along the eastern seaboard	habitat alterations from discharges, dredging or disposal of material into rivers, or related development activities involving estuarine/riverine mudflats and marshes; commercial exploitation up until

				the 1950s
Plants				
Sea-beach amaranth *Amaranthus pumilus*	T	T	Atlantic coast barrier island beaches, on overwash flats at accreting ends of islands and lower foredunes of non-eroding beaches	beach-armoring, construction of other beach-stabilization structures, beach grooming, insect herbivory, off-road vehicles
Pondberry *Lindera melissifolia*	E	E	found in swamp and pond margins, sandy sinks, swampy depressions or wet flats that are subject to drying but the roots are submerged at times	drainage ditching and subsequent conversion of habitat to other uses, lack of seedling production
Canby's dropwort *Oxypolis canbyi*	E	E	found in pond-cypress savannahs in Carolina Bay formations dominated by grasses and sedges or ditches next to bays; prefer borders and shallows of cypress-pond pine ponds and sloughs	loss or alteration of wetland habitats
American chaffseed *Schwalbea americana*	E	E	found in various sandy soil areas on the coastal plain; plants are usually found on margins of savannas and cypress ponds that are seasonally wet; best managed by prescribed fire	fire suppression, habitat conversion, and incompatible agriculture and forestry practices

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Endangered and Threatened Species and Critical Habitats
under the Jurisdiction of the NOAA Fisheries Service

South Carolina

Listed Species	Scientific Name	Status	Date Listed
Marine Mammals			
blue whale	*Balaenoptera musculus*	Endangered	12/02/70
finback whale	*Balaenoptera physalus*	Endangered	12/02/70
humpback whale	*Megaptera novaeangliae*	Endangered	12/02/70
North Atlantic right whale	*Eubalaena glacialis*	Endangered	12/02/70
sei whale	*Balaenoptera borealis*	Endangered	12/02/70
sperm whale	*Physeter macrocephalus*	Endangered	12/02/70
Turtles			
green sea turtle	*Chelonia mydas*	Threatened[1]	07/28/78
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	12/02/70
leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/70
loggerhead sea turtle	*Caretta caretta*	Threatened	07/28/78
Fish			
shortnose sturgeon	*Acipenser brevirostrum*	Endangered	03/11/67

Designated Critical Habitat
None

Species Proposed for Listing
None

Proposed Critical Habitat
None

[1] Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered

South Carolina

Candidate Species[2]	Scientific Name
none	

Species of Concern[3]	Scientific Name
Fish	
Atlantic sturgeon	*Acipenser oxyrhynchus oxyrhynchus*
dusky shark	*Carcharhinus obscurus*
night shark	*Carcharinus signatus*
sand tiger shark	*Carcharias taurus*
speckled hind	*Epinephelus drummondhayi*
Warsaw grouper	*Epinephelus nigritus*
Invertebrates	
ivory tree coral	*Oculina varicosa*

[2] The Candidate Species List has been renamed the Species of Concern List. The term candidate species is limited to species that are the subject of a petition to list and for which NOAA Fisheries Service has determined that listing may be warranted (69 FR 19975).

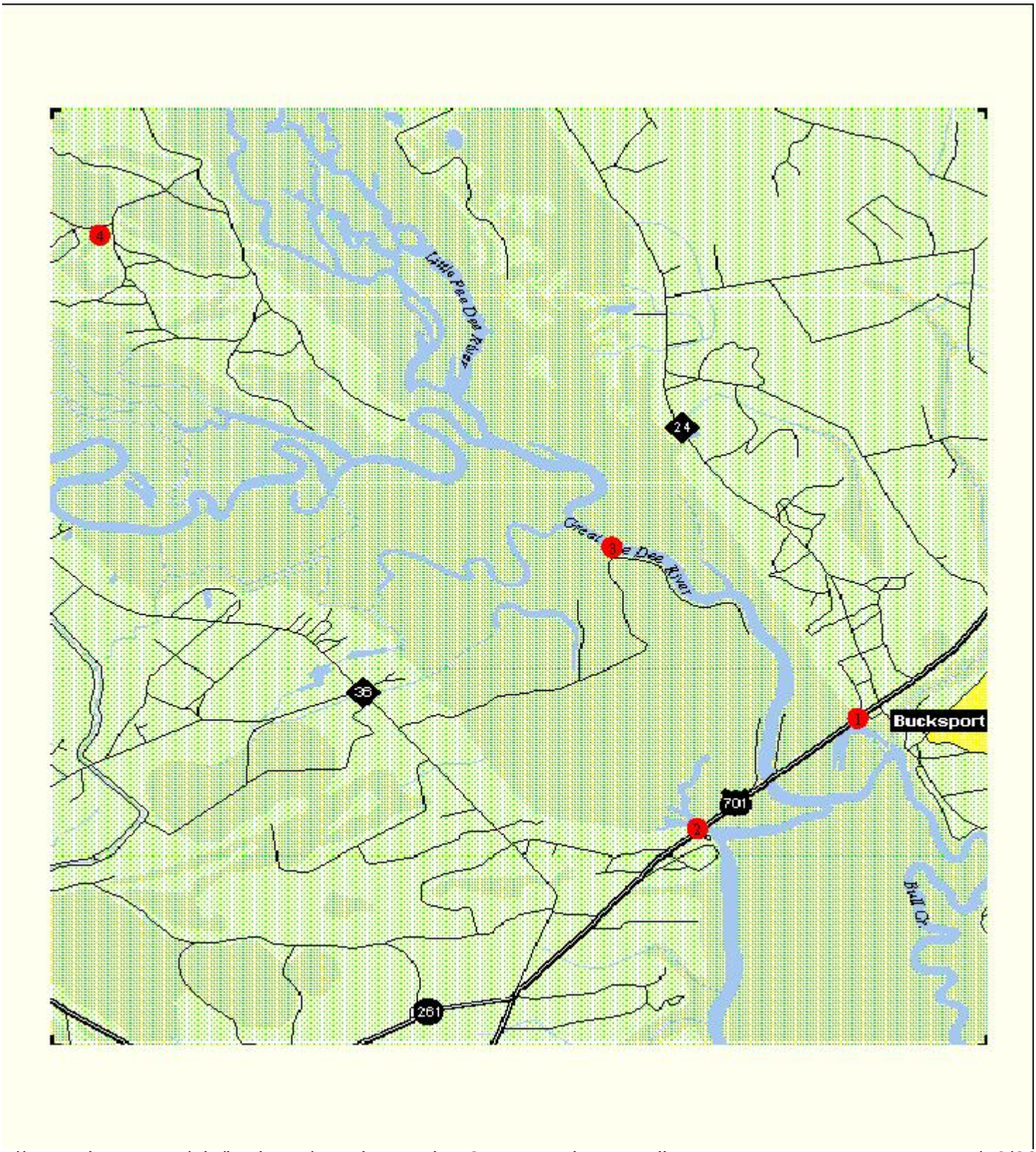
[3] Species of Concern are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided

South Carolina Rare, Threatened & Endangered Species Inventory

Species Map of the YAUHANNAH Quadrangle

Data Last Updated January 17th, 2006.

Refer to Table Below Map for List of Species at the Location of Interest Indicated on the Map



Map Legend

Marker ID	Genus species
1	CORYNORHINUS RAFINESQUII
2	CORYNORHINUS RAFINESQUII
3	COLONIAL WATERBIRD
4	COLONIAL WATERBIRD

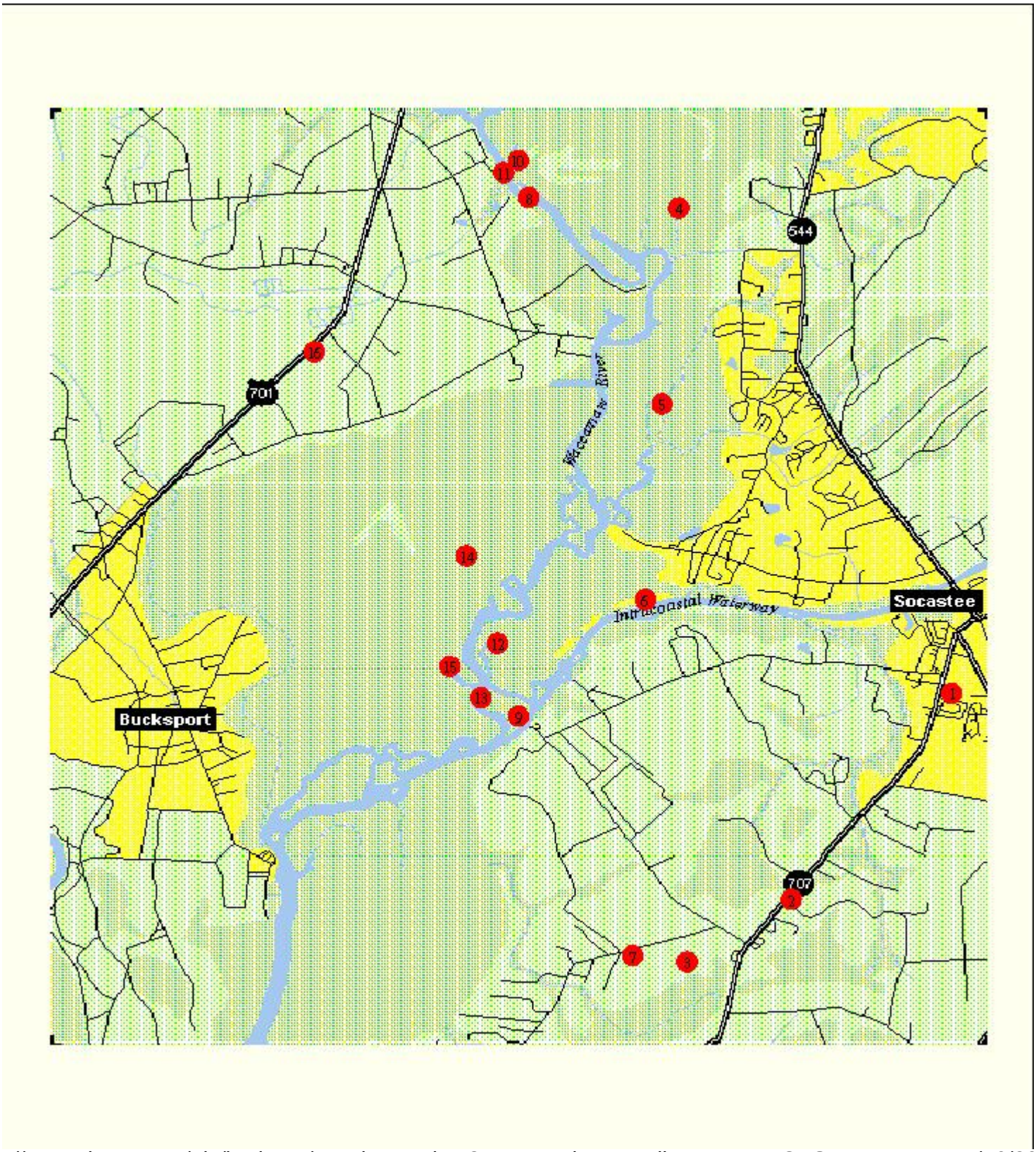
[Horry County Quad Selection Map | County Selection Map | SCDNR GIS Data Home Page]

South Carolina Rare, Threatened & Endangered Species Inventory

Species Map of the BUCKSVILLE Quadrangle

Data Last Updated January 17th, 2006.

Refer to Table Below Map for List of Species at the Location of Interest Indicated on the Map



Map Legend

Marker ID	Genus species
1	DIONAEA MUSCIPULA
2	PLANTAGO SPARSIFLORA
3	ANDROPOGON MOHRII
3	SPOROBOLUS TERETIFOLIUS
3	ANTHAENANTIA RUFA
4	PHYSOSTEGIA LEPTOPHYLLA
5	PHYSOSTEGIA LEPTOPHYLLA
6	FUNDULUS DIAPHANUS
7	PTEROGLOSSASPIS ECRISTATA
7	PARNASSIA CAROLINIANA
7	AGALINIS APHYLLA
7	ANTHAENANTIA RUFA
7	COREOPSIS GLADIATA
7	SCHWALBEA AMERICANA
8	ILEX AMELANCHIER
9	COLONIAL WATERBIRD
10	SABATIA KENNEDYANA
11	VILLOSA DELUMBIS
12	PHYSOSTEGIA LEPTOPHYLLA
13	ILEX AMELANCHIER
14	PHYSOSTEGIA LEPTOPHYLLA
15	COLONIAL WATERBIRD
16	RHYNCHOSPORA OLIGANTHA
16	SPOROBOLUS TERETIFOLIUS
16	SCLERIA BALDWINII

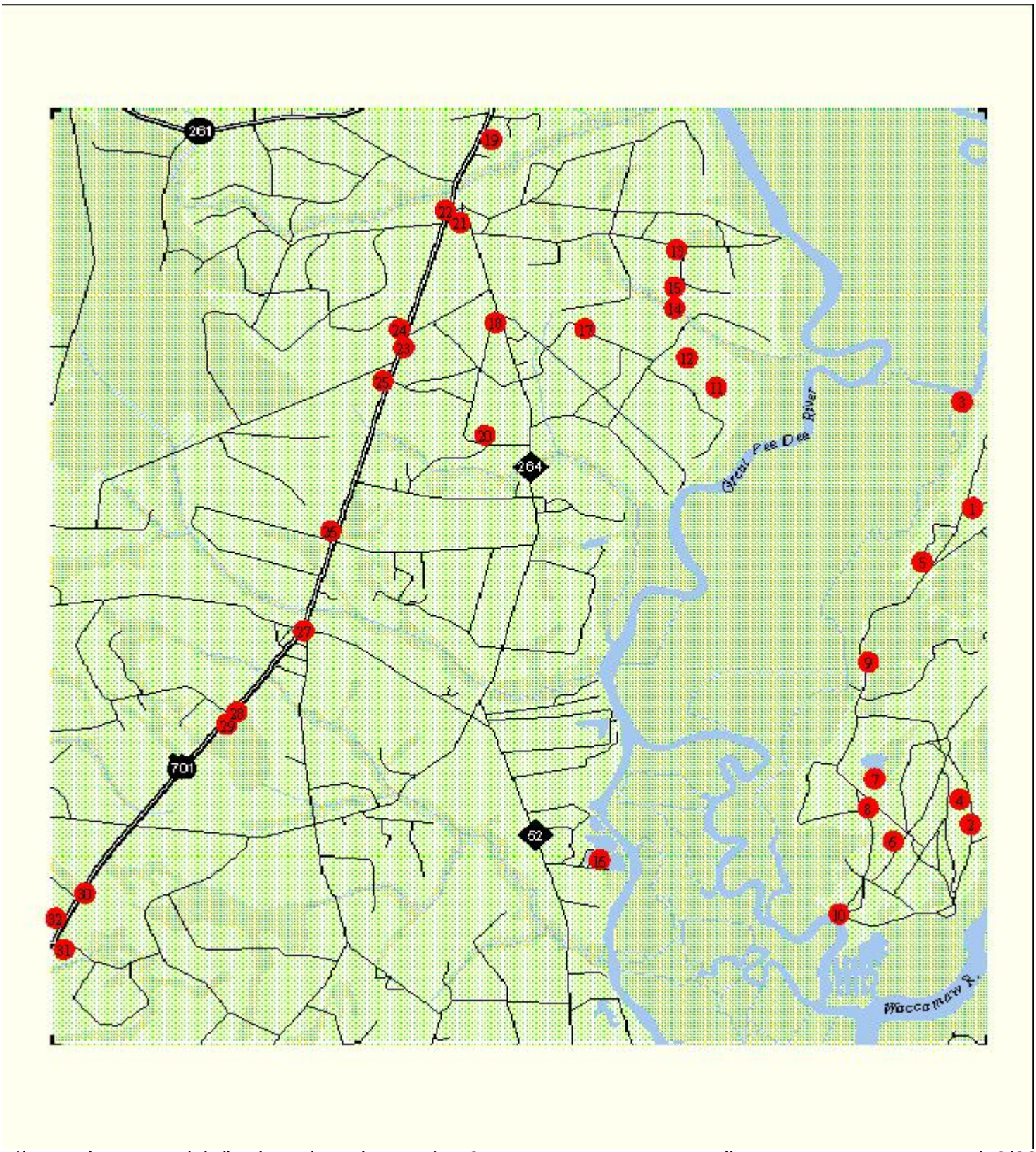
[Horry County Quad Selection Map | County Selection Map | SCDNR GIS Data Home Page]

South Carolina Rare, Threatened & Endangered Species Inventory

Species Map of the PLANTERSVILLE Quadrangle

Data Last Updated January 17th, 2006.

Refer to Table Below Map for List of Species at the Location of Interest Indicated on the Map



Map Legend

Marker ID	Genus species
1	LITSEA AESTIVALIS
2	LACHNOCAULON BEYRICHIANUM
3	STACHYS TENUIFOLIA
4	ELEOCHARIS VIVIPARA
5	CYPERUS LECONTEI
6	RHYNCHOSPORA INUNDATA
6	ELEOCHARIS ROBBINSII
7	ELEOCHARIS VIVIPARA
7	SAGITTARIA ISOETIFORMIS
8	LITSEA AESTIVALIS
8	RHYNCHOSPORA INUNDATA
9	COLONIAL WATERBIRD
10	ARISTIDA CONDENSATA
11	SPOROBOLUS TERETIFOLIUS
11	PLATANTHERA LACERA
11	PLATANTHERA INTEGRA
11	PARNASSIA CAROLINIANA
11	GENTIANA AUTUMNALIS
12	PARNASSIA CAROLINIANA
13	COLONIAL WATERBIRD
13	COLONIAL WATERBIRD
14	GENTIANA AUTUMNALIS
15	BALDUINA UNIFLORA
16	HALIAEETUS LEUCOCEPHALUS
17	PARNASSIA CAROLINIANA
18	PARNASSIA CAROLINIANA
18	SPOROBOLUS TERETIFOLIUS
19	PLATANTHERA INTEGRA
20	SPOROBOLUS TERETIFOLIUS
21	BALDUINA UNIFLORA
22	AIMOPHILA AESTIVALIS
22	PICOIDES BOREALIS
22	PARNASSIA CAROLINIANA
22	SPOROBOLUS TERETIFOLIUS
23	SPOROBOLUS TERETIFOLIUS
23	XYRIS SEROTINA
23	XYRIS DIFFORMIS VAR FLORIDANA
24	SPIRANTHES LACINIATA
24	COREOPSIS GLADIATA
25	ANTHAENANTIA RUFA

25	PARNASSIA CAROLINIANA
26	PARNASSIA CAROLINIANA
27	LASIURUS INTERMEDIUS
28	RHYNCHOSPORA OLIGANTHA
29	COREOPSIS GLADIATA
30	PLANTAGO SPARSIFLORA
30	RHYNCHOSPORA GLOBULARIS VAR PINETORUM
31	GENTIANA AUTUMNALIS
32	PLATANTHERA INTEGRA

[Georgetown County Quad Selection Map | County Selection Map | SCDNR GIS Data Home Page]

Richard Ciccolella

From: "Mark Collins" <collinsm@mrd.dnr.state.sc.us>
To: "Richard Ciccolella" <rciccolella@armenv.com>
Sent: Monday, January 10, 2005 10:14 AM
Subject: RE: Shortnose Sturgeon

Shortnose sturgeon definitely occur in the PeeDee. Based on our telemetry work, they make a spawning migration past that bridge (upriver and then downriver) during January-midApril. I would suggest that period be a window of no blasting, piledriving, or other loud construction activity that might disrupt the migration.

Mark R. Collins, Ph.D
Marine Resources Research Institute
SC Dept. of Natural Resources
P.O.Box 12559
Charleston, SC 29422

843-953-9815

-----Original Message-----
From: Richard Ciccolella [mailto:rciccolella@armenv.com]
Sent: Friday, January 07, 2005 4:14 PM
To: Mark Collins
Cc: Harry Parrish
Subject: Shortnose Sturgeon

Dr. Mark Collins
SCDNR
Marine Resources Division
217 Ft. Johnson Road
P.O. Box 12559
Charleston, SC 29412

Dr. Collins,
We are assisting Tuhin Basu & Associates with the collection of data necessary for the completion of an SCDOT Environmental Assessment related to the proposed replacement of the US 701 Bridges over the Great Pee Dee River, Pee Dee Overflow, and Lake Yauhannah, between Georgetown and Horry Counties.

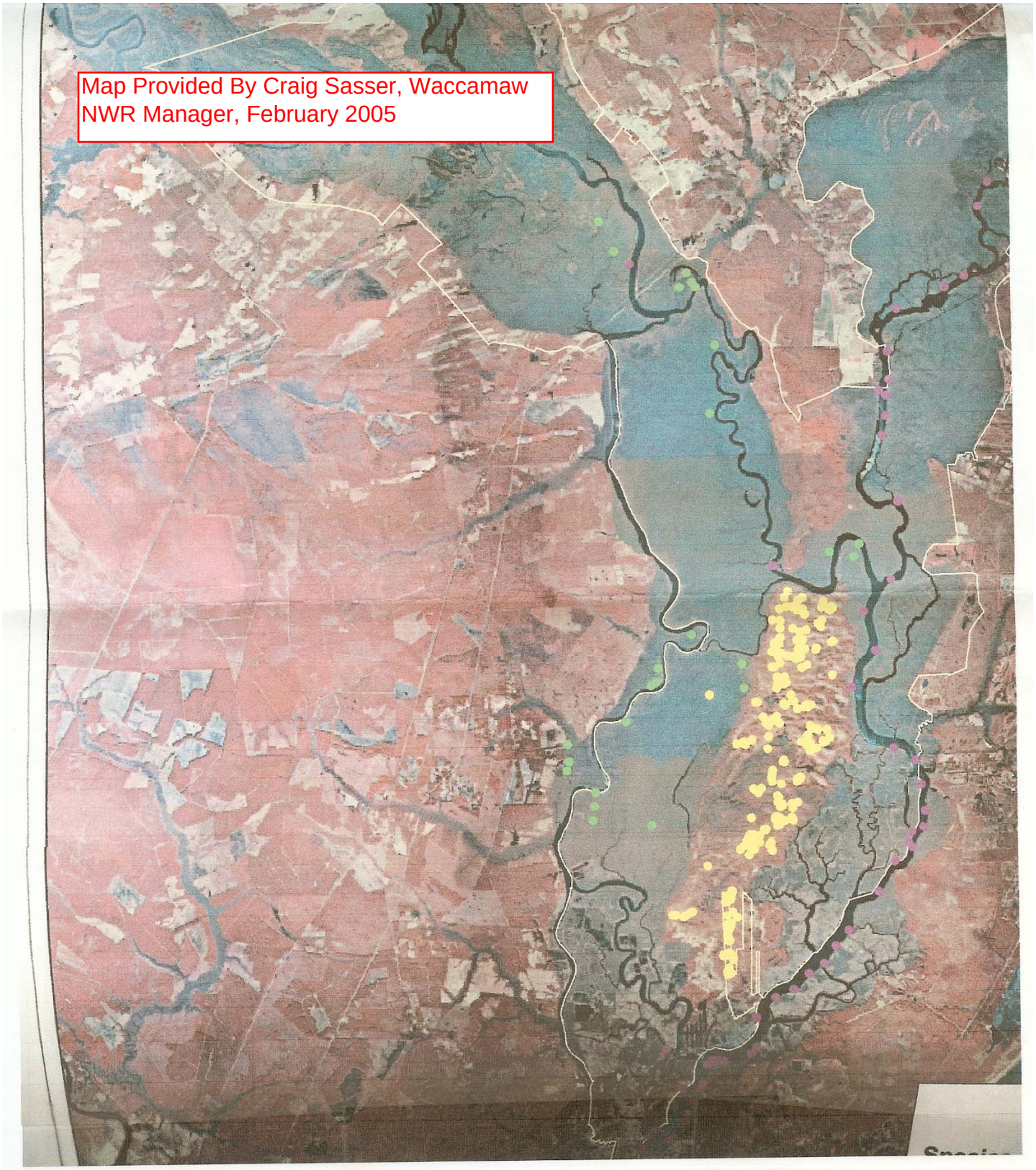
The shortnose sturgeon is listed for both of these counties, and I understand that it may potentially occur in the Great Pee Dee River. I also understand that the sturgeon would likely make seasonal migrations upstream and downstream. I wanted to see if you could provide some input as to when the sturgeon would likely be present in the study area, as well as any other information that may be helpful in the planning stages of this project. I have attached location maps of the project area.

I sincerely appreciate your time. Please feel free to contact me at the number below or my e-mail address.

Thank you,

Richard Ciccolella
ARM Environmental Services, Inc.
1210 First Street South Ext.
Columbia, SC 29209
(803) 783-3314
(803) 783-2587
rciccolella@armenv.com

Project Area Location Maps



BIRD DATA

Waccamaw National Wildlife Refuge

0 1.25 2.5 5 Miles

0 1.25 2.5 5 Kilometers

N W S

PINK - OSPREY
GREEN - KITE
- 2 YEARS OF DATA

YELLOW - RCW
FROM MTG W/ C. SASSER 2-15-05

Appendix B

Water Quality

03040201-170

(Pee Dee River)

General Description

Watershed 03040201-170 is located in Georgetown and Horry Counties and consists primarily of the ***Pee Dee River*** and its tributaries from the Little Pee Dee River to Winyah Bay. The watershed occupies 78,626 acres of the Lower Coastal Plain and Coastal Zone regions of South Carolina. The predominant soil types consist of an association of the Levy-Chastain-Yemassee-Yauhannah-Tawcaw series. The erodibility of the soil (K) averages 0.25; the slope of the terrain averages 1%, with a range of 0-2%. Land use/land cover in the watershed includes: 47.0% forested land, 25.8% forested wetland (swamp), 14.1% nonforested wetland (marsh), 5.6% scrub/shrub land, 4.2% water, 2.6% agricultural land, and 0.7% urban land.

This section of the Pee Dee River accepts drainage from its upper reaches, together with Conch Creek (Sally Branch), Bradley Branch (Sheep Pen Branch), and Bull Creek (Cowford Swamp, Horsepen Branch). Also draining into the Pee Dee River are Vandross Bay, Yauhannah Creek (Tupelo Bay), Pole Castle Branch, St. Pauls Branch, Cypress Creek, and Chapel Creek. Little Bull Creek connects Bull Creek to the Pee Dee River and Cooter Creek (Joe Bay) connects Little Bull Creek to Thoroughfare Creek. Streams that connect the Pee Dee River to the Waccamaw River include Bull Creek, Thoroughfare Creek, Guendalose Creek/Bullins Creek, Squirrel Creek, Jericho Creek, and Middleton Cut. Carr Creek and Little Carr Creek connect the Pee Dee River to Jericho Creek. There are a total of 112.9 stream miles in this watershed, 354.0 acres of lakes and ponds, and 1,522.3 acres of estuarine areas. The streams are classified FW from the beginning of the watershed to the Pee Dee River's confluence with Thoroughfare Creek. Downstream of the confluence, the river is classified SB* (dissolved oxygen not less than daily average of 5.0 mg/l with a minimum of 4.0 mg/l) and its tributaries are classified SB.

Water Quality

Station #	Type	Class	Description
PD-061	P	FW	PEE DEE RIVER AT US 701 2.75 MILES NE YAUHANNAH
MD-080	P	SB	WINYAH BAY @ MARKER 92 AT MOUTH OF PEE DEE AND WACCAMAW RIVERS

Pee Dee River - There are two monitoring stations along this section of the Pee Dee River. Aquatic life uses are not supported at ***PD-061*** due to occurrences of zinc in excess of the aquatic life acute standards, including high concentrations of zinc measured in 1994 and 1997, and a very high concentration of zinc measured in 1995. In addition, there was a significant decreasing trend in dissolved oxygen. Significant decreasing trends in five-day biochemical oxygen demand, total nitrogen concentration, and total suspended solids suggest improving conditions for these parameters. A very high concentration of lead was measured in the 1994 sediment sample. Recreational uses are fully supported.

MD-080 is physically located in this watershed, but also reflects a mixing area of waters including Winyah Bay (03040207-040) and the Waccamaw River (03040206-150). Aquatic life uses are fully

supported at ***MD-080***; however, there is a significant decreasing trend in dissolved oxygen. Significant decreasing trends in five-day biochemical oxygen demand and total suspended solids suggest improving conditions for these parameters. Recreational uses are fully supported and a significant decreasing trend in fecal coliform bacteria concentration suggests improving conditions for this parameter.

A fish consumption advisory has been issued by the Department for mercury and includes the Pee Dee River within this watershed (see advisory p.115).

NPDES Program

Active NPDES Facilities

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
CHAPEL CREEK	SC0047660
GCW&SD/PLANTERSVILLE WTP	MINOR DOMESTIC
PIPE #: 001 FLOW: 0.001	WATER QUALITY
WQL FOR TRC; UNCONSTRUCTED	

Nonpoint Source Management Program

Mining Activities

MINING COMPANY	***PERMIT #***
MINE NAME	***MINERAL***
JAMES M. MILL, JR.	1073-43
INGLESIDE MINE	SAND/CLAY

Water Supply

Portions of this watershed fall within the Waccamaw Capacity Use Area and large groundwater uses must be reported (see Capacity Use Program p.23).

WATER USER (TYPE)	***REGULATED CAPACITY (MGD)***
STREAM	***PUMPING CAPACITY (MGD)***
GSW&SA/BULL CREEK REGIONAL WTP (M)	22.0
BULL CREEK	30.0

Growth Potential

There is a low potential for growth in this watershed, except for the area surrounding the City of Georgetown. A permit to expand the Georgetown treatment facility to 9.0 MGD is in process. This will allow Georgetown to incorporate the City of Andrews and Georgetown County with an expansion for the

city too. Water infrastructure is located in the Plantersville community and areas closer to the City of Georgetown. The portion of the Georgetown area within this watershed should see primarily commercial and residential growth. Outside of this area, the watershed is predominately rural with some agricultural uses and timberlands.

Watershed Protection and Restoration

Special Projects

Establishment of National Wildlife Refuge in Coastal South Carolina

In 1997, the U.S. Fish and Wildlife Service established the **Waccamaw National Wildlife Refuge**. The refuge extends over portions of the Pee Dee River and the Waccamaw River incorporating this watershed along with portions of watersheds 03040206-140 and 03040206-150. The purpose of the refuge is to protect and manage an important coastal river ecosystem, which includes a significant number of rare and endangered species, and large contiguous blocks of riverine wetlands and bottomland hardwood forests that provide habitat for wetland-dependent wildlife. The refuge also provides compatible wildlife-dependent recreational activities, such as hunting, fishing, wildlife observation, and environmental education. The refuge was established due to the cooperative efforts of the Winyah Bay Focus Area Task Force, a regional coalition of federal and state agencies, industry, conservation organizations, and citizens.

03040207-02

(Great Pee Dee River/Winyah Bay)

General Description

Watershed 03040207-02 (formerly 03040201-160, 03040201-170, and a portion of 03040207-040) is located in Marion, Florence, Williamsburg, Georgetown, and Horry Counties and consists primarily of the final segment of the ***Great Pee Dee River*** from the Lynches River through ***Winyah Bay*** and their tributaries. The watershed occupies 259,235 acres of the Lower Coastal Plain and Coastal Zone regions of South Carolina. Land use/land cover in the watershed includes: 30.0% forested wetland, 22.6% forested land, 20.3% water, 14.2% agricultural land, 6.9% nonforested wetland, 3.2% scrub/shrub land, 2.4% urban land, and 0.4% barren land.

This lowest section of the Great Pee Dee River accepts drainage from its upper reaches, together with Crooked Lake, Negro Lake Run (Maple Swamp), and Clark Creek (Muddy Creek, Mill Creek, Soccee Swamp, Island Branch, Cedar Branch). Apple Orchard Slough and Staple Lake connect Clark Creek to the river. Further downstream, the river accepts drainage from Jacobs Creek, Port Creek (Flat Run Swamp, Boser Swamp, Squirrel Run Bay, Pennyroyal Swamp, Bells Swamp, Tyler Creek), Larrimore Gully, Gravel Gully Branch, and Jordan Lake (Jordan Creek). Dog Lake and several unnamed oxbow lakes drain into the river. Conch Creek (Sally Branch) enters the river next, followed by Bradley Branch (Sheep Pen Branch), and Bull Creek (Cowford Swamp, Horsepen Branch). Also draining into the Great Pee Dee River are Vandross Bay, Yauhannah Creek (Tupelo Bay), Pole Castle Branch, St. Pauls Branch, Cypress Creek, and Chapel Creek. Little Bull Creek connects Bull Creek to the Great Pee Dee River and Cooter Creek (Joe Bay) connects Little Bull Creek to Thoroughfare Creek. Streams that connect the Great Pee Dee River to the Waccamaw River include Bull Creek, Thoroughfare Creek, Guendalose Creek/Bullins Creek, Squirrel Creek, Jericho Creek, and Middleton Cut. Carr Creek and Little Carr Creek connect the Great Pee Dee River to Jericho Creek. The streams are classified FW from the beginning of the watershed to the Great Pee Dee River's confluence with Thoroughfare Creek. Downstream of the confluence, the river is classified SB* (dissolved oxygen not less than daily average of 5.0 mg/l with a minimum of 4.0 mg/l) and its tributaries are classified SB. Clark Creek and Muddy Creek are classified FW* (dissolved oxygen not less than 4.0 mg/l and pH between 5.0 and 8.5) and the remaining streams mentioned above are classified FW.

The Great Pee Dee River Watershed accepts drainage from the Sampit River Watershed and the Waccamaw River Watershed to form Winyah Bay, which is classified SB and drains into the Atlantic Ocean. White Oak Bay drains into the upper portion of Winyah Bay, and Kinloch Creek and Mosquito Creek (Lagoon Creek) drain into both Winyah Bay and North Santee Bay (in Santee River Basin), all classified SB. Esterville Minim Creek Canal (SA) runs along Cat Island and connects the North Santee Bay to Winyah Bay through the Western Channel (SB). Mud Bay (SB) drains into Winyah Bay and accepts drainage from No Mans Friend Creek (SB), Haulover Creek (SB), Sign Creek (SB), Jones Creek (Dividing Creek-SB, Nancy Creek-SB, Little Jones Creek-SFH, Boor Creek-ORW, Noble Slough-SB), and Cotton Patch Creek (SB). Jones Creek (SB, SFH, ORW) connects Mud Bay to North Inlet. Oyster Bay (SB) connects Jones Creek to

Town Creek (Sawmill Creek-SB, Cutoff Creek-SFH), both draining to Winyah Bay and North Inlet. There are a total of 351.9 stream miles, 629.6 acres of lake waters, and 16,642.3 acres of estuarine areas in this watershed.

Surface Water Quality

Station #	Type	Class	Description
PD-060	W/INT	FW	PEE DEE RIVER AT PETERS FIELD LANDING OFF S-22-36
PD-061	P/W	FW	PEE DEE RIVER AT US 701 2.75 MI NE OF YAUHANNAH
MD-275	INT	SB*	PEE DEE RIVER AT WHITE HOUSE PLANTATION
MD-080	P/W	SB	WINYAH BAY AT MARKER 92 AT MOUTH OF PEE DEE AND WACCAMAW RIVERS
RO-02012	RO02	SB	WINYAH BAY NEAR MOUTH OF SAMPIT RIVER
RO-01121	RO01	SB	WINYAH BAY , 1.75 MI E OF GEORGETOWN
RO-01161	RO01	SB	WINYAH BAY , 3 MI S OF GEORGETOWN
RS-03331	RS03	FW	TRIB TO WINYAH BAY AT S-22-18, 0.6 MI NW OF INTERSECTION W S-22-30
RO-02010	RO02	SB	WINYAH BAY W CHANNEL AT MOUTH OF ESTERVILLE MINUM CREEK CANAL
MD-278	INT	SB	WINYAH BAY MAIN CHANNEL, BUOY 19A RANGE E (05-20)

Great Pee Dee River - There are three SCDHEC monitoring sites along this section of the Great Pee Dee River and recreational uses are supported at all sites. At the upstream site ***(PD-060)***, aquatic life uses are not supported due to occurrences of copper in excess of the aquatic life acute criterion. Significant decreasing trends in five-day biochemical oxygen demand and increasing trends in dissolved oxygen concentration suggest improving conditions for these parameters. At the midstream site ***(PD-061)***, aquatic life uses are fully supported. This is a blackwater system, characterized by naturally low pH and dissolved oxygen conditions. Although pH and dissolved oxygen excursions occurred, they were typical of values seen in swamps and blackwater systems and were considered natural, not standards violations. Significant decreasing trends in five-day biochemical oxygen demand and fecal coliform bacteria concentration suggest improving conditions for these parameters. A very high concentration of cadmium and a high concentration of zinc were measured in the 2003 sediment sample. At the downstream site ***(MD-275)***, aquatic life uses are not supported due to dissolved oxygen excursions, which are compounded by a significant decreasing trend in dissolved oxygen concentration. This monitoring site is located in the freshwater-saltwater mixing zone. Although pH excursions occurred, the low values exemplify the natural transition of the river and are typical of values seen in tidally influenced systems with significant marsh drainage. As such they were considered natural, not standards violations.

Winyah Bay – There are six SCDHEC monitoring sites along Winyah Bay. The furthest upstream site ***(MD-080)*** is at the mixing zone of the Pee Dee and Waccamaw Rivers and Winyah Bay waters. It takes on the natural blackwater characteristics of low pH conditions from draining rivers systems and tidally influenced systems with significant marsh drainage and limited flushing. Aquatic life and recreational uses are fully supported. Although pH excursions occurred, they were typical of values seen in blackwater systems and were considered natural, not standards violations. There is a significant increasing trend in pH. Significant decreasing trends in total nitrogen concentration and fecal coliform bacteria concentration suggest improving conditions for these parameters. Stations ***RO-02012, RO-01121, RO-01161***, and ***RO-02010*** all fully support aquatic life and recreational uses. Aquatic life uses are partially supported at

MD-278 due to dissolved oxygen excursions, which are compounded by a significant decreasing trend in dissolved oxygen concentration. Recreational uses are fully supported at this site; however, there is a significant increasing trend in fecal coliform bacteria concentration. *Fish tissue samples from Winyah Bay indicate no advisories are needed at this time.*

Unnamed Tributary to Winyah Bay (RS-03331) – Aquatic life and recreational uses are fully supported.

*A fish consumption advisory has been issued by the Department for mercury and includes **Clark Creek,** the **Great Pee Dee River,** and the **Atlantic Intracoastal Waterway** within this watershed (see advisory p.130).*

Shellfish Monitoring Stations

Station #	Description
05-01	JONES CREEK AT NANCY CREEK
05-02	NOBLE SLOUGH
05-05	OYSTER BAY NEAR CUTOFF CREEK
05-06	NO MAN'S FRIEND CREEK AT MUD BAY
05-07	JONES CREEK AT MUD BAY
05-20	WINYAH BAY MAIN CHANNEL, BUOY 19A, RANGE E
05-21	WINYAH BAY MAIN CHANNEL, BUOY 17, RANGE E
05-24	WINYAH BAY MAIN CHANNEL, COAST GUARD DOCK, RANGE C
05-25	WINYAH BAY, TIP OF WESTERN CHANNEL ISLAND

Groundwater Quality

Well #	Class	Aquifer	Location
AMB-050	GB	MIDDENDORF	HEMMINGWAY
AMB-012	GB	BLACK CREEK	GEORGETOWN #2

NPDES Program

Active NPDES Facilities

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)*	*NPDES#* *TYPE* *COMMENT*
BOSER SWAMP GCSD/DEEP CREEK ELEM SCHOOL PIPE #: 001 FLOW: 0.009	SC0039195 MINOR DOMESTIC
FLAT RUN SWAMP GCSD/PLEASANT HILL ELEM SCHOOL PIPE #: 001 FLOW: 0.018	SC0039101 MINOR DOMESTIC
MAPLE SWAMP CAROLINA SAND INC./BRITTONS NECK PIPE #: 001 FLOW: M/R	SCG730043 MINOR INDUSTRIAL
MAPLE SWAMP JAYCO/CANNONS LAKE MINE PIPE #: 001 FLOW: M/R	SCG730538 MINOR INDUSTRIAL

CHAPEL CREEK TRIBUTARY GCW&SD/PLANTERSVILLE EDR PIPE #: 001 FLOW: M/R	SCG645051 MINOR DOMESTIC
CLARK CREEK TOWN OF HEMINGWAY/WWTP PIPE #: 001 FLOW: 0.45	SC0039934 MINOR DOMESTIC

Nonpoint Source Management Program

Land Disposal Activities

Landfill Facilities

LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
TOWN OF HEMINGWAY DUMP MUNICIPAL	---------- CLOSED
TOWN OF HEMMINWAY COMPOSTING SITE COMPOSTING	451003-3001 ACTIVE
THOMPSONS LAND CLEARING COMPOSTING	222678-3001 ACTIVE
GEORGETOWN COUNTY AIRPORT INDUSTRIAL	IWP-194 INACTIVE

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
CAROLINA SAND, INC. GRESHAM MINE NECK SAND MINE #2	0899-67 SAND
JAYCO INC. BACCHUS LAKE MINE	1682-67 SAND
JAYCO INC. CANNONS LAKE MINE	1552-67 SAND
BEN COX CO. WHITE HALL SAND MINE	1675-67 SAND
AMERICAN MATERIALS CO. RICHARDSON MINE	1765-67 SAND/GRAVEL
CAROLINA SAND INC. JOHNSON ROAD MINE	1704-67 SAND
JAYCO INC. CHARLIE RICHARDSONS LAKE MINE	1776-67 SAND

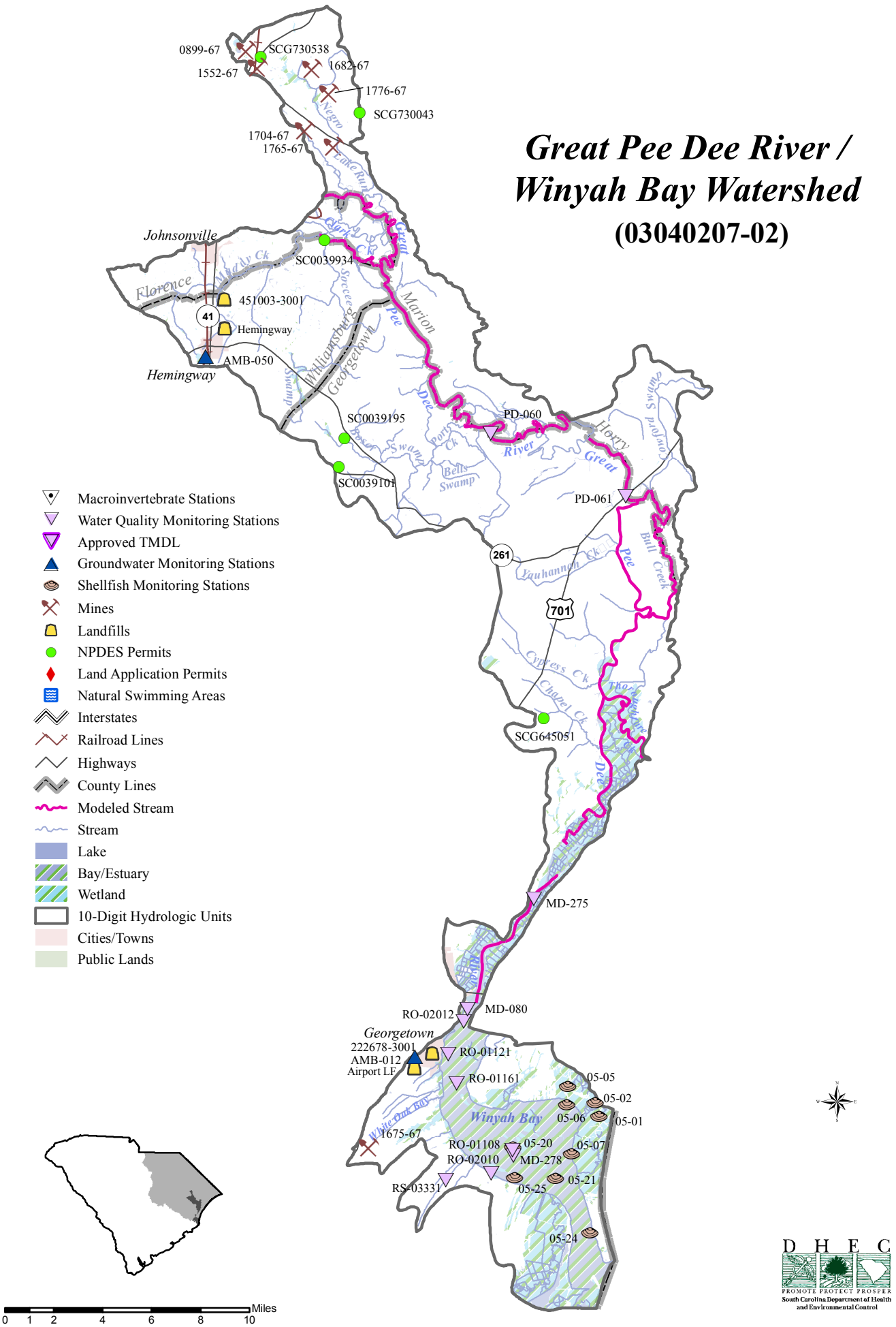
Water Quantity

Portions of this watershed fall within the Waccamaw Capacity Use Area and large groundwater uses must be reported (see Capacity Use Program p.27).

WATER USER ***STREAM***	***REGULATED CAP. (MGD)*** ***PUMPING CAP. (MGD)***
CITY OF GEORGETOWN	5.2
GREAT PEE DEE RIVER	10.5
GSW&SA/BULL CREEK REGIONAL WTP	50.87
BULL CREEK	60.42

Growth Potential

There is an overall low potential for growth in this watershed, which contains the Towns of Hemingway, Bucksport, and Pawleys Island, the City of Johnsonville, and a portion of the City of Georgetown. Hemingway and Johnsonville have water and sewer infrastructure, but outside of the area, the Pee Dee River area is rural with primarily agricultural uses and timberlands. The area surrounding the City of Georgetown is expected to grow. The Georgetown treatment facility expanded to 12.0 MGD to allow more growth. Water infrastructure is located in the Plantersville community and areas closer to the City of Georgetown. The portion of the Georgetown area within this watershed should see primarily commercial and residential growth. The northern most area is expected to experience a high population increase, a medium increase is expected along the south side of Winyah Bay and the remaining area is only expected to experience a low increase due to lands protected from development by land trusts.


Great Pee Dee River / Winyah Bay Watershed
(03040207-02)
0899-67
SCG730538
1552-67
1682-67
1776-67
SCG730043
1704-67
1765-67
Johnsonville
SC0039934
Florence
451003-3001
41
Hemingway
AMB-050
Hemingway
Marion
Williamsburg
Georgetown
SC0039195
SC0039101
PD-060
PD-061
Horry
261
701
SCG645051
MD-275
MD-080
RO-02012
Georgetown
222678-3001
AMB-012
Airport LF
RO-01121
RO-01161
1675-67
RO-01108
RO-02010
RS-03331
MD-278
05-05
05-02
05-06
05-01
05-20
05-07
05-21
05-25
05-24
Winyah Bay
Macroinvertebrate Stations
Water Quality Monitoring Stations
Approved TMDL
Groundwater Monitoring Stations
Shellfish Monitoring Stations
Mines
Landfills
NPDES Permits
Land Application Permits
Natural Swimming Areas
Interstates
Railroad Lines
Highways
County Lines
Modeled Stream
Stream
Lake
Bay/Estuary
Wetland
10-Digit Hydrologic Units
Cities/Towns
Public Lands
0 1 2 4 6 8 10
Miles
D H E C
PROMOTE PROTECT PROSPER
South Carolina Department of Health and Environmental Control

Classified Waters, Standards, and Natural Conditions

The waters of the State have been classified in regulation based on the desired uses of each waterbody. State standards for various parameters have been established to protect all uses within each classification. The water-use classifications that apply to this basin are as follows.

Class ORW, or "outstanding resource waters", are freshwaters or saltwaters that constitute an outstanding recreational or ecological resource, or those freshwaters suitable as a source for drinking water supply purposes, with treatment levels specified by the Department.

Class A were freshwaters that were suitable for primary contact recreation. This class was also suitable for uses listed as Class B. As of April 1992, Class A and Class B waters were reclassified as Class FW, which protects for primary contact recreation.

Class B were freshwaters that were suitable for secondary contact recreation and as a source for drinking water supply, after conventional treatment, in accordance with the requirements of the Department. These waters were suitable for fishing, and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. This class was also suitable for industrial and agricultural uses. The main difference between the Class A and B freshwater was the fecal coliform standard. Class A waters were not to exceed a geometric mean of 200/100ml, based on 5 consecutive samples during any 30 day period; nor were more than 10% of the total samples during any 30 day period to exceed 400/100ml. Class B waters were not to exceed a geometric mean of 1000/100ml, based on 5 consecutive samples during any 30 day period; nor were more than 20% of the total samples during any 30 day period to exceed 2000/100ml. As of April 1992, Class A and Class B waters were reclassified as Class FW, which protects for primary contact recreation.

Class FW, or "freshwaters", are freshwaters that are suitable for primary and secondary contact recreation and as a source for drinking water supply, after conventional treatment, in accordance with the requirements of the Department. These waters are suitable for fishing, and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. This class is also suitable for industrial and agricultural uses.

Class SFH, or "shellfish harvesting" waters, are tidal saltwaters protected for shellfish harvesting, and are suitable also for uses listed in Classes SA and SB.

Class SA comprises "tidal saltwaters" suitable for primary and secondary contact recreation, crabbing and fishing. These waters are not protected for harvesting of clams, mussels, or oysters for market purposes or human consumption. The waters are suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora.

Class SB are "tidal saltwaters" suitable for the same uses listed in SA. The difference between the Class SA and SB saltwater concerns the DO limitations. Class SA waters must maintain daily DO averages not less than 5.0 mg/l, with a minimum of 4.0 mg/l, and Class SB waters maintain DO levels not less than 4.0 mg/l.

Class GB, or "groundwaters", include all groundwaters of the State, unless classified otherwise, which meet the definition of underground sources of drinking water.

Site specific numeric standards (*) for surface waters may be established by the Department to replace the numeric standards found in Regulation 61-68 or to add new standards not contained in R.61-68. Establishment of such standards shall be subject to public participation and administrative procedures for adopting regulations. In addition, such site specific numeric standards shall not apply to tributary or downstream waters unless specifically described in the water classification listing in R.61-69.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

JUL 11 2008

David Wilson
Chief
South Carolina Department of Environmental Control
Bureau of Water
2600 Bull Street
Columbia, SC 29201

SUBJ: Approval of the State of South Carolina's 2008 303(d) List Submittal

Dear Mr. Wilson:

The U.S. Environmental Protection Agency (EPA), Region 4, has completed its review of the South Carolina Department of Health and Environmental Control's Final 2008 Clean Water Act (CWA) Section 303(d) list of water quality limited segments. EPA has determined that each of the water quality limited segments still requiring Total Maximum Daily Loads identified on the State's 2008 list meets the requirements of the CWA Section 303(d) and its implementing regulations, 40 CFR 130.7. EPA hereby approves the State of South Carolina's decision to include each of the waters designated by the State in its 2008 303(d) list. Enclosed for your information is the accompanying decision document for this approval action.

Appendix C of the enclosed decision document contains 23 waters of concern for which EPA is not acting on at this time. These waters were submitted based on a preliminary assessment method that has recently been modified in the State's monitoring program so that more representative data can be obtained. Listing determinations for these waters should be included in the 2010 303(d) list submittal.

If you have questions concerning this matter, please feel free to contact me at (404) 562-9345 or Annie Godfrey, Chief, East Standards, Monitoring, and TMDL Section at (404) 562-9967.

Sincerely,

James D. Giattina, Director
Water Management Division

Enclosure

D H E C
PROMOTE PROTECT PROSPER

C. Earl Hunter, Commissioner

Promoting and protecting the health of the public and the environment

March 31, 2008

Joanne Benante, Chief
Standards, Monitoring, & TMDL Branch
U.S. Environmental Protection Agency Region 4
61 Forsyth Street, SW
Atlanta, GA 30303

Dear Ms. Benante:

The State of South Carolina's *2008 Integrated Report, Part 1: Listing of Impaired Waters,* required by Section 303(d) of the Clean Water Act and 40 CFR 130.7(b)(4), is enclosed for your approval. The list, which corresponds to Category 5 in EPA's *Guidance for 2008 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act*, is presented by 12-digit hydrologic unit and identifies waters not meeting State water quality standards after application of required pollutant controls. We have indicated TMDL development targets for the next two years, taking into account the severity of pollution and the designated uses of the waters. We have also included in our submission the listing, delisting, and TMDL targeting methodology; data solicitation, public notice, and responsiveness summary; a list of sites removed due to standard attainment and a list of sites removed due to approved TMDLs.

We complied with public participation requirements by publishing a notice of availability in three statewide newspapers, by e-mailing the notice to interested parties, and by posting the notice and draft list on our web site. The public notice included a 32-day comment period from February 8, 2008 through March 10, 2008. We requested written comments on the draft list and methodology. A responsiveness summary to the comments received during this time period is included in *Part 1, Appendix G* of this package. Minor revisions to the draft list were also made after pubic notice. The revisions were not as a result of public comments, but were due to errors in listing. Those corrections are also outlined in *Part 1, Appendix G* of this package.

The State of South Carolina's *2008 Integrated Report, Part 2: Section 305 (b) Assessment and Reporting,* required by Section 305(b) of the Clean Water Act, is also enclosed. *Part 2* includes a description of and data summaries from South Carolina's statewide probability-based monitoring design, through which all waters of the state are assessed.

The South Carolina Department of Health and Environmental Control (the Department) has included all 2008 assessment results in the Assessment Database (ADB) and is committed to continue and work closely with EPA Region 4 to complete reach indexing (georeferencing) for the 2008 Integrated Report. Once indexing is completed (approximately 30 days), electronic versions of State of South Carolina's *2008 Integrated Report Parts 1 & 2*, the ADB and associated reach indexing files will be uploaded to the following FTP site: ftp://web05.dhec.sc.gov/. The Department will notify EPA Region 4 staff once the information is available for download. The referenced information can be accessed on the FTP site by following these instructions:

From the toolbar, Go to File Login as…
UserID: water
Password: WaTeR2007 (case-sensitive)

The Department appreciates EPA Region 4 staff and management assistance and timely feedback during the process of developing the *2008 Integrated Report Parts 1 & 2*.

If you have any questions or need more information, please contact Matt Carswell at 803-898-3609 or by E-Mail at carsweme@dhec.sc.gov.

Sincerely,

Heather Preston, Director
Division of Water Quality
Bureau of Water

cc: Amy Bennett
Matt Carswell
Annie Godfrey, EPA Region 4
Bonita Johnson, EPA Region 4
Tina Lamar, EPA Region 4
John Litton
Mihir Mehta
David Wilson

The State of South Carolina's 2008 Integrated Report
Part I: Listing of Impaired Waters

INTRODUCTION

The South Carolina Department of Health and Environmental Control (Department) developed this priority list of waterbodies pursuant to §303(d)of the Federal Clean Water Act (CWA) and Federal Regulation 40 CFR 130.7 last revised in 1992. The listing identifies South Carolina waterbodies that do not currently meet State water quality standards after application of required controls for point and nonpoint source pollutants. Use attainment determinations were made using water quality data collected from 2002-2006. Pollution severity and the classified uses of waterbodies were considered in establishing priorities and targets. The list will be used to target waterbodies for further investigation, additional monitoring, and water quality improvement measures, including Total Maximum Daily Loads (TMDLs).

Over the past three decades, impacts from point sources to waterbodies have been substantially reduced through point source controls achieved via National Pollutant Discharge Elimination System (NPDES) permits. Since 1990, steady progress in controlling nonpoint source impacts has also been made through implementation of South Carolina's Nonpoint Source Management Program. In conjunction with TMDL development and implementation, the continued expansion and promotion of these and other state and local water quality improvement programs are expected to be effective in reducing the number of impaired waterbodies.

In compliance with 40 CFR 25.4(c), the Department, beginning February 8, 2008, issued a public notice in statewide newspapers, to ensure broad notice of the Department's intent to update its list of impaired waterbodies. Public input was solicited. The notice included a person to contact for information regarding the development of the list and asked for comments regarding the draft listing and methodology. The notice will allow for a thirty-one day comment period in which to respond. The Department also provided direct notice to interested parties, including environmental groups, industries, private individuals, local governments, universities, research groups, federal agencies, other state agencies, and the USEPA. The Department also posted the public notice and the draft list on its Internet website. A copy of the notice of availability of the draft listing is provided in Appendix E.

Additional public input was solicited through regular interactions between Department staff, interested members of the public, and other resource agencies. Bureau of Water Watershed Managers have regular interaction with stakeholders throughout the eight major river basins during stakeholder meetings, educational events, and individual contact sessions. Through this process valuable information is received which supports list development and TMDL prioritization. Public participation in the §303(d) process will continue in accordance with the Department's watershed approach.

Part II of the integrated report submittal makes use of the identical data and assessment methodology that follows; therefore, no separate consideration of the 305(b) report is required for these listings. In consideration of EPA's Assessment Data Base (ADB) initiative all 303(d) listed assessment units will also be included in South Carolina's portion of that repository.

TMDL TARGET DATE(S) ++	NOTE	BASIN	HUC	LOCATION	STATION	COUNTY	USE	CAUSE
2017		PEEDEE	030402060906	INTRACOASTAL WATERWAY @ SOCASTEE	CSTL-558	HORRY	FISH	HG
2011		PEEDEE	030402060906	UNNAMED TRIBUTARYTO INTERCOASTAL WATERWAY AT SC 707 1.2 MI ENE OF SOCASTEE & SC 544	RS-03332	HORRY	REC	FC
2017		PEEDEE	030402060907	WACCAMAW RIVER @ PEACH TREE	MD-136	HORRY	FISH	HG
2017		PEEDEE	030402060907	WACCAMAW RIVER @ BUCKSVILLE	MD-145	HORRY	FISH	HG
2017		PEEDEE	030402061002	WACCAMAW RIVER @ BUCKSPORT LANDING	CSTL-557	HORRY	FISH	HG
2017		PEEDEE	030402061002	WACCAMAW RIVER @ WACCA WACHE LANDING	MD-138	GEORGETOWN	FISH	HG
2017		PEEDEE	030402061003	WACCAMAW RIVER @ SANDY ISLAND	MD-140	GEORGETOWN	FISH	HG
2017		PEEDEE	030402061003	WACCAMAW RIVER @ HAGLEY LANDING	MD-141	GEORGETOWN	FISH	HG
2014		PEEDEE	030402070103	SAMPIT RVR BTWN MOUTHS OF PORTS CK & PENNY ROYAL CK	MD-075	GEORGETOWN	AL	DO
2014	#	PEEDEE	030402070106	SAMPIT RVR OPP AMER CYANAMID CHEM CO	MD-073	GEORGETOWN	AL	DO
2014, 2014	#	PEEDEE	030402070106	SAMPIT RVR AT CHANNEL MARKER #30	MD-074	GEORGETOWN	AL	DO, PH
2014	#	PEEDEE	030402070106	SAMPIT RVR AT US 17	MD-077	GEORGETOWN	AL	DO
2014		PEEDEE	030402070106	WHITES CK 100 YDS UPSTRM OF JCT WITH SAMPIT RVR	MD-149	GEORGETOWN	REC	FC
2017		PEEDEE	030402070106	SAMPIT RIVER APPROXIMATELY 1.4 MILES WEST OF US 17 BRIDGE	PD-628	GEORGETOWN	FISH	HG
2017		PEEDEE	030402070203	CLARKS CREEK @ SNOW LAKE	PD-317	WILLIAMSBURG	FISH	HG
2017		PEEDEE	030402070203	GREAT PEE DEE RIVER @ STAPLES LAKE	PD-621	WILLIAMSBURG	FISH	HG
2016		PEEDEE	030402070204	PEE DEE RVR AT PETERS FIELD LANDING OFF S-22-36 US IP PUMP STATION	PD-060	GEORGETOWN	AL	CU
2017		PEEDEE	030402070204	PEE DEE RVR AT PETERS FIELD LANDING OFF S-22-36 US IP PUMP STATION	PD-060	GEORGETOWN	FISH	HG
2017		PEEDEE	030402070205	GREAT PEE DEE RIVER ABOVE HWY 701 BRIDGE	CSTL-559	HORRY	FISH	HG
2010	#	PEEDEE	030402070207	WINYAH BAY AT JCT OF PEE DEE & WACCAMAW AT MARKER 92	MD-080	GEORGETOWN	AL	PH
2016	#	PEEDEE	030402070207	PEE DEE RVR AT WHITE HOUSE PLANTATION	MD-275	GEORGETOWN	AL	CU
2017		PEEDEE	030402070207	GREAT PEE DEE RIVER @ SAMWORTH WMA	PD-663	GEORGETOWN	FISH	HG
2017		PEEDEE	030402070207	CYPRESS CREEK AT BRIDGE ON S-22-264 1.5 MI SE OF PLANTERSVILLE	RS-06013	GEORGETOWN	REC	FC
2012		PEEDEE	030402070208	JONES CREEK AT NANCY CREEK	05-01	GEORGETOWN	SHELLFISH	FC
2012		PEEDEE	030402070208	OYSTER BAY NEAR CUTOFF CREEK	05-05	GEORGETOWN	SHELLFISH	FC
2012		PEEDEE	030402070208	MUD BAY AT NO MAN'S FRIEND CREEK	05-06	GEORGETOWN	SHELLFISH	FC
2012		PEEDEE	030402070208	JONES CREEK AT MUD BAY	05-07	GEORGETOWN	SHELLFISH	FC
2012		PEEDEE	030402070208	WINYAH BAY MAIN CHANNEL, BUOY 19A, RANGE E	05-20	GEORGETOWN	SHELLFISH	FC
2012		PEEDEE	030402070208	WINYAH BAY MAIN CHANNEL, BUOY 17, RANGE E	05-21	GEORGETOWN	SHELLFISH	FC
2012		PEEDEE	030402070208	WINYAH BAY, TIP OF WESTERN CHANNEL ISLAND	05-25	GEORGETOWN	SHELLFISH	FC
2016		PEEDEE	030402080301	INTRACOASTAL WTRWAY AT PT 3 MI N OF BRDG ON US 501	MD-085	HORRY	AL	CU
2016		PEEDEE	030402080301	INTRACOASTAL WTRWY (LITTLE RVR) ON SC 9 (US 17)	MD-125	HORRY	AL	CU
2017		PEEDEE	030402080301	INTRACOASTAL WATERWAY @ NORTH MYRTLE	MD-163	HORRY	FISH	HG
2011		PEEDEE	030402080305	LITTLE RIVER JETTY	01-01	HORRY	SHELLFISH	FC
2011		PEEDEE	030402080305	MOUTH OF DUNN SOUND CREEK	01-02	HORRY	SHELLFISH	FC
2011		PEEDEE	030402080305	BIG BEND UP DUNN SOUND CREEK	01-05	HORRY	SHELLFISH	FC
2011		PEEDEE	030402080305	BRIDGE TO WAITES ISLAND	01-06	HORRY	SHELLFISH	FC

South Carolina Department of Transportation
Engineering Directive Memorandum

Number: 23

Primary Department: Preconstruction

Referrals: S.C. Code of Law 48-18-10, et seq., S.C. Code of Regulations 72-400, et. seq.

Subject: Standards for Stormwater Management and Sediment Reduction

The following procedures should be followed in order to ensure compliance with S.C. Code of Regulations 72-400:

1. All land-disturbing activities under the jurisdiction of SCDOT, herein after called the Department, must be performed in such a manner that erosion is controlled and sediment is retained on the site concerned to the maximum extent feasible, and stormwater is managed in such a manner that neither any significant onsite nor offsite damage and/or problem is caused or increased.

2. All construction plans prepared by or for the Department must include plans to manage stormwater runoff and control erosion and sedimentation using state-of-the-art practices. All plans must be sealed by a qualified design professional and prepared in accordance with all regulations, standards, and specifications. All plans must include details and descriptions of temporary and permanent erosion and sediment control measures and other protective measures shown on the stormwater and sediment management plan. Specifications for a sequence of construction operations shall be contained on all plans describing the relationship between the implementation and maintenance of sediment controls, including permanent and temporary stabilization and the various stages or phases of earth disturbance and construction. The specifications for the sequence of construction shall, at a minimum, include the requirements of "Standard Specifications for Highway Construction" and standard drawings prepared by the Department.

3. After the contract has been awarded and prior to the start of construction, the contractor must submit in writing to the Director of Construction Office, for approval, his/her stormwater pollution prevention plan (SWPPP) for the accomplishment of temporary and interim erosion and sediment control and stormwater management for areas where the work is to be performed, based on his/her phasing of the project.

4. Stormwater management and stormwater drainage computations must be used in the design of temporary and permanent structural controls such as pipe culverts, channels, inlets, ditches, and other components of the stormwater management and erosion and sediment control systems.

5. Water quantity control must be an integral component of overall stormwater management. The following design criteria for flow control are established for water quantity control purposes, unless a waiver is granted based on a case-by-case basis.

    a. Evaluate the capacity of the outfall for 2-year and 10-year peak discharges based on prior and post-construction conditions. The evaluation should take into account the condition and capacity of existing structures downstream from the outfall point.

    b. The velocity for the design peak discharge at the outlet of hydraulic structures will be reduced to non-erosive velocities. Ditches and channels must be protected from erosion from the design discharge by the appropriate channel lining.

6. Water quality control must be an integral component of stormwater management. The following design criteria are established for water quality protection, unless a waiver or variance is granted on a case-by-case basis.

    a. Stormwater runoff that drains to a single outlet from land-disturbing activities that disturb ten acres or more shall be controlled during the land-disturbing activity by a sediment basin where sufficient space and other factors allow these controls to be used until the final inspection. The sediment basin shall be designed and constructed to accommodate anticipated sediment loading from the land-disturbing activity and meet a removal efficiency of 80 percent suspended solids or 0.5 ML/L peak settable solids concentration for the 10-year, 24-hour design event.

    b. Other sediment control practices may be utilized if they achieve an equivalent removal efficiency of 80 percent for suspended solids or 0.5 ML/L peak settable solids concentration for the 10-year, 24-hour design event.

    c. Permanent water quality ponds having permanent pools shall be designed to store and release the first ½-inch of runoff from the site over a 24-hour period. The storage volume shall be designed to accommodate at least ½-inch of runoff from the entire site.

    d. Permanent water quality ponds not having permanent pools shall be designed to release the first inch of runoff from the site over a 24-hour period.

    e. Permanent infiltration practices, when used, shall be designed to accept, at a minimum, the first inch of runoff from all impervious areas.

    f. For activities in the eight coastal counties of Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Jasper, and Horry, additional water quality requirements may be imposed to comply with South Carolina Ocean and

Coastal Resource Management (OCRM) guidelines. If conflicting requirements exist for activities in the eight coastal counties, OCRM guidelines will apply.

7. The Director of Construction Office shall file with the South Carolina Department of Health and Environmental Control (SCDHEC) a copy of the sediment reduction and stormwater management plan, in accordance with S.C. Code of Regulations 72-420A, for each construction and maintenance activity as required by the regulations.

8. The Department's certified sediment and erosion control inspector and the contractor's certified inspector shall inspect all stormwater management and erosion and sediment control practices at least once every seven calendar days until the notice of termination (NOT) has been filed with SCDHEC. Where sites have been finally stabilized, such inspection shall be conducted at least once every month until the NOT has been filed. The Department's certified inspector and resident engineer shall require that additional practices be implemented in the event that the practices included in the stormwater management and sediment control plan are not sufficient to adequately control erosion, sedimentation, and stormwater runoff. Once final vegetation has been accepted, the resident engineer in charge shall submit an NOT to SCDHEC to remove the project from permit coverage.

9. SCDHEC may periodically inspect land-disturbing activities performed pursuant to the plan required by this regulation. In the event that SCDHEC finds the measures in the plan are not adequate to control erosion, retain sediment on the site, and manage stormwater in a manner that neither any onsite nor offsite damage or problem is caused or increased, it shall require that necessary additional measures be implemented. Upon completion, the resident engineer shall notify SCDHEC of the completion and acceptance of the project. In the event that SCDHEC finds a land-disturbing activity is not being performed in accordance with the submitted stormwater management and sediment control plan, SCDHEC may issue a written order either directing conformance with the plan, suspending additional work until conformance is achieved, or directing other measures that it deems necessary to control erosion, retain sediment on the site, and manage stormwater in a manner that neither any onsite nor offsite damage or problem is caused or increased. Complaints from any party shall be investigated by SCDHEC.

10. After a project has been completed and accepted in its entirety, the Department's maintenance forces must maintain the areas with top priority being to take the necessary steps to ensure the continuance of proper erosion and sediment control and stormwater management measures as may be needed to prevent onsite and offsite damages or contamination of watercourses or impoundments. Each resident maintenance engineer must prepare an inventory of existing erosion, sedimentation, and stormwater problem areas. This list must be kept current and updated as conditions change. The resident maintenance engineer, in conjunction with district office personnel, must set priorities on the inventory and make necessary corrections as time and funds permit.

Submitted by: *Robert I. Pratt*
Director of Preconstruction

Submitted by: *D. R. Shealy*
Director of Construction

Recommended by: *John V. Walsh*
Chief Engineer for Planning, Location, and Design

Submitted by: *James J. Feda, Jr.*
Director of Maintenance

Recommended by: *J. C. Watson*
Chief Engineer for Operations

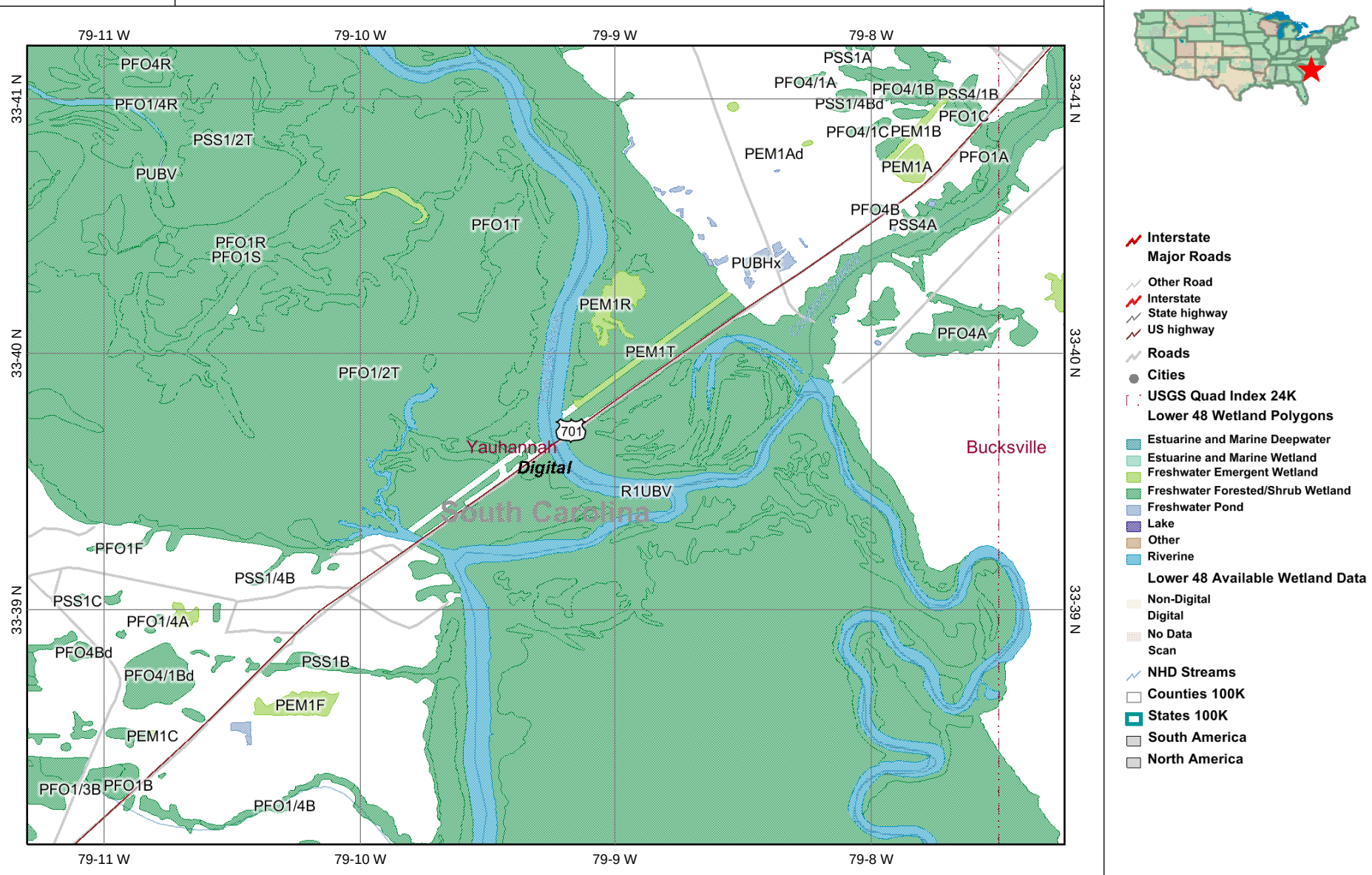
Approved by: *Tony L. Chapman*
Deputy Secretary for Engineering

Effective Date: *March 10, 2009*

Original signed by Deputy Secretary for Engineering Tony L. Chapman, P.E. March 10, 2009. All original engineering directives maintained by the Office of the Deputy Secretary for Engineering.

Appendix C

Wetlands



Interstate
Major Roads

Other Road
Interstate
State highway
US highway

Roads
Cities
USGS Quad Index 24K
Lower 48 Wetland Polygons

Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine

Lower 48 Available Wetland Data

Non-Digital
Digital
No Data
Scan

NHD Streams
Counties 100K
States 100K
South America
North America

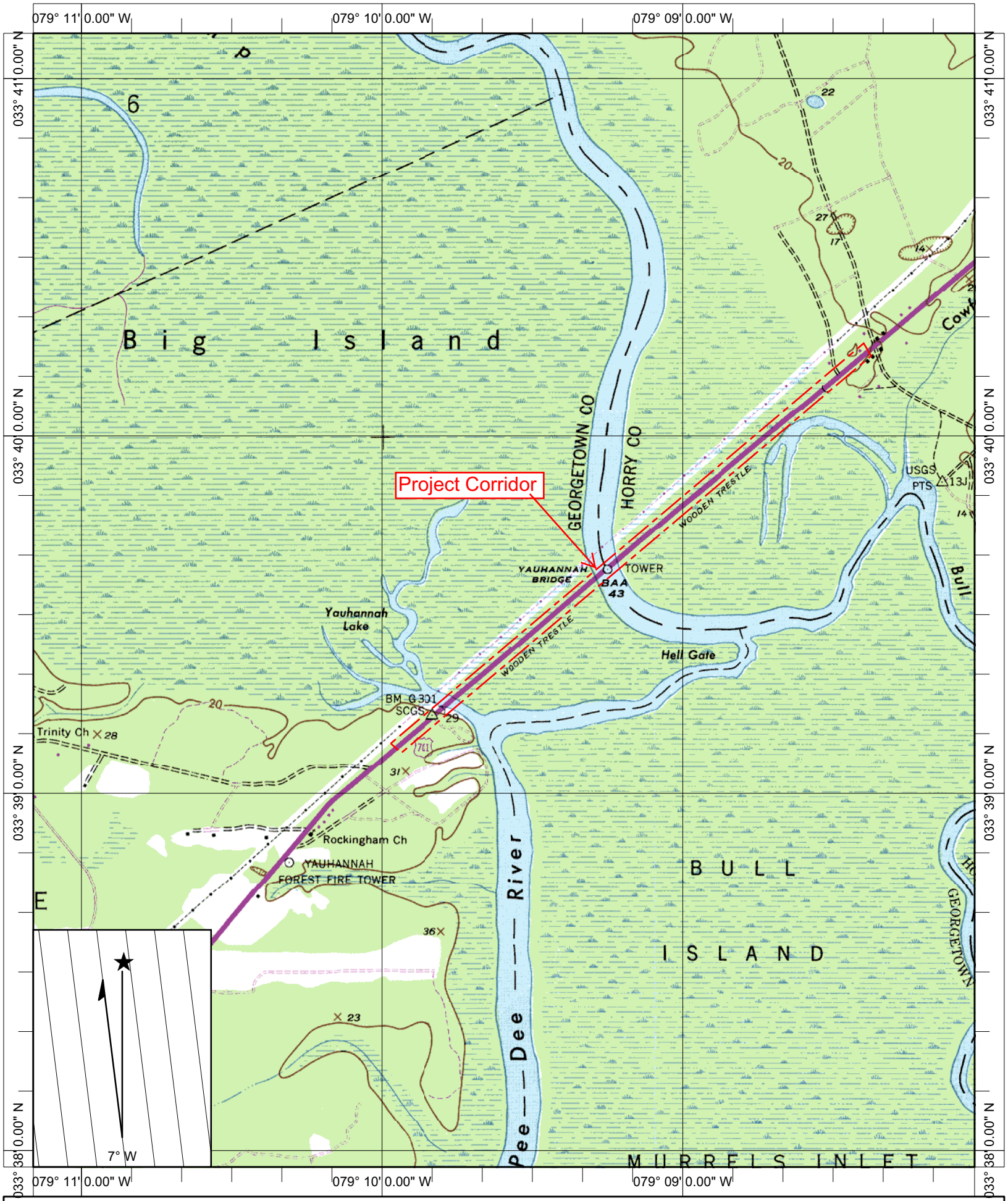
National Wetlands Inventory NWI Map

US 701 BRIDGE REPLACEMENT PROJECT

Project Background and Wetland Description

The US 701 Bridge Replacement project consists of the replacement and realignment of an approximately two mile long section of US 701 located in Georgetown and Horry Counties. The project involves the replacement of three bridges on US 701 through rural, undeveloped, light residential and light commercial portions of Horry and Georgetown Counties. The project would involve replacing the three existing US 701 bridges over Yauhannah Lake, the Great Pee Dee River, and the Great Pee Dee River Overflow. The study area consists of a corridor that is approximately two miles long, 300 feet wide, and is centered on the existing US 701 alignment from a point near the US 701 / Lucas Bay Road intersection in Horry County, to a point near the US 701 / Trinity Road intersection in Georgetown County. The project involves the bridge replacements as well as the construction of new roadway approach alignment. The project corridor crosses the referenced water bodies, as well as extensive floodplain forested wetlands. The Waccamaw National Wildlife Refuge occupies much of the project corridor study area. The study area wetlands were delineated and surveyed in 2005; however, a Jurisdictional Determination has not been issued. A combination of vegetation analysis, hydrological observations, and soil sampling was utilized to determine the locations of wetlands within the proposed US 701 Bridge Replacement project area. The wetlands are considered to be palustrine forested floodplain wetland. Based on the homogeneity of the forested floodplain wetlands, the wetland depiction should remain as delineated.

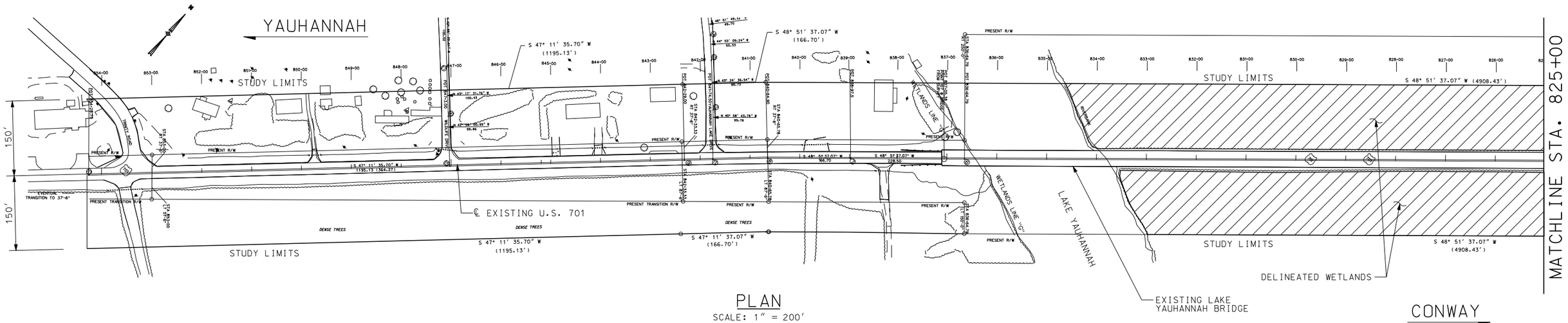
Alternatives to the northwest side of the existing route, to the southeast side of the existing route, and a combination of sides were initially considered in the development of the recommended project alignment. Four alternative alignments were included for an in-depth evaluation as part of this study. Alternatives 1 and 2 are located 72 feet and 55 feet, respectively, northwest of the existing alignment. Alternatives 3 and 4 are located 55 and 72 feet, respectively, southeast of the existing alignment. Based on a review of potential environmental impacts and other considerations, Alternative 3 has been identified as the preferred alternative.



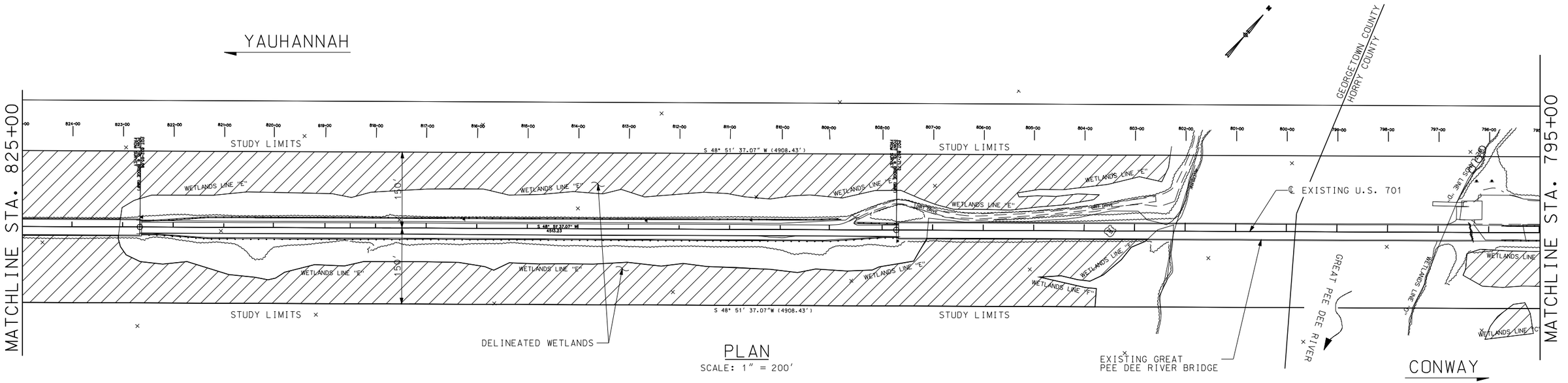
Yauhannah Quad

USGS Topographic Map Showing Approximate Project Limits
ARM Environmental Services, Inc

1" = 2000'



PLAN
SCALE: 1" = 200'



PLAN
SCALE: 1" = 200'

WETLANDS DETERMINATION PLAN

WETLANDS SURVEYED
BY B.P. BARBER & ASSOCIATES, INC.
APRIL 22, 2005

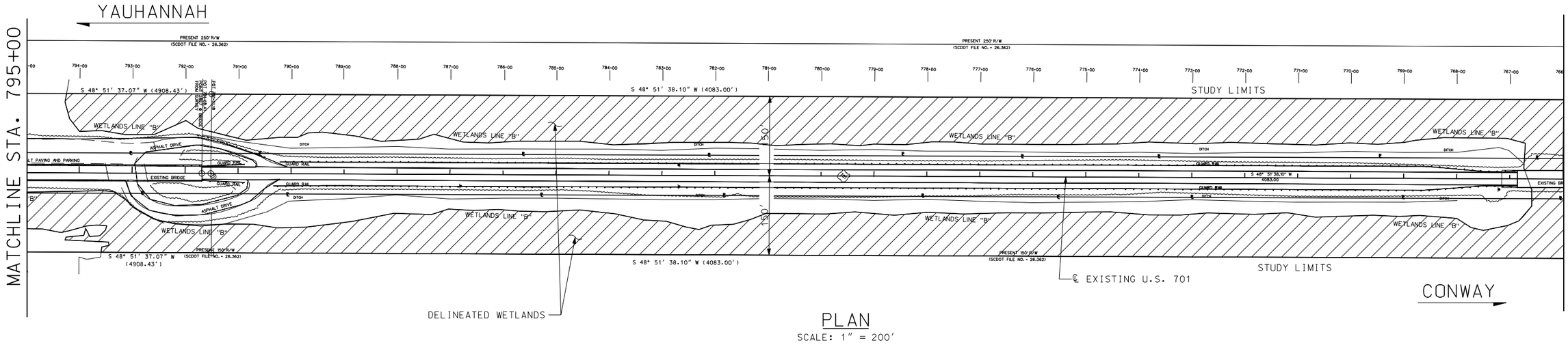
TUHIN BASU & ASSOCIATES, INC.

SCDOT

REPLACEMENT OF US 701 BRIDGES OVER
GREAT PEE DEE RIVER, PEE DEE OVERFLOW
& YAUHANNAH LAKE

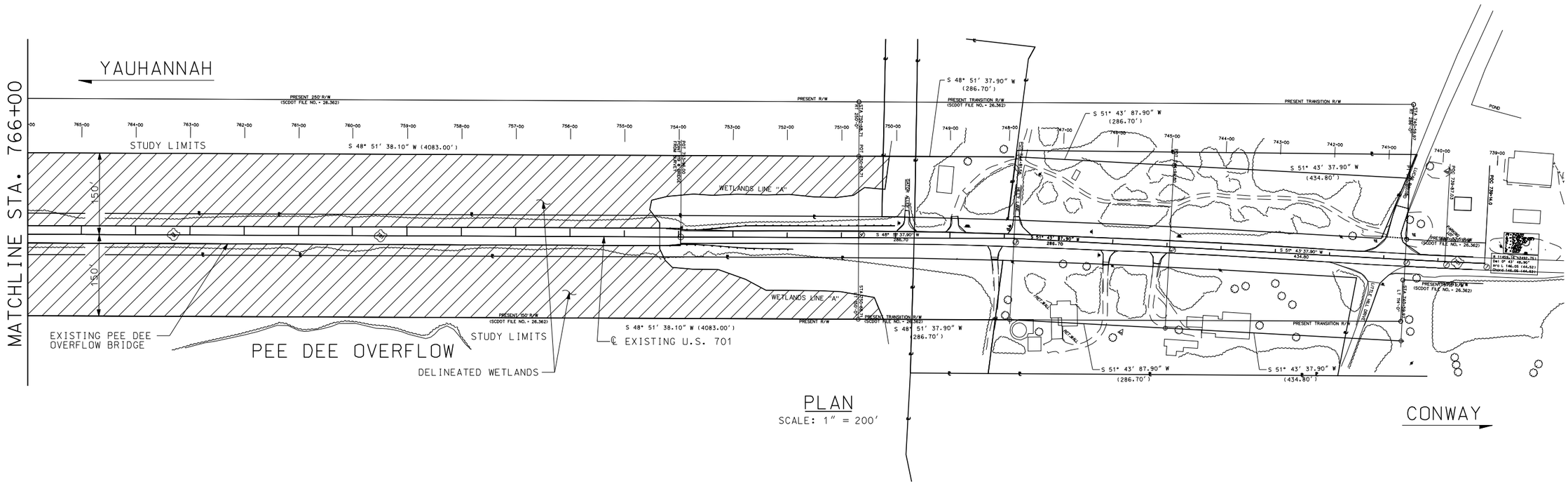
HORRY/GEORGETOWN COUNTIES, SC

Sheet No. 1



PLAN

SCALE: 1" = 200'



PLAN

SCALE: 1" = 200'

WETLANDS DETERMINATION PLAN

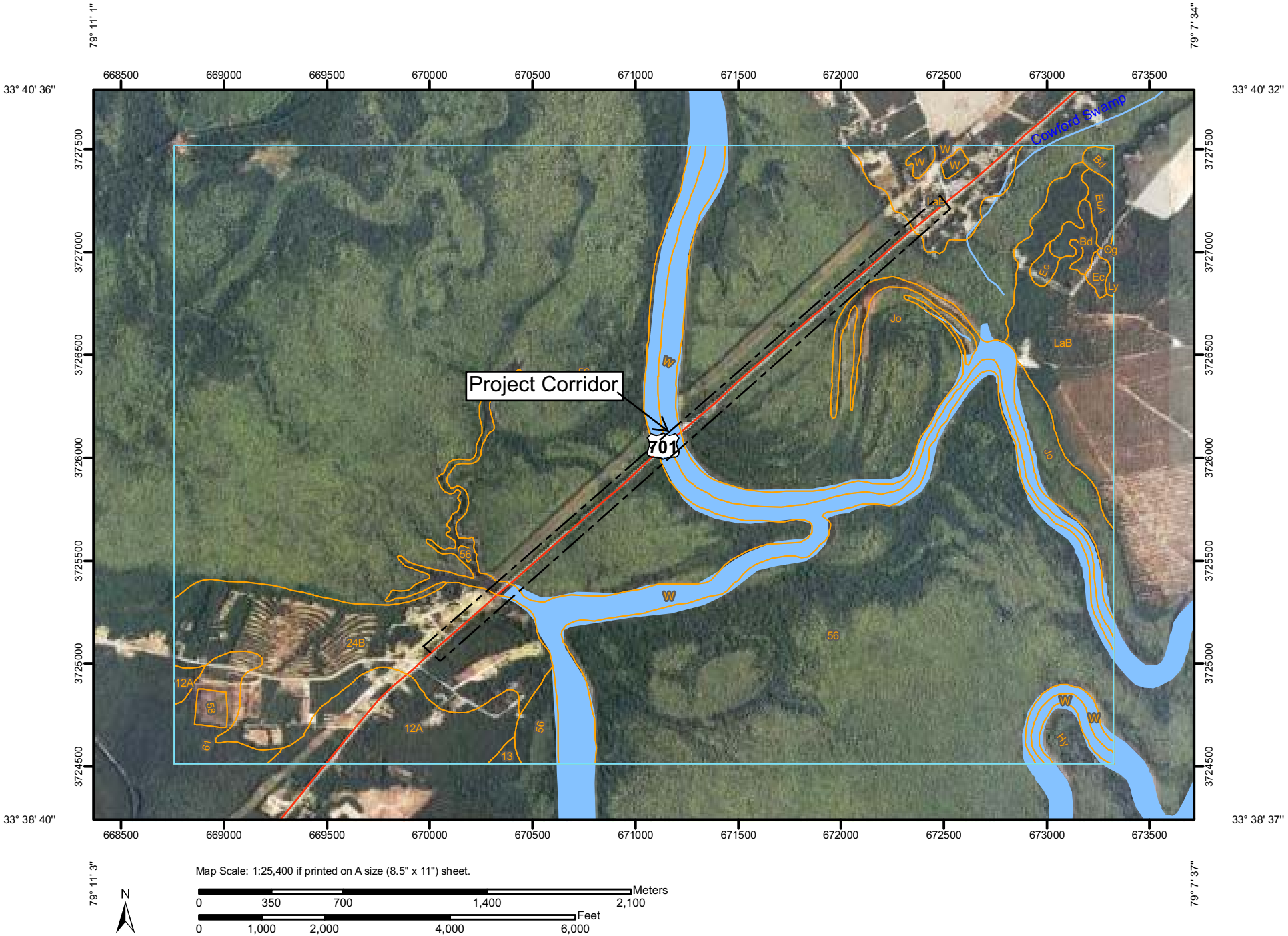
WETLANDS SURVEYED
BY B.P. BARBER & ASSOCIATES, INC.
APRIL 22, 2005

TUHIN BASU & ASSOCIATES, INC.

REPLACEMENT OF US 701 BRIDGES OVER
GREAT PEE DEE RIVER, PEE DEE OVERFLOW
& LAKE YAUHANNAH

HORRY/GEORGETOWN COUNTIES, SC

Sheet No. 2



Map Scale: 1:25,400 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 350 700 1,400 2,100

Feet: 0 1,000 2,000 4,000 6,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:25,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Georgetown County, South Carolina
Survey Area Data: Version 8, Jan 8, 2009

Soil Survey Area: Horry County, South Carolina
Survey Area Data: Version 15, Jan 8, 2009

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 6/10/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Georgetown County, South Carolina (SC043)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
12A	Yauhannah loamy fine sand, 0 to 2 percent slopes	92.4	2.7%
13	Bladen loam	2.6	0.1%
24B	Chisolm sand, 0 to 4 percent slopes	224.1	6.6%
56	Chastain silty clay loam	1,985.9	58.5%
58	Udorthents, loamy	6.4	0.2%
61	Yemassee loamy fine sand	32.8	1.0%
W	Water	161.2	4.8%
Subtotals for Soil Survey Area		**2,505.4**	**73.8%**
Totals for Area of Interest		**3,393.3**	**100.0%**

Horry County, South Carolina (SC051)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Bd	Bladen fine sandy loam	14.5	0.4%
Ec	Echaw sand	8.1	0.2%
EuA	Eulonia loamy fine sand, 0 to 2 percent slopes	9.4	0.3%
Hy	Hobonny muck	14.4	0.4%
Jo	Johnston loam	553.8	16.3%
LaB	Lakeland sand, 0 to 6 percent slopes	174.4	5.1%
Ly	Lynn Haven sand	2.1	0.1%
Og	Ogeechee loamy fine sand	0.4	0.0%
W	Water	110.9	3.3%
Subtotals for Soil Survey Area		**888.0**	**26.2%**
Totals for Area of Interest		**3,393.3**	**100.0%**

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: US 701 BRIDGE REPLACEMENT PROJECT (HORRY / G'TOWN) Applicant/Owner: FOR SCDOT Investigator: RICHARD CICCOLELLA (AS SCDOT CONSULTANT)	Date: 1-15-05 County: HORRY State: SC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: _____

VEGETATION

Dominant Plant Species	Stratum	Indicator
1 BETULA NIGRA	T	FACW
2 ACER RUBRUM	T	FACW
3 SABAL MINOR	S/S	FACW
4 ILEX OPACA	T	FAC-
5 CHASMANTHIUM LATIF.	H	FAC-
6 VITIS ROT.	WV	FAC
7 LIQUIDAMBAR STYRACIFLUA	T	FAC+
8 CARPINUS CAROLINIANA	T	FAC
9 QUERCUS PHELLOS	T	FACW-
10 QUERCUS LAURIFOLIA	T	FACW
11		
12		
13		
14		
15		
16		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). _____

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: NONE (in.)

Depth to Free Water in Pit: > 24 (in.)

Depth to Saturated Soil: > 24 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: NO WATER IN PIT OR OTHER EVIDENCE OF HYDROLOGY

SOILS

Map Unit Name
(Series and Phase): JOHNSTON LOAM

Drainage Class: _____

Taxonomy (Subgroup): _____

Field Observations
Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-10"	A	7.5YR 4/6	—	—	SANDY CLAY LOAM
10"-20"	B	10YR 5/3	7.5YR 4/6	M/D	SANDY CLAY LOAM
20"-24"	B	10YR 5/3	10YR 4/6	M/D	SNDY CL LM

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

SOIL DOES NOT APPEAR HYDRIC

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	Yes (No)	
Hydric Soils Present?	Yes (No)	Is this Sampling Point Within a Wetland? Yes (No)

Remarks:

Approved by HQUSACE 3/92

A

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: US 701 BRIDGE REPLACEMENT PROJECT (HORRY / G'TOWN) Applicant/Owner: FOR SCDOT Investigator: RICHARD CICCOLELLA (AS SCDOT CONSULTANT)	Date: 1-15-05 County: HORRY State: SC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: _____

VEGETATION

Dominant Plant Species	Stratum	Indicator
1 TAXODIUM DISTICHUM	T	OBL
2 ACER RUBRUM	T	FACW
3 BETULA NIGRA	T	FACW
4 CYRILLA RACEMIFLORA	S/S	FACW
5 NYSSA BIFLORA	T	OBL
6		
7		
8		

Dominant Plant Species	Stratum	Indicator
9		
10		
11		
12		
13		
14		
15		
16		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). >50

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: 3 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ✓ Saturated in Upper 12 inches
- ✓ Water Marks
- ___ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 inches
- ✓ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: STANDING WATER JUST BEYOND THIS POINT. WATER MARKS ON TREES AT APPROX. 5'

A

SOILS

Map Unit Name (Series and Phase): JOHNSTON LOAM

Drainage Class: VPD

Taxonomy (Subgroup): _____

Field Observations
Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8	A	10YR/2/1	—	—	COARSE, SANDY LOAM

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
✓ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
✓ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:
PIT FILLS W/WATER. MUCKY, ORGANIC.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

E

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: US 701 BRIDGE REPLACEMENT PROJECT (HEARY / G'TOWN)
Applicant/Owner: FOR SCDOT
Investigator: RICHARD CICCOLELLA (AS SCDOT CONSULTANT)

Date: 1-16-05
County: GEORGETOWN
State: SC

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? Yes (No)
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID: _____
Transect ID: _____
Plot ID: _____

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. TAXODIUM DIST.	T	OBL
2. ACER RUBRUM	T	FACW
3. BETULA NIGRA	T	FACW
4. TOXICODENDRON RADICANS	WV	FAC
5. NYSSA BIFLORA	T	OBL
6. QUERCUS PHELLOS	T	FACW-
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 750

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)
Depth to Free Water in Pit: 28 (in.)
Depth to Saturated Soil: 3 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
✓ Saturated in Upper 12 Inches
✓ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
✓ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: STANDING WATER JUST BEYOND THIS POINT. WATER MARKS ON TREES @ ABOUT 5'.

E

SOILS

Map Unit Name (Series and Phase): CHASTAIN SILTY CLAY LOAM

Drainage Class: PD

Taxonomy (Subgroup): _____

Field Observations
Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-4"	A	10YR 5/4	10YR 5/8	M/IND/ST	CO. SND
4-8"	A	10YR 6/1	10YR 5/8	M/IND/ST	CO. SNDY LOAM
8-20"	B	10YR 5/1	10YR 5/6	M/IND/ST	" " "
20"-24"	B	10YR 4/1	—	—	SANDY CL

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ✓ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: OX. RHIZOSPHERE @ 20+ INCHES.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

http://www.dnr.state.sc.us/water/envaff/river/gr_pee_dee_scenic.htm

Project Overview

In June 2001, the Georgetown County Historical Society, the South Carolina Coastal Conservation League and a number of riparian landowners requested that the SCDNR seek State Scenic River designation for the Great Pee Dee River. Less than a year later, the governor signed a bill placing a segment of the Great Pee Dee River in our Scenic Rivers Program. This segment, running from the US 378 Bridge between Florence and Marion Counties and the US 17 Bridge in Georgetown, is the eighth state scenic river to be designated in South Carolina.

While the Great Pee Dee can accurately be described as the life's blood of the Pee Dee region, it has largely been overlooked by outdoor recreation enthusiasts of all stripes, except for those living within close proximity of the river. Anyone who has paddled or motored through this 70-mile ribbon of brownwater or simply sat on its banks, can vouch for its rich beauty.

Most of the land bordering the Scenic Great Pee Dee River is floodplain forest. Aside from the US 701 Bridge and one railroad bridge, the entire stretch is broken only by logging and farm roads. The corridor is a 70-mile by 3-mile swath of high quality wildlife habitat, boasting 120 species of fish, at least 25 rare plant species, several endangered and threatened species (including the American alligator, red-cockaded woodpecker, bald eagle and swallow-tailed kite), 17 species of duck (all but the wood duck are migratory visitors), a number of wading birds and fur bearing species, and typical South Carolina game species, such as white tail deer and turkey.

River travelers will notice a distinct change in the Great Pee Dee's character as they wend their way from the US 378 Bridge to Winyah Bay. Bald cypress – tupelo gum and bottomland hardwood forests, with hairpin meanders, sandy point bars and many interconnected oxbow lakes surround the upper portions. Abandoned channels of the river, often called "lakes" (e.g., Jordan Lake, Thomas Lake), have a distinct blackwater character, and can be explored in small boats. But beyond the confluence with the Little Pee Dee River, sandy point bars and banks disappear. The surrounding forest becomes tidal swamp. The main forest species are still present, but some, like the swamp and black willows that dominate sandy banks upstream, vanish completely. Below Thoroughfare Creek, the freshwater tidal marshes that were once the basis for antebellum rice plantations begin to displace the tidal swamp forest.

Leadership for the Great Pee Dee Scenic River Project comes from the Great Pee Dee Scenic River Advisory Council, which represents local landowners, river users, community interests, and SCDNR. The first major task of the advisory council is the creation of a management plan. This plan will be created using an open community-based process where local citizens identify their vision and goals for the river, discuss and define issues of concern, and then seek resolutions to

Appendix D

Terrestrial and Aquatic Wildlife

Janet Ertel/R4/FWS/DOI
02/15/2008 04:36 PM

To mbayless@batcon.org
cc Marshall Sasser/R4/FWS/DOI@FWS
bcc
Subject Fw: Rafinesque's big-eared bat questions

History: This message has been forwarded.

Mylea,

I would like to submit the following request for financial and design support to Bat Conservation International, in response to your recent request for Rafinesque's roost rehabilitation & replacement projects.

Contact:

Craig Sasser
Refuge Manager
Waccamaw National Wildlife Refuge
843/527-8069
marshall_sasser@fws.gov

Secondary Contact:

Janet Ertel
Refuge Biologist
National Wildlife Refuge System, Southeast Region
870/282-8247
janet_ertel@fws.gov

Summary of Proposal:

Waccamaw NWR includes portions of the Great Pee Dee, Little Pee Dee and Waccamaw rivers of coastal South Carolina. Refuge habitats range from black water forested wetlands to tidal forested and emergent wetlands. Rafinesque's big-eared bats have been identified roosting associated with two man-made structures on Waccamaw NWR. Both of these structures are slated for removal/demolition within the next two to ten years. The refuge would like these structures to be repaired or replaced previous to their demolition, in order to provide continued roosting habitat for resident bats. Site 1 is considered the priority project at this point. Both projects would be well suited for implementation next year.

Site 1, Highway bridge: The road associated with this old bridge crossing Yauhannah Lake is scheduled for relocation, and the bridge for removal within 10 years. Rafinesque's big-eared bat maternity roosts have been identified using this location in two years with 21 and 16 individuals identified in 2002 and 2003, respectively. See attached survey information from Susan Loeb. We hope that BCI will considered supporting the refuge in order to provide an artificial roost structure in association with the bridge to be removed and thereby provide these bats an alternative roost site. Waccamaw NWR has an active environmental education program and is currently constructing an education center near the bridge site. An artificial roost structure, perhaps outfitted with a remote camera if appropriate, could additionally provide a unique and valuable opportunity for on-site education regarding bats.

Site 2, Abandoned hunt cabin: This abandoned cabin is in disrepair and has been identified through a National Wildlife Refuge System Facilities inspection as a priority for demolition within two to five years. Individual roosting Rafinesque's big-eared bats have been identified in this structure on multiple occasions. This structure may be appropriate for rehabilitation in order to retain a condition suitable for roosting bats and refuge public safety. This site is relatively remote.

Many thanks, Mylea.

-Janet

Janet Ertel
National Wildlife Refuge System
Southeast Region
P.O. Box 205
St. Charles, AR 72140
office: 870/282-8247
cell: 870/270-3481

----- Forwarded by Janet Ertel/R4/FWS/DOI on 02/15/2008 01:40 PM -----

Marshall Sasser/R4/FWS/DOI
02/15/2008 07:16 AM

To Janet Ertel/R4/FWS/DOI@FWS
cc Ray Paterra/R4/FWS/DOI@FWS
Subject Fw: Rafinesque's big-eared bat questions

Janet,

I finally got the data set for the old bridge which is adjacent to our new EE center. The old bridge is slated for demo in the next 5-10 years. One idea that I have is to build a new roost facility that has a camera w/in so that we could monitor the roost in the new facility. Obviously it might be best to see what success we might have before going to the expense of a remote camera. Please let me know what we should do next.

Thanks,

Craig

Marshall Craig Sasser
Refuge Manager - Waccamaw NWR
1601 North Fraser Street
P.O. Box 1439
Georgetown, SC 29440

843/527- 8069 Office
843/527- 8494 Fax

----- Forwarded by Marshall Sasser/R4/FWS/DOI on 02/15/2008 08:11 AM -----

Susan Loeb
<sloeb@CLEMSON.EDU>
02/14/2008 10:50 AM

To Marshall_Sasser@fws.gov
cc
Subject Re: Rafinesque's big-eared bat questions

Craig,

On 6/6/2002 there were 2 groups of bats under bridge 222070100400 which crosses Yauhannah Lake. One of the groups was a maternity colony of

21 individuals. The maternity colony used the bridge again in 2003. On 6/5/2003 there were 16 bats (15 adults and 1 young) under the bridge. On 7/11/2003 there were 4 adults and 2 young and on 7/15/2003 there were 9 adults and 4 young under the bridge. It is not uncommon for the numbers to fluctuate as some females move to alternate roosts.

Please let me know if you need further information. I hope that you have been in contact with Mylea Bayless of BCI (mbayless@batcon.org). She is in charge of their artificial bat roost program and has done a lot of work with Rafinesque's big-eared bat roosts. If I can be of further assistance, please let me know.

At 11:35 AM 2/13/2008, you wrote:

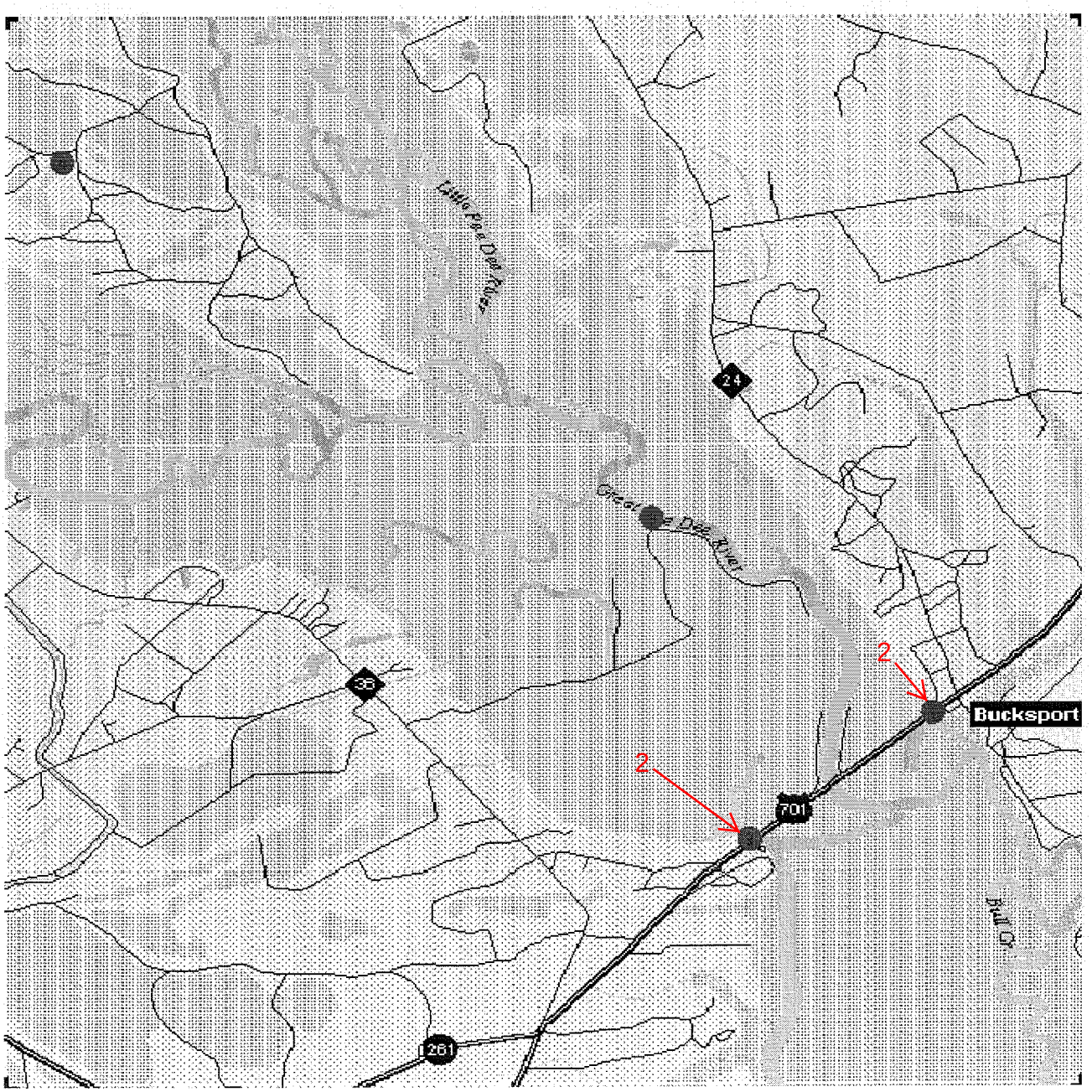
>Susan,
>
>Many thanks for your help on this. The two bridges that I am most
>interested in are the US Hwy 701 bridges that cross over Yauhannah Lake
>and the Great Pee Dee River. I need the most basic info regarding use
>(presence) and numbers documented during the survey. If I recall
>correctly, one of the two bridges was being used as brooding habitat. Our
>new Center will be located immediately adjacent to the Yauhannah Lake
>Bridge which is a very old bridge that is being slated for demolition by
>SCDOT. My hope is that we can get a grant to build a structure to
>supplement/replace the habitat that may be lost if/when the bridge is
>replaced. Sorry that I do not have the actual bridge numbers
>
>Thanks,
>
>Craig Sasser
>
>Marshall Craig Sasser
>Refuge Manager - Waccamaw NWR
>1601 North Fraser Street
>P.O. Box 1439
>Georgetown, SC 29440
>
>843/527- 8069 Office
>843/527- 8494 Fax
>
>
>
>Susan Loeb <sloeb@CLEMSON.EDU>
>
>02/08/2008 11:07 AM
>To
>Marshall_Sasser@fws.gov
>cc
>Subject
>Rafinesque's big-eared bat questions
>
>
>
>
>Marshall,
>Mary Kay Clark forwarded your message to me about the Rafinesque's
>big-eared bats near your refuge. I have all of Frances' data and will be
>more than happy to provide any information I can. Please contact me with
>your specific questions and the number of the bridge in question. Look
>forward to hearing from you.
>

South Carolina Rare, Threatened & Endangered Species Inventory

Species Map of the YAUHANNAH Quadrangle

Data Last Updated January 17th, 2006.

Refer to Table Below Map for List of Species at the Location of Interest Indicated on the Map



Map Legend

Marker ID	Genus species
1	CORYNORHINUS RAFINESQUII
2	CORYNORHINUS RAFINESQUII
3	COLONIAL WATERBIRD
4	COLONIAL WATERBIRD

BIG EARED BAT

[Horry County Quad Selection Map | County Selection Map | SCDNR GIS Data Home Page]

Element Occurence of
CORYNORHINUS RAFINESQUII
(RAFINESQUE'S BIG-EARED BAT)
in the YAUHANNAH quadrangle

DOT ID	2
CODE	AMACC08020*047*SC
SCIENTIFIC NAME	CORYNORHINUS RAFINESQUII
COMMON NAME	RAFINESQUE'S BIG-EARED BAT
GLOBAL RANK	G3G4
STATE RANK	S2?
LEGAL STATUS	SE
COUNTY	Georgetown
QUADRANGLE	YAUHANNAH
LATITUDE	333915N
LONGITUDE	0790949W
LAT/LON PRECISION	Within Three Seconds
DESCRIPTION	A MATERNAL ROOST OF 23 BATS WAS FOUND UNDER BRIDGE #222070100400, LOCATED 2 MILES NORTHEAST OF YAUHANNAH ON US 701 OVER THE YAUHANNAH LAKE/GREAT PEE DEE RIVER.
FIRST OBSERVED	2002-06-02
LAST OBSERVED	2002-06-02

[Other Yauhannah Species | Georgetown County Quad Selection Map]
[County Selection Map | SCDNR GIS Data Home]

Element Occurence of
CORYNORHINUS RAFINESQUII
(RAFINESQUE'S BIG-EARED BAT)
in the YAUHANNAH quadrangle

DOT ID	1
CODE	AMACC08020*048*SC
SCIENTIFIC NAME	CORYNORHINUS RAFINESQUII
COMMON NAME	RAFINESQUE'S BIG-EARED BAT
GLOBAL RANK	G3G4
STATE RANK	S2?
LEGAL STATUS	SE
COUNTY	Horry
QUADRANGLE	YAUHANNAH
LATITUDE	334008N
LONGITUDE	0790832W
LAT/LON PRECISION	Within Three Seconds
DESCRIPTION	A SOLITARY BAT WAS FOUND UNDER BIDGE #262070100100, 11 MILES SOUTH OF CONWAY, ON US 701 OVER THE GREAT PEE DEE OVERFLOW.
FIRST OBSERVED	2002-06-05
LAST OBSERVED	2002-06-05

[Other Yauhannah Species | Horry County Quad Selection Map]
[County Selection Map | SCDNR GIS Data Home]

Year 2005 *Paper Bennett2005a*

Use and selection of highway bridges by Rafinesque's big-eared bats in South Carolina

Frances M. Bennett
University of Cincinnati

Bennett FM. 2006. Use and selection of highway bridges by Rafinesque's big-eared bats in South Carolina. IN: Proceedings of the 2005 International Conference on Ecology and Transportation, Eds. Irwin CL, Garrett P, McDermott KP. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC: p. 675. (Abstract)

Use and selection of highway bridges by Rafinesque's big-eared bats in South Carolina

Abstract

Rafinesque's big-eared bats (Corynorhinus rafinesquii) occur throughout the South and into some Midwestern states. However, they are rare throughout their range and are considered to be a species of special concern in every state in which they occur. Previous studies have documented the use of bridges by Rafinesque's big-eared bats in Louisiana, Mississippi, and North Carolina, but information on bridge use across the range is lacking. Furthermore, two of the three studies on bridge use were conducted in national forests. Thus, our objective was to determine the use and selection of bridges as day roosts by Rafinesque's big-eared bats on all public roads in South Carolina. We surveyed 1,129 bridges within all 46 counties from May to August 2002. During the summer of 2003, we monitored 236 bridges in previously occupied areas of the state one to five times to evaluate bridge-roost fidelity. Colonies (including maternal groups) and solitary big-eared bats were found beneath 38 bridges in 2002 and 55 bridges in 2003. Occupancy in both years was strongly influenced by bridge size ($P < 0.001$) and construction type ($P < 0.001$); bats selected large, concrete-girder bridges and avoided flat-bottomed, slab bridges. Rafinesque's big-eared bats occupied bridges in the Upper and Lower Coastal Plain, but were absent from bridges in the Piedmont and Blue Ridge Mountains. Big-eared bats demonstrated a high degree of roost fidelity (65.9 percent). We also found that checking bridges three times at two-week intervals ensured the detection of bats, but checking more than three times did not increase detection probabilities. The high degree of fidelity and use by maternal groups suggest that highway bridges are important roosting sites for Rafinesque's big-eared bats in the South Carolina Coastal Plain. Our results also suggest that if repair or maintenance work is planned for girder bridges during the summer, they should be inspected three times over a four to six week period. Because other studies have shown that Rafinesque's big-eared bats rarely use bridges during winter, delaying work on occupied bridges until that time will aid in the conservation of this rare species. Biographical Sketch: Frances Bennett completed an honor's degree in biology from the University of Saskatchewan in 1999, after which she worked as a field biologist for three years in eastern Canada for provincial and federal agencies and Acadia University. She attended Clemson University to complete a master's degree in environmental/wildlife toxicology from 2002-2004, where she conducted a statewide survey for Rafinesque's big-eared bats in South Carolina and also carried out an assessment of metal exposure in these bats. Ms. Bennett

attends the University of Cincinnati, where she plans to continue her research into the effects of environmental contaminants on insectivorous bats.

Use and Selection of Highway Bridges by Rafinesque's Big-Eared Bats in South Carolina

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Abstract

Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) occur throughout the South and into some Midwestern states. However, they are rare throughout their range and are considered to be a species of special concern in every state in which they occur. Previous studies have documented the use of bridges by Rafinesque's big-eared bats in Louisiana, Mississippi, and North Carolina, but information on bridge use across the range is lacking. Furthermore, two of the three studies on bridge use were conducted in national forests. Thus, our objective was to determine the use and selection of bridges as day roosts by Rafinesque's big-eared bats on all public roads in South Carolina.

We surveyed 1,129 bridges within all 46 counties from May to August 2002. During the summer of 2003, we monitored 236 bridges in previously occupied areas of the state one to five times to evaluate bridge-roost fidelity. Colonies (including maternal groups) and solitary big-eared bats were found beneath 38 bridges in 2002 and 55 bridges in 2003. Occupancy in both years was strongly influenced by bridge size ($P < 0.001$) and construction type ($P < 0.001$); bats selected large, concrete-girder bridges and avoided flat-bottomed, slab bridges. Rafinesque's big-eared bats occupied bridges in the Upper and Lower Coastal Plain, but were absent from bridges in the Piedmont and Blue Ridge Mountains. Big-eared bats demonstrated a high degree of roost fidelity (65.9 percent). We also found that checking bridges three times at two-week intervals ensured the detection of bats, but checking more than three times did not increase detection probabilities.

The high degree of fidelity and use by maternal groups suggest that highway bridges are important roosting sites for Rafinesque's big-eared bats in the South Carolina Coastal Plain. Our results also suggest that if repair or maintenance work is planned for girder bridges during the summer, they should be inspected three times over a four to six week period. Because other studies have shown that Rafinesque's big-eared bats rarely use bridges during winter, delaying work on occupied bridges until that time will aid in the conservation of this rare species.

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Am. Midl. Nat. 160:386–399

Use and Selection of Bridges as Day Roosts by Rafinesque's Big-Eared Bats

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ABSTRACT.—Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) use bridges as day roosts in parts of their range, but information on bridge use across their range is lacking. From May to Aug. 2002 we surveyed 1129 bridges (12.5%) within all 46 counties of South Carolina to determine use and selection of bridges as day roosts by big-eared bats and to document their distribution across the state. During summer 2003, we visited 235 bridges in previously occupied areas of the state to evaluate short-term fidelity to bridge roosts. We found colonies and solitary big-eared bats beneath 38 bridges in 2002 and 54 bridges in 2003. Construction type and size of bridges strongly influenced use in both years; bats selected large, concrete girder bridges and avoided flat-bottomed slab bridges. The majority of occupied bridges (94.7%) were in the Upper and Lower Coastal Plains, but a few bridges (5.3%) were located in the Piedmont. Rafinesque's big-eared bats were absent beneath bridges in the Blue Ridge Mountains. We established new records of occurrence for 10 counties. In the Coastal Plains, big-eared bats exhibited a high degree of short-term fidelity to roosts in highway bridges. For bridges that were occupied at least once, mean frequency of use was 65.9%. Probability of finding bats under a bridge ranged from 0.46 to 0.73 depending on whether the bridge was occupied in the previous year. Thus, bridges should be inspected three to five times in a given year to determine whether they are being used. Regional bridge roost surveys may be a good method for determining the distribution of *C. rafinesquii*, particularly in the Coastal Plains, and protection of suitable bridges may be a viable conservation strategy where natural roost sites are limited.

INTRODUCTION

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) is found in the southern and midwestern United States (Fig. 1) and is one of the least studied bats in North America (Harvey *et al.*, 1999). Despite having a relatively widespread distribution, this species is considered uncommon and is recognized as a species of special concern across most of its range (Hurst and Lacki, 1999; Martin *et al.*, 2002). However, because Rafinesque's big-eared bats are not easily captured or detected with standard methods (*e.g.*, mist nets, acoustic

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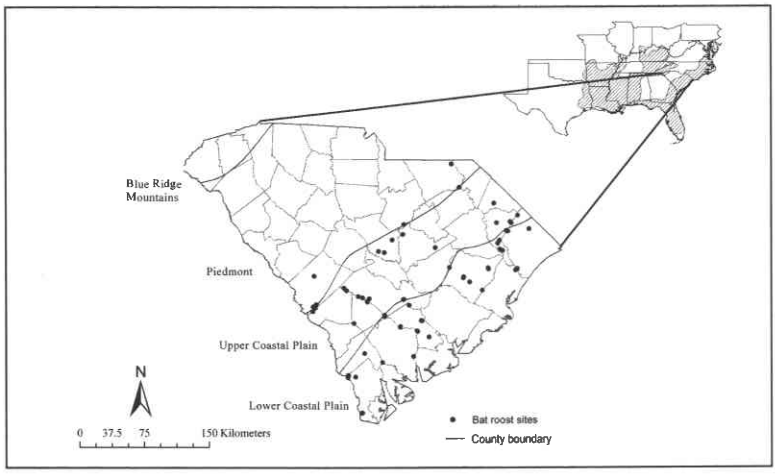

FIG. 1.—Upper right: range of Rafinesque's big-eared bats. Enlargement shows the four physiographic provinces of South Carolina and the locations of bridges used by Rafinesque's big-eared bats, late May through mid-Aug. 2002–2003

sampling), it has been difficult to estimate their relative abundance and determine their geographic distribution.

Historical accounts, museum specimens and incidental capture records place this species in the Blue Ridge Mountains, the Upper Coastal Plain and the Lower Coastal Plain physiographic regions in North Carolina, South Carolina and Georgia (Handley, 1959; Clark, 1990; Menzel *et al.*, 2003). In the Carolinas, Rafinesque's big-eared bat is commonly associated with bottomland hardwood forests (Clark, 1990) which are most abundant within the Upper and Lower Coastal Plains (Conner, 1993). Although bottomland hardwood forests also occur in the Piedmont, this bat appears to be absent from this physiographic region (Menzel *et al.*, 2003). It is not clear whether the Piedmont truly does not support populations of big-eared bats or whether there have been insufficient sampling efforts in this region. A reliable method for locating Rafinesque's big-eared bats is clearly needed to determine their population status and distribution.

Rafinesque's big-eared bats are non-migratory and use tree cavities, caves, mines, buildings and other man-made structures for roosting (Barbour and Davis, 1969). Like most cavity-roosting species, Rafinesque's big-eared bats that use tree cavities and bridges frequently switch roost sites (Lance *et al.*, 2001; Trousdale and Beckett, 2005), whereas cave roosting Rafinesque's big-eared bats rarely switch roosts (Hurst and Lacki, 1999). In the Coastal Plains, naturally occurring structures include cavities in large diameter gum (*Nyssa* sp.) and cypress (*Taxodium* sp.) trees (Clark, 1990; Gooding and Langford, 2004; Trousdale and Beckett, 2005). Artificial sites are structurally similar to natural cavities, and include dimly lit areas in abandoned buildings, cisterns, wells and highway bridges (Barbour and Davis, 1969; Clark, 1990; Lance *et al.*, 2001; Mirowsky *et al.*, 2004; Trousdale and Beckett, 2002, 2004; Ferrara and Leberg, 2005a). Both artificial and natural structures are used as day and night roosts year-round, but frequency of use in anthropogenic structures peaks during May–Aug. when maternity colonies appear (Felts and Webster, 2003; Trousdale and Beckett, 2004). Thus, summer is the most appropriate time to conduct surveys in artificial structures, particularly bridges (Ferrara and Leberg, 2005b).

The relative use of artificial versus natural structures may depend upon the availability of structures in each physiographic region. Rafinesque's big-eared bats more commonly roost in artificial structures in the southern portion of their range, and in natural roost sites in the northern portion of their range (Jones, 1977). The Coastal Plain lacks an abundance of natural roost sites (*i.e.*, large trees) because many were harvested over a century ago. However, artificial structures now are widespread and are frequently used as roost sites. By contrast, in the northern portions of the range natural roost sites such as tree cavities, rock houses, abandoned mines and caves are more frequently used (Bunch *et al.*, 1998; Hurst and Lacki, 1999), possibly because of their higher occurrence on the landscape.

Type of bridge construction is the strongest predictor of bridge occupancy by Rafinesque's big-eared bats (Lance *et al.*, 2001; McDonnell, 2001; Trousdale and Beckett, 2002). Bats roost in the space between girders on the underside of bridges and have not been observed in enclosed and concealed expansion joints (Ferrara and Leberg, 2005a). In South Carolina, three main bridge types are present: flat-bottomed slab bridges, multi-beam (MB) girder bridges and T-beam (TB) cast-in-place girder bridges (L. R. Floyd, South Carolina Department of Transportation, unpubl.). MB bridges are variable in structure, but generally consist of parallel beams that span the entire length of the bridge and sometimes are referred to as I-beam or channel beam bridges. TB bridges also have parallel beams that span the entire length of the bridge, but the support beams are intersected at right angles by cross beams. Although Rafinesque's big-eared bats most frequently use girder bridges in Louisiana and North Carolina (Lance *et al.*, 2001; McDonnell, 2001), it is not known whether they select either of the two girder type bridges found in South Carolina.

Most studies of bridge use by Rafinesque's big-eared bats have been conducted within relatively small geographic areas restricted to the Coastal Plain regions (Lance *et al.*, 2001; McDonnell, 2001; Trousdale and Beckett, 2002; Felts and Webster, 2003). Limited bridge surveys have been conducted in South Carolina, but no day-roosting bats were found under the 44 bridges examined (Keeley and Tuttle, 1999). The objectives of our study were to: (1) document the use of bridges by Rafinesque's big-eared bats in South Carolina, (2) conduct a statewide bridge survey to determine their distribution across the state, (3) evaluate bridge attributes such as size and type that influence occupancy and (4) determine short term bridge fidelity and the number of visits needed to document presence. By identifying bridge types used by Rafinesque's big-eared bat and its fidelity to these structures, it may be possible to improve survey methods across its range.

METHODS

STUDY AREA

South Carolina consists of four physiographic regions: the Blue Ridge Mountains, the Piedmont, the Upper Coastal Plain and the Lower Coastal Plain (Fig. 1). The climate of South Carolina is warm temperate to subtropical and is characterized by short, mild winters and long, hot and humid summers. Rainfall occurs throughout the year, but peak levels occur during the winter months in the mountains, and in Mar. and Jul. throughout the rest of the state. Average monthly rainfall amounts range from 11.4 cm to 17.3 cm in the mountains, 7.4 cm to 11.7 cm in the Piedmont and 6.0 cm to 16.6 cm in the Coastal Plains.

The Blue Ridge Mountain region, a part of the southern Appalachian Mountains, is situated in the upper northwestern portion of South Carolina. This region covers approximately 1.9% of the state, has a mountainous topography and ranges in elevation from 366 to 1067 m. Oak-hickory (*Quercus* sp. - *Carya* sp.), oak-pine (*Quercus* sp. *Pinus* sp.)

and loblolly-shortleaf pine (*P. taeda – P. echinata*) are the dominant forest types (Conner, 1993).

The Piedmont region is adjacent to the Blue Ridge Mountains and covers 31.9% of South Carolina. It has a rolling topography and ranges in elevation from 91 to 366 m. Urbanization and agriculture are common in this region; the dominant forests are loblolly-shortleaf pine forests. Localized stands of mixed pine-hardwoods and bottomland hardwood forests consisting of oak-bald cypress-tupelo gum (*Quercus* sp. - *Taxodium distichum* - *Nyssa* sp.) trees also are found in the Piedmont, but are concentrated in areas adjacent to the Upper Coastal Plain (Conner, 1993).

The Upper and Lower Coastal Plain provinces cover the largest area of South Carolina (66.2%), extending 193 to 241 km inland from the Atlantic Ocean. The topography of this region is flat; the highest elevation is 91 m. Forests in both Coastal Plain regions are dominated by loblolly-shortleaf and longleaf-slash pine (*P. palustris* - *P. elliotti*) forests; however, bottomland hardwood forests are more extensive in these physiographic provinces than any other in the state (Conner, 1993). The Upper Coastal Plain has comparatively more urban, agriculture and other non-forest cover types than the Lower Coastal Plain region.

2002 STATEWIDE BRIDGE SURVEY

We conducted a county-by-county survey from 22 May to 8 Aug. 2002. Bridge data including structure type, construction material, latitude/longitude, feature crossed (*i.e.*, waterway), unique identification number and bridge length and width were obtained from the South Carolina Department of Transportation (SC DOT; L. R. Floyd, South Carolina Department of Transportation, unpubl.). For each of the 46 counties in South Carolina, we grouped and surveyed bridges according to type (slab, MB and TB). Because bats rarely roost in bridges over roadways and train tracks (Erickson, 2002) we only surveyed bridges over water bodies. We surveyed bridges on public roads, including those on National Forests and National Wildlife Refuges. For safety reasons, we did not survey bridges on interstate highways. Each bridge was surveyed once.

For the first 9 d of the survey, we used a stratified random sampling design based on bridge type and inspected bridges in proportion to their occurrence. Slab bridges were the most common bridge type over water in South Carolina (n = 4025), followed by MBs (n = 1616) and TBs (n = 676). Based on the results of this initial sampling period (Bennett, 2004) and data from previous studies (Lance *et al.*, 2001; McDonnell, 2001), we modified the study design to increase the likelihood of locating bats under bridges. For the remainder of the survey, we inspected bridges in the following order of precedence: TB, MB, and slab. We attempted to inspect every TB bridge over water and simultaneously surveyed a randomly generated subset of MB and slab bridges.

We inspected the underside of each bridge during the day for presence of bats with 1,000,000 candle-power flashlights. Data collected included: date, county, latitude and longitude, physiographic region, bridge type and material, number of Rafinesque's big-eared bats present, number and species of other bats present, presence of bat feces and disturbance level. If bats were found under a bridge, we recorded details of the roost location and the group type (maternity colony or solitary). Where possible, independent counts of pups and adults were made by at least two field personnel and compared to ensure the most accurate count of bats. In some instances, total counts were not made to reduce disturbance to the bats. In these instances, we recorded an approximate range of the numbers of bats present. For data analysis, we used the lowest estimate.

We rated disturbance beneath each bridge on a discrete scale of 0–3. Bridges with no obvious disturbances were given a rating of 0, low levels of disturbance were recorded as 1, medium levels of disturbance were recorded as 2, and bridges with high levels of disturbance were given a rating of 3. Disturbance factors included presence or evidence of humans such as trash, vandalism, footprints, all terrain vehicle tracks and heavy vehicular traffic on the surface of the structure.

2003 BRIDGE SURVEYS AND ROOST MONITORING

We conducted bridge surveys from 23 May to 1 Aug. 2003 using the same methods as in 2002. Although the 2003 field survey was similar in execution to the 2002 statewide survey, there were two important differences. First, we did not survey the entire state. Instead, we focused surveys in areas where big-eared bats were found in 2002. Second, we inspected bridges occupied in 2002 several times in 2003; most bridges with big-eared bats were surveyed every 2–3 wk so that bridges were examined up to five times. We also inspected additional bridges over water that were not visited in 2002, but were within occupied areas of the state. If a bridge was occupied in 2003 but not in 2002, we also monitored it regularly. However, due to restricted access, some bridges (<10) were only inspected once in 2003.

DATA ANALYSIS

We used likelihood ratio chi-square tests (PROC FREQ; SAS, 2002) to determine the association between the presence of big-eared bats and qualitative attributes of bridges (type, physiographic region and disturbance) in 2002 and 2003. Due to small sample size, we used a Fisher's exact test to evaluate the association between the presence of big-eared bats and the occurrence of other bat species in 2002, and big-eared bat presence and disturbance in 2003 (Freeman and Halton, 1951). Associations between the presence of bats and quantitative attributes of bridges (length, width and area) were assessed using the Kruskall-Wallis one-way analysis of variance. We were unable to attain bridge size for 11 bridges in 2002 and eight bridges in 2003. Because of differences in sampling procedures between years, we analyzed data from 2002 and 2003 separately. Furthermore, because our sampling procedure was biased against slab bridges and no bats were found under these structures, we also ran the above analyses after excluding slab bridges from the dataset. We were unable to determine the association between bridge material (concrete, timber, steel alloy) and presence of bats because material and bridge type were not independent.

We used logistic regression analysis with a stepwise selection process ($\alpha = 0.05$) to determine bridge attributes selected or avoided by Rafinesque's big-eared bats (PROC LOGISTIC). We determined the goodness of fit of the logistic regression equations for binary response models (Hosmer and Lemeshow, 2000). Models were run with and without slab bridges. Because bridge area was highly correlated with bridge length ($r > 0.95$) it was not included in the models. We used an $\alpha \leq 0.05$ to determine statistical significance for all tests. Data are presented as the mean $\pm$ SD throughout the results.

We used program PRESENCE (MacKenzie *et al.*, 2002) to estimate the probability of detecting bats (p) under a bridge and bridge occupancy (Ψ) for the 2003 sampling period. We used estimates of p to determine the minimum number of times a bridge needs to be inspected to determine whether it is occupied. However, because the bridges were not chosen randomly, p and Ψ are biased. Models were run on all bridges inspected once in 2002 and ≥ 2 times in 2003. We included bridge use in 2002 as a covariate to test whether previous occupation of a bridge was an important variable in detection probabilities and occupancy in 2003. We compared models using Akaike's Information Criterion

corrected for small sample sizes (AICc; Burnham and Anderson, 2002). Models with $\Delta_i > 2$ were not considered to have strong support. We estimated the minimum number of surveys needed to detect bats at a bridge using the following equation (MacKenzie and Royle, 2005):

$$p* = 1 - (1 - p)^K$$

where p^* = the probability of finding bats at a bridge at least once, p = the probability of detection, and K = the number of surveys.

RESULTS

BRIDGE ROOSTS OF RAFINESQUE'S BIG-EARED BATS

We surveyed 1129 bridges in 2002 and conducted 443 surveys of 235 bridges in 2003. Overall, we surveyed 7.1% of the slab bridges, 17.4% of the MB bridges and 83.4% of the TB bridges in the state, representing 17.9% of all bridges spanning permanent water bodies. We found Rafinesque's big-eared bats beneath 38 bridges (3.4%) in 2002 and 54 bridges (22.9%) in 2003. Many bridges were used in both years (*see* below); the total number of occupied bridges was 73. Colonies and solitary bats were sometimes found under the same bridge, but were always spatially separated. In 2002, we observed 196 big-eared bats in colonies (n = 13 bridges) and 49 solitary bats (n = 33 bridges). Colonies observed in 2002 ranged in size from 2–53 bats (median = 12 bats). These numbers are conservative as it often was difficult to get an exact count of bats, particularly when neonates still clung to their mother. In 2003, colonies and solitary bats roosted beneath 24 and 47 bridges, respectively. The number of bats (range = 2–31 bats) in colonies fluctuated throughout the 2003 monitoring period; the median number of bats in a group was eight. We found multiple roosts of solitary bats beneath nine bridges; one large bridge had five separate solitary big-eared bats roosting beneath it at one time.

In 2003, we were unable to inspect eight bridges occupied by solitary bats the previous year due to logistical and time constraints. We located Rafinesque's big-eared bats under an additional 35 bridges in 2003. Twenty-six of these bridges had been inspected in 2002 and did not have any day roosting big-eared bats, but 15 bridges (57.7%) had feces in 2002.

Big-eared bats primarily roosted over the dry banks on either end of a bridge near the abutments; we found 4 of 108 (3.7%) solitary bats roosting in the middle section of bridges where the waterbed was dry, and three of 37 (8.2%) colonies over both water and dry bank under bridges where there was little dry substrate present. Rafinesque's big-eared bats roosted between support beams in the moderately open areas of a bridge; they were never found in small expansion joints. Bats occasionally flew to adjacent sections of the bridge during surveys; however, bats were only observed leaving bridges twice during the study. Rafinesque's big-eared bats did not leave fecal stains on the bridge walls. Fecal pellets were most often observed as individual pieces on the concrete walls of the bridges; occasionally we found guano in larger quantities on the ground.

We observed other bat species beneath 45 bridges during the statewide survey: eastern pipistrelle (*Perimyotis subflavus*; n = 26); big brown bat (*Eptesicus fuscus*; n = 10); southeastern myotis (*Myotis austroriparius*; n = 1); Brazilian free-tailed bat (*Tadarida brasiliensis*; n = 1); and unidentified *Myotis* species (n = 7). Solitary big-eared bats roosted under bridges with birds (n = 7) and other bat species (n = 3), but did not roost under bridges where domestic animals were found. When Rafinesque's big-eared bats used the same bridge as other species, they usually used separate sections of a bridge. However, we

TABLE 1.—Numbers and percentages (in parentheses) of bridges surveyed in South Carolina occupied by Rafinesque's big-eared bats and other species of bats, May–Aug. 2002. n = number of bridges examined

Bridge variable	n	Rafinesque's big-eared bats	Other bat spp.
Type			
Slab	284	0 (0.0)	0 (0.0)
Multi-Beam	281	6 (2.1)	15 (5.3)
T-Beam	564	32 (5.7)	28 (5.0)
Material			
Concrete	1015	38 (3.9)	41 (4.0)
Steel	87	0 (0.0)	2 (2.3)
Timber	27	0 (0.0)	0 (0.0)
Disturbance			
0	318	3 (0.9)	14 (4.4)
1	381	12 (3.2)	19 (5.0)
2	275	18 (6.6)	9 (3.3)
3	155	5 (3.2)	1 (0.7)
Region			
Blue Ridge	32	0 (0.0)	2 (6.3)
Piedmont	381	2 (0.5)	23 (6.0)
Upper Coastal Plain	502	23 (4.6)	16 (3.2)
Lower Coastal Plain	214	13 (6.1)	2 (0.9)

located one maternity colony of big-eared bats (n = 37 bats) roosting next to a maternity group of big brown bats (n = 6 bats) on a single occasion in 2003. We regularly found both species beneath this bridge.

USE OF BRIDGES BY PHYSIOGRAPHIC REGION

Bridges used by Rafinesque's big-eared bats in 2002 were not distributed evenly across the state (Fig. 1, Table 1). Although the majority of big-eared bat roosts (94.7%) were beneath bridges in the Upper and Lower Coastal Plains, a small percentage (5.3%) were located in the Piedmont. No bridges in the Blue Ridge Mountains were used by bats. We found a significant association between physiographic region and presence of Rafinesque's big-eared bats ($\chi^2 = 22.7$, df = 3, $P \leq 0.001$, n = 1129) in 2002. However, we did not find significant differences in the presence of bats between Upper and Lower Coastal Plain regions in 2002 ($\chi^2 = 0.7$, df = 1, P = 0.411, n = 716) or 2003 ($\chi^2 = 1.9$, df = 1, P = 0.169, n = 235). We established new county records for Rafinesque's big-eared bats in Allendale, Bamberg, Barnwell, Chesterfield, Dillon, Horry, Marion, Orangeburg, Sumter and Williamsburg counties.

In the Coastal Plain, many of the bridge roost sites were grouped within the same watershed (Fig. 1). The South Fork of the Edisto River and its tributaries, which cross both the Upper and Lower Coastal Plain in the western part of South Carolina, contained the highest concentration of occupied bridges (23.3%). In addition, we found 12.3% of the bridge roosts along the Great Pee Dee River in the eastern portion of the state.

BRIDGE ATTRIBUTES ASSOCIATED WITH ROOST SELECTION

In 2002, the presence of Rafinesque's big-eared bats was associated with bridge type ($\chi^2 = 28.6$, df = 2, $P \leq 0.001$, n = 1129), disturbance ($\chi^2 = 14.8$, df = 3, P = 0.002, n = 1129), bridge length ($\chi^2 = 17.35$, df = 1, $P \leq 0.0001$, n = 1120), width ($\chi^2 = 12.56$, df = 1, $P \leq$

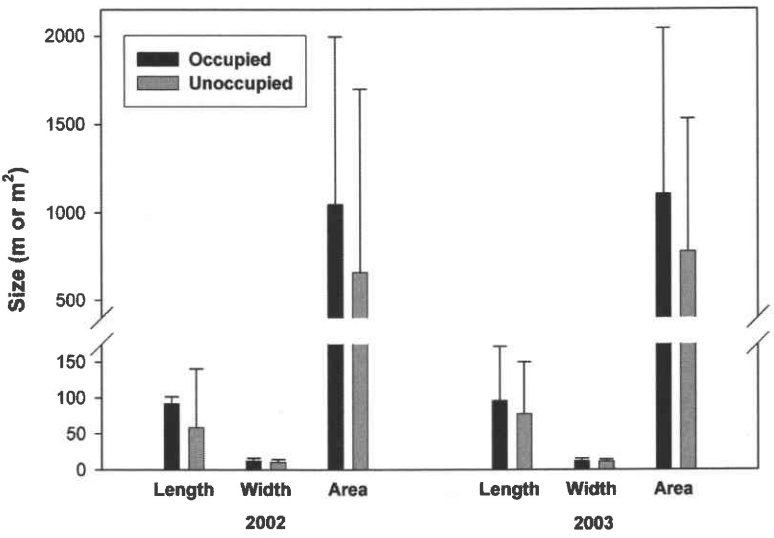

FIG. 2.—Mean length, width and area of occupied and unoccupied bridges by Rafinesque's big-eared bats in South Carolina May–Aug. 2002 and 2003. Error bars represent 1 SD

0.0001, n = 1120) and area (χ^2 = 23.20, df = 1, P ≤ 0.0001, n = 1120). We only located Rafinesque's big-eared bats beneath TB and MB bridges; no bats were observed under slab bridges (Table 1). When slab bridges were excluded from the analyses, similar results were obtained: presence of big-eared bats was associated with bridge type (χ^2 = 6.2, df = 1, P = 0.013, n = 845), disturbance (χ^2 = 9.8, df = 3, P = 0.02, n = 845), length (χ^2 = 9.67, df = 1, P = 0.002, n = 842), width (χ^2 = 9.22, df = 1, P = 0.002, n = 842) and area (χ^2 = 15.18, df = 1, P < 0.002, n = 842). The presence of other bat species was not associated with roosting big-eared bats (P = 0.120). Occupied bridges had a median disturbance level of 2. In general, we found bats under large girder bridges that were 36.4% longer, 13.7% wider, and covered 37.2% more area than bridges not occupied (Fig. 2). All occupied bridges were concrete.

Results of the logistic regression analysis for bridge selection in 2002 indicated that physiographic region (χ^2 = 24.5, df = 2, P ≤ 0.0001), bridge type (χ^2 = 20.1, df = 1, P ≤ 0.0001) and bridge width (χ^2 = 5.2, df = 1, P = 0.023) were the best predictors of big-eared bat presence. The overall regression equation was significant (χ^2 = 57.8, df = 3, P ≤ 0.001) and the model did not deviate from a logistic fit (χ^2 = 6.1, df = 8, P = 0.637). Interactions between variables were not significant and were removed from the final model. Although bridge length and disturbance differed significantly between occupied and unoccupied bridges in the univariate analyses, they did not enter the model indicating no influence on selection of bridge roosts when the other variables were controlled. We obtained similar results when we excluded slab bridges from the analyses. Presence of big-eared bats was influenced by physiographic region (χ^2 = 28.8, df = 1, P < 0.0001), bridge type (χ^2 = 4.2, df = 1, P = 0.04) and bridge width (χ^2 = 5.1, df = 1, P = 0.02). The overall model was significant (χ^2 = 42.7, df = 3, P < 0.0001) and did not deviate from a logistic fit (χ^2 = 12.8, df = 8, P = 0.117).

In 2003, presence of bats was significantly associated with bridge type and disturbance level. As in 2002, we found Rafinesque's big-eared bats only beneath TB and MB bridges

TABLE 2.—Number and percentage (in parentheses) of highway bridges in the Upper and Lower Coastal Plains of South Carolina occupied by Rafinesque's big-eared bats, May–Aug. 2003. n = number of bridges examined

Bridge variable	n	Rafinesque's big-eared bats
Type		
Slab	11	0 (0.0)
Multi-Beam	38	7 (18.4)
T-Beam	187	47 (25.0)
Disturbance		
0	130	29 (22.3)
1	86	24 (27.9)
2	13	1 (7.7)
3	7	0 (0.0)
Region		
Upper Coastal Plain	120	32 (26.7)
Lower Coastal Plain	116	22 (19.0)

(Table 2). There was a significant association between structure type and occupancy (χ^2 = 6.8, df = 2, P = 0.034, n = 235). Although TB bridges were >6 times more likely to be used than MB bridges, there was no statistical difference in occupancy between MB and TB in 2003 (χ^2 = 0.8, df = 1, P = 0.357, n = 224). Most big-eared bats used bridges with a disturbance level of 0 or 1 in 2003, and there was a significant association between disturbance level and bat presence (P = 0.001, n = 235).

Bridges occupied by big-eared bats in 2003 were longer (χ^2 = 8.7, df = 1, P = 0.003, n = 227) and had greater area (χ^2 = 11.9, df = 1, P = 0.0006, n = 227) than unoccupied bridges (Fig. 2). Width did not differ significantly between occupied and unoccupied bridges (χ^2 = 3.6, df = 1, P = 0.06). Bridge type was the only variable that entered into the logistic regression model (χ^2 = 5.9, df = 1, P = 0.02).

ROOST FIDELITY AND PROBABILITY OF DETECTION

We visited occupied bridges an average of 3.06 times (range 1–5) and unoccupied bridges 2.0 times (range 1–5) during the 2003 survey. For bridges that were occupied at least once and inspected more than once, the frequency of bridge use ranged from 33% to 100% (mean = 65.9% ± 24.7%). For all bridges (occupied and unoccupied) inspected more than once, frequency of use was 24.7 ± 35.8%. Of the 30 bridges occupied in 2002 and surveyed in 2003, 19 (63.3%) were occupied both years.

Bridge use in 2002 affected both detection probability and occupancy in 2003 (Table 3). Probability of detecting Rafinesque's big-eared bats under bridges in 2003 that were not

TABLE 3.—Model selection results for probability of detection and occupancy by Rafinesque's big-eared bats under bridges in the Upper and Lower Coastal Plains of South Carolina, May–Aug. 2003. Occupancy (Ψ) and probability of detection (p) were modeled with or without consideration of whether the bridge was occupied in 2002 (Occ02). (.) indicates that Occ02 was held constant

Model	K	AICc	ΔAICc
Ψ(Occ02) p(Occ02)	4	303.10	0
Ψ(.) p(Occ02)	3	307.09	3.99
Ψ(Occ02) p(.)	3	308.54	5.44
Ψ(.) p(.)	2	320.54	17.44

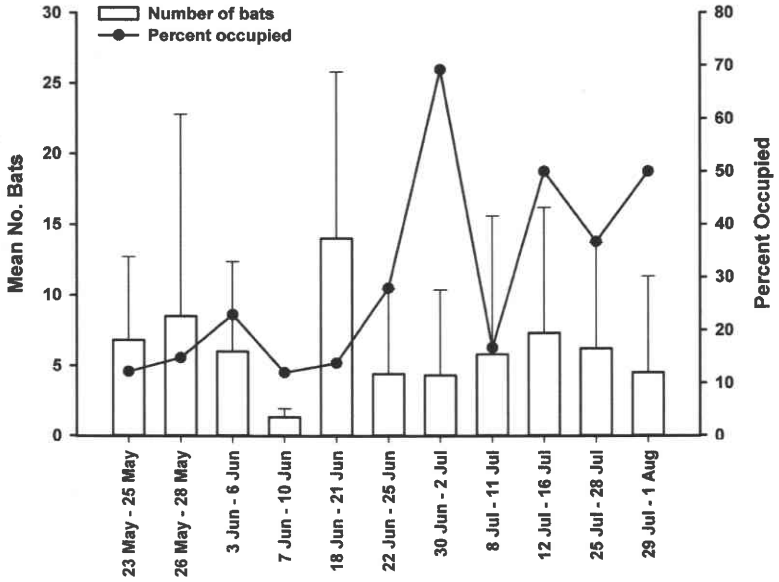

FIG. 3.—Mean number of Rafinesque's big-eared bats under bridges and the percent of bridges occupied in the Coastal Plain of South Carolina from late May through early Aug., 2003. Error bars represent 1 SD

used in 2002 was 0.457 and occupancy was 0.385. In contrast, p for bridges that had bats in 2002 was 0.730 and occupancy was 0.727. Thus, if bats were not observed under a bridge in 2002, there was a 91% chance of detecting bats under the same bridge in 2003 if they were inspected four times and a 95% chance of detecting them if they were inspected five times. By contrast, if bats were observed under a bridge in 2002, there was a 93% chance of detecting them in 2003 if the bridge was inspected only twice and a 98% chance of detecting them if it was inspected three times.

SEASONAL BRIDGE USE

The highest mean number of bats per occupied bridge (14.0 ± 11.8 bats) was observed in mid-Jun. (Fig. 3). However, we recorded the highest percent of occupied bridges (69.2%) in early Jul. In general, although the mean number of bats per occupied bridge was similar throughout the 2003 survey period, we found more occupied bridges during the latter part of the survey.

DISCUSSION

Our study represents the most extensive regional bridge survey conducted for Rafinesque's big-eared bats. Although only a small proportion of the state's bridges were occupied, they were occupied by both maternity colonies and solitary bats, and were used over multiple years. However, use of bridges was not distributed randomly with respect to region, bridge type or size. Bats selected large girder bridges, primarily in the Upper and Lower Coastal Plains. Results from the logistic regression analysis indicated the importance of physiographic region and bridge type to the bat's distribution and selection of roosts.

The distribution of Rafinesque's big-eared bats under bridges in South Carolina was similar to historical records for this species (Menzel *et al.*, 2003). Although new occurrence records were obtained for 10 counties, they were all within the bat's previously described range. The majority of bridges used as big-eared bat day roosts were located in the Upper and Lower Coastal Plains. However, two bridge roosts were located in the Piedmont. Both bridges contained solitary bats and were located <30 km from the Upper Coastal Plain within bottomland deciduous forests, the bat's primary roosting habitat in the Coastal Plain (Clark, 1990; Lance *et al.*, 2001; Trousdale and Beckett, 2005). Thus, it appears that Rafinesque's big-eared bats are largely absent from the Piedmont of South Carolina, but use localized tracts of bottomland hardwood forest that are contiguous with those of the Coastal Plain.

It is unlikely that we failed to locate a significant population of Rafinesque's big-eared bats in the Piedmont. Although bottomland hardwood forests and large cavity forming trees are present in this physiographic region, they are uncommon. However, suitable bridges for roosting are plentiful (275 TB bridges and 1188 MB bridges). Thus, if bats were present they would be expected to be beneath bridges. Although we determined that at least two to five surveys are necessary to determine whether a bridge is being used, we used the same sampling method (*i.e.*, one survey per bridge) in the Coastal Plains and located bats under 36 bridges.

The lack of occupied bridges in the Blue Ridge Mountains was surprising. Rafinesque's big-eared bats were captured and observed in this region during the time of the survey by two of the authors (SCL, MSB) thus, we expected to find them using bridges. However, the Blue Ridge region has fewer suitable bridges (only 25 TB bridges and 5 MB bridges) than the Coastal Plain (376 TB bridges and 332 MB bridges). Thus, if bats used bridges at the same rate in the Blue Ridge as in the Coastal Plain, they only would be expected to occupy one bridge. Moreover, use of artificial roosts appears to be rare in the northern portion of the range (Jones, 1977). Although a maternity colony was observed under one bridge in Kentucky (James Kiser, *in litt.*), no Rafinesque's big-eared bats were found under 232 bridges in southern Illinois (Feldhamer *et al.*, 2003). Thus, bridge use may be rare in the northern portion of the range, perhaps because natural roost sites such as rock houses, caves, tree cavities and abandoned mines are still abundant. Moreover, because a large percentage (>60%) of the Blue Ridge Mountains is protected through state conservation programs or is in federal ownership, natural roost sites may be more available than in other parts of South Carolina.

We found a strong relationship between presence of Rafinesque's big-eared bats and bridge type. Results of the logistic regression analysis indicated the odds of locating big-eared bats were highly dependent upon bridge structure. Although we only examined a small proportion of the slab bridges in the state, we found no evidence of use of these bridges by Rafinesque's big-eared bats or other species. Our observations are consistent with the pattern of bridge use by Rafinesque's big-eared bats in other states. In Louisiana, approximately 97% of Rafinesque's big-eared bat observations were from girder type bridges (Lance *et al.*, 2001) and in the Coastal Plain of North Carolina 100% of the Rafinesque's big-eared bat observations from girder bridges (McDonnell, 2001).

Although many of our findings were similar to previous studies, we found some unique patterns of bridge selection in this study. Rafinesque's big-eared bats showed a higher rate of occupancy in TB bridges (9.1%, n = 31 of 341 TB bridges; Upper and Lower Coastal Plains only) than MB bridges (3.2%, n = 5 of 155 bridges; Upper and Lower Coastal Plains only) in South Carolina. However, in the Coastal Plains of North Carolina, the rate of occupancy was higher beneath MB bridges (16.6%, n = 29 of 259 MB bridges) than TB bridges (9.0%, n =

6 of 67 TB bridges; McDonnell, 2001). In addition, big-eared bats used a small number of timber MB bridges in North Carolina (5.0%, n = 6 of 120 bridges; McDonnell, 2001); no timber bridges were occupied in either year of the South Carolina survey (0 of 27 bridges). Differences in the use of MB versus TB bridges may be related to other bridge variables such as surrounding habitat and roost microclimate, which are significant factors in the selection of roosts by Rafinesque's big-eared bats (Clark, 1990; Lacki, 2000; Lance *et al.*, 2001). Measurement of these extrinsic variables may help to resolve the difference in bridge use patterns within the Coastal Plain.

Occupancy of larger bridges also was unique to Rafinesque's big-eared bats in South Carolina. Bridge use in Louisiana and North Carolina was not related to length or width (Lance *et al.*, 2001; McDonnell, 2001), but in South Carolina, occupied bridges were longer, wider and covered a larger area than bridges not occupied. Bridge size is a significant factor in night roost selection for many bats in western North America (Perlmeter, 1996; Adam and Hayes, 2000). Larger bridges maintain higher nighttime temperatures thus, provide a better microclimate than smaller bridges. Higher nighttime temperatures may be a particularly significant factor for maternity colonies during the lactation period when females leave their young to forage (*e.g.*, Chruszcz and Barclay, 2002). Larger bridges also may provide a greater diversity of microclimates, allowing bats to choose among them as environmental conditions change, as well as providing greater protection from predators (Ferrara and Leberg, 2005a).

Disturbance was a significant variable in roost selection by bats, but was inconsistent between years. In the 2002 statewide survey, bridges with a disturbance rating of 2 were more likely to be occupied than any other bridges. In 2003, most occupied bridges had a disturbance rating of 0. The difference between years was probably due to variation among observers. The apparent occupation of bridges with a high level of disturbance in 2002 is in disagreement with other studies (Lacki, 1998, 2000; Lance *et al.*, 2001), likely because disturbance caused by traffic on bridge surfaces and the disturbance levels underneath a bridge were not separated in our study. Often, bridges with heavy traffic levels had little disruption underneath the structure; this may account for the occupation of bridges with seemingly elevated disturbance in 2002.

Rafinesque's big-eared bats exhibited high short-term fidelity to bridges in the Coastal Plains of South Carolina. For structures occupied at least once, the frequency of use was 65.9%. Although this estimation of bridge roost fidelity may be somewhat biased because bridges were inspected more often if bats initially were present, the frequency of bridge use was similar to other studies. Lance *et al.* (2001) reported that female big-eared bats primarily used bridges, but that the proportion of days spent at a bridge roost varied from 20% to 100%. The remaining roost days were spent in trees (*Nyssa* spp.). Ferrara and Leberg (2005b) also found high short-term fidelity to bridge roosts by tagged individuals. We found that the probability of finding bats under a bridge and bridge occupancy in 2003 were strongly associated with presence of bats under the bridge in 2002. This indicates there was strong year-to-year fidelity to bridges. High roost fidelity is directly related to the permanency of a structure and inversely related to roost availability (Lewis, 1995). Bridges are permanent, available and abundant in South Carolina, so the high fidelity of Rafinesque's big-eared bats to bridges is not surprising.

Our results suggest that large-scale bridge surveys may be a good method for determining the distribution of Rafinesque's big-eared bats across a region, as well as for locating local colonies and individuals. While surveys can be conducted throughout the summer, Jul. represents the time when the most bridges were occupied. Further, young Rafinesque's big-

eared bats are independent by early Jul. (Jones and Suttkus, 1975) thus, disturbance of maternity colonies should be reduced during this time. Although surveying bridges once is sufficient for determining large-scale distribution patterns, multiple surveys are necessary to determine whether a particular bridge is occupied by bats. Our estimates of p and Ψ in 2003 were biased because we did not select bridges at random. Thus, our estimates of the number of times that bridges should be inspected represent the lowest end of the range. However, based on our estimates, a bridge should be inspected at least four or five times during the summer if there is no indication of prior use and at least two times if the bridge was used in the prior year to determine whether it is currently being used. Ferrara and Leberg (2005b) suggested that bridges be inspected ≥ 3 times to ensure that a known roost is not being occupied. However, we suggest that further studies be conducted using repeat visits of randomly selected bridges to obtain unbiased estimates of the minimum number of surveys necessary to determine whether a bridge is being occupied by Rafinesque's big-eared bats.

Acknowledgments.—Financial and logistical support for this research was provided by the U.S. Fish and Wildlife Service's Candidate Conservation program, the South Carolina Department of Natural Resources and the USDA Forest Service Southern Research Station. We thank A. Trousdale and two anonymous reviewers for valuable comments and M. Collingwood, C. Dachelet, D. Eggert A. Elzerman, J. Schwenter and A. Sjollema for field assistance. Thanks to W. Bridges for help with statistical analyses.

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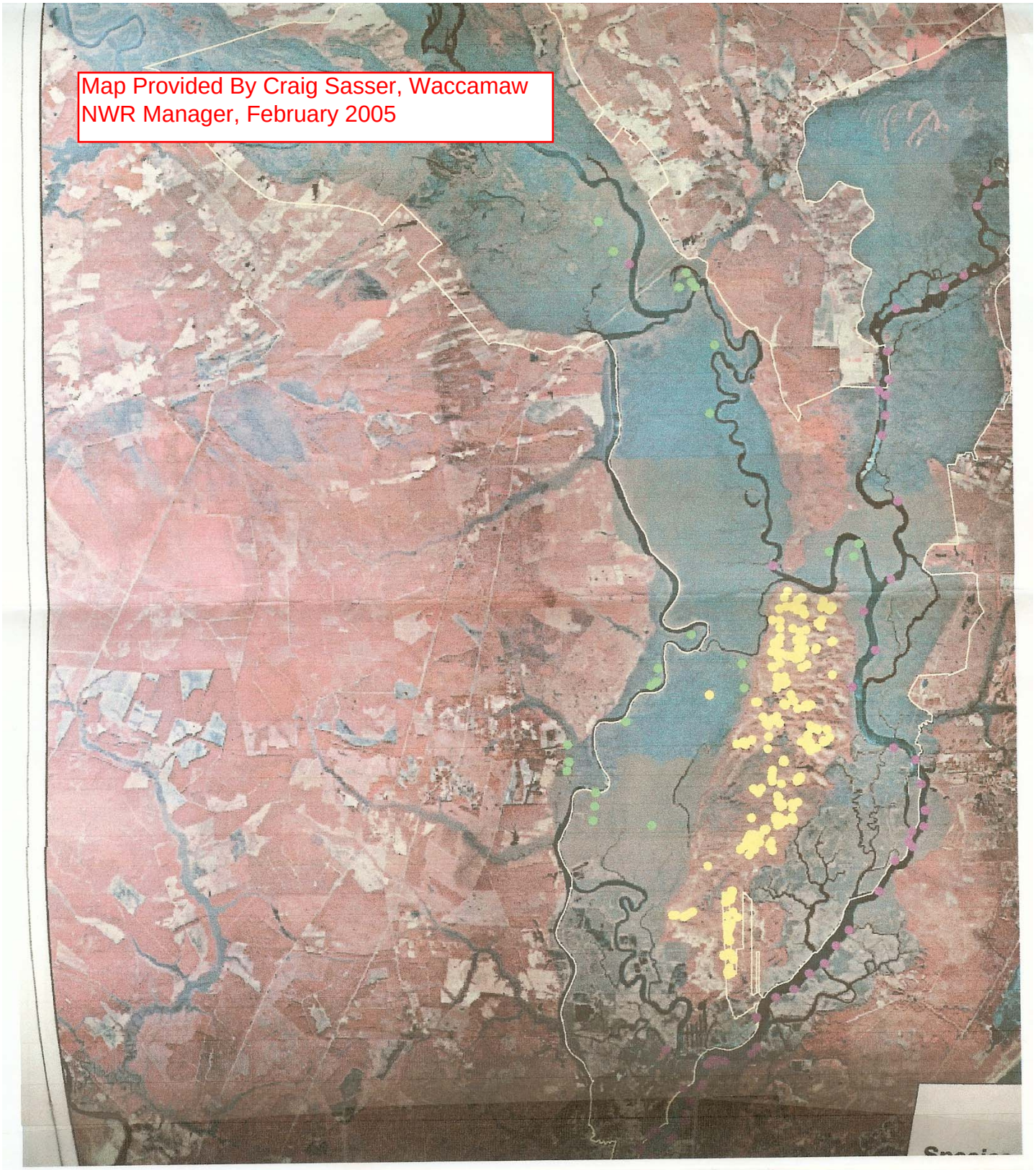
SUBMITTED 21 DECEMBER 2007 ACCEPTED 27 MARCH 2008



BIRD DATA

Waccamaw National Wildlife Refuge

0 1.25 2.5 5 Miles

0 1.25 2.5 5 Kilometers

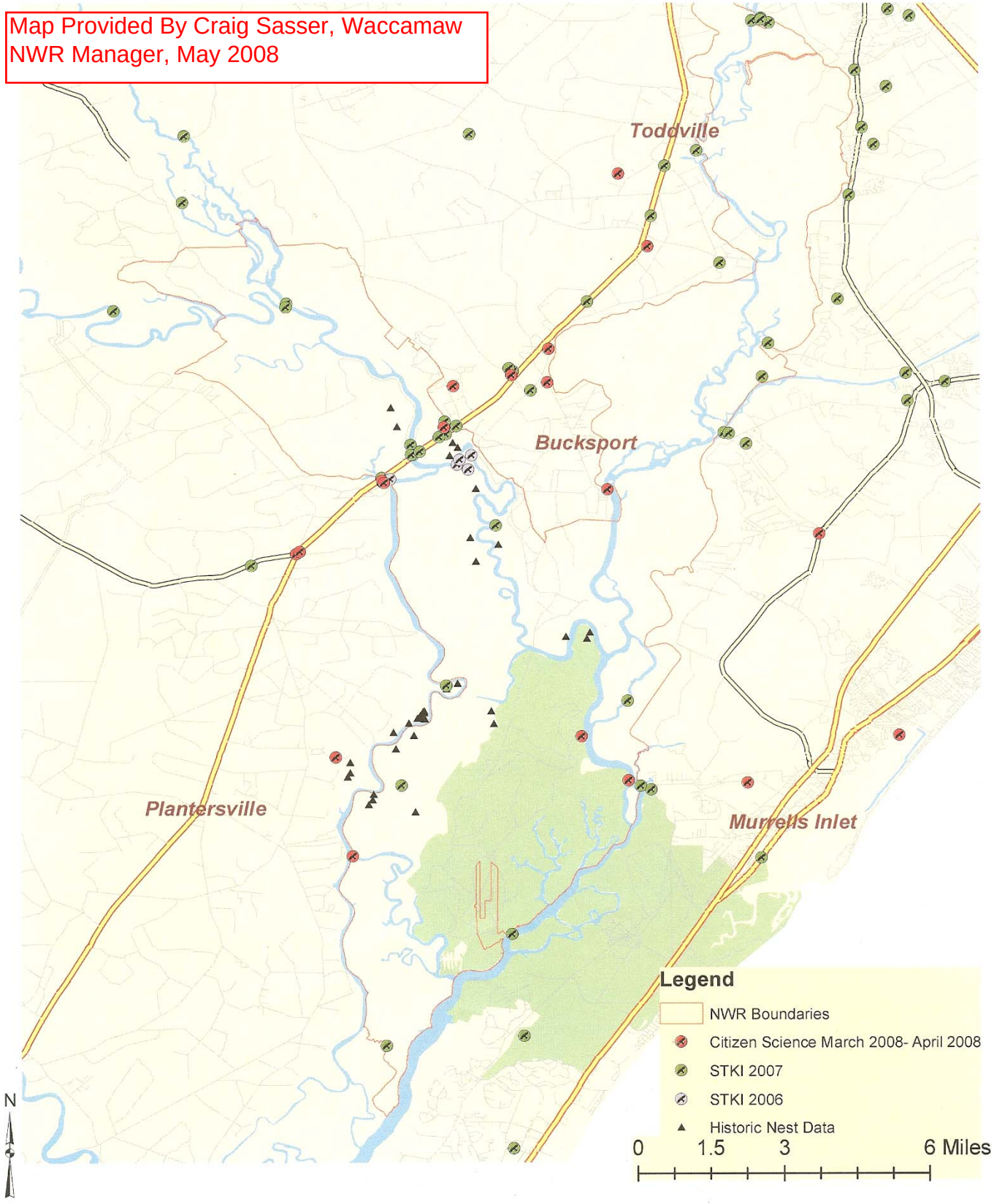
N W S

PINK - OSPREY
GREEN - KITE
- 2 YEARS OF DATA

YELLOW - RCW
FROM MTG W/ C. SASSER 2-15-05

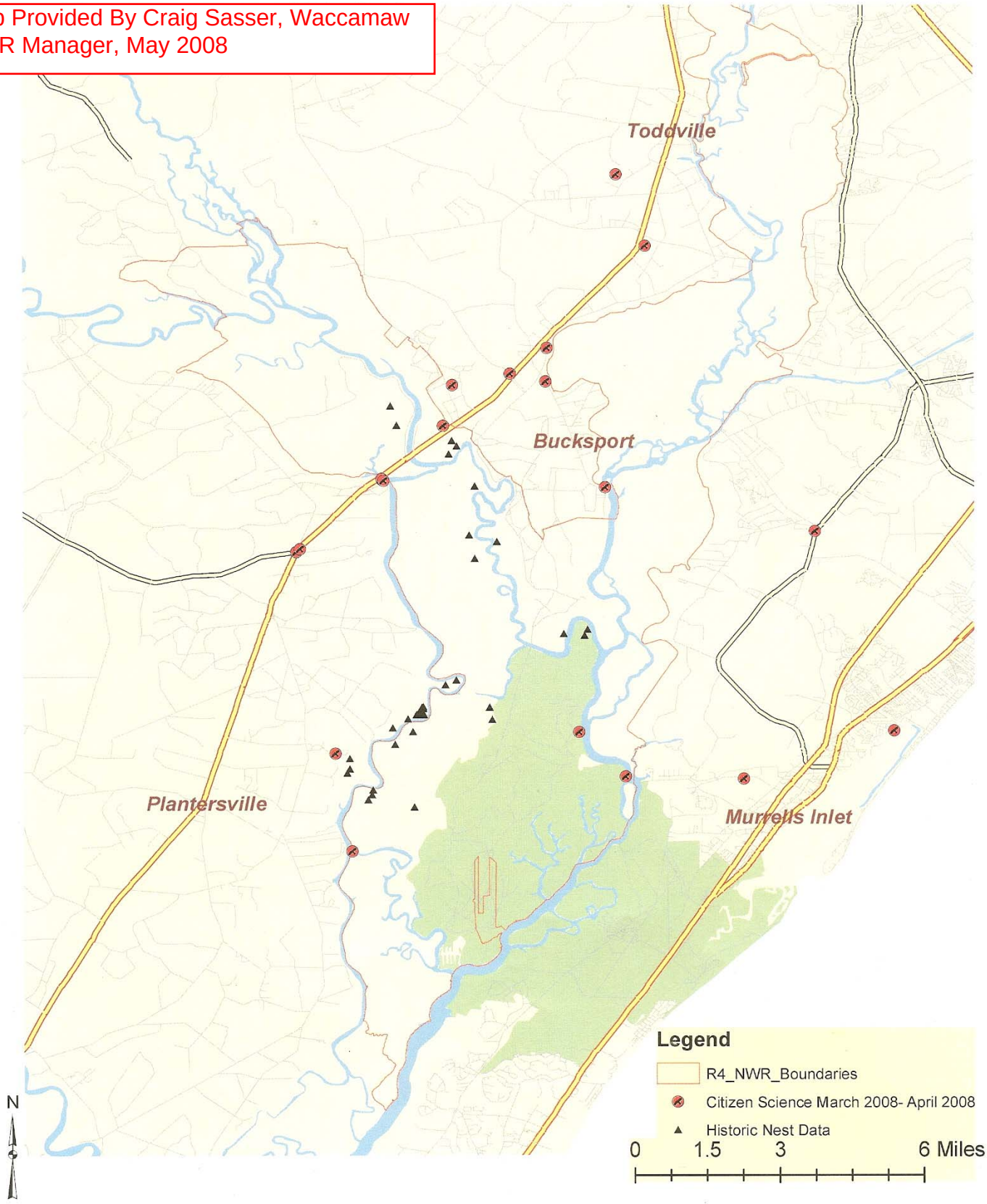
STKI Sightings 2006 -2008 & Historic Nest Locations 1999 -2004

Map Provided By Craig Sasser, Waccamaw NWR Manager, May 2008



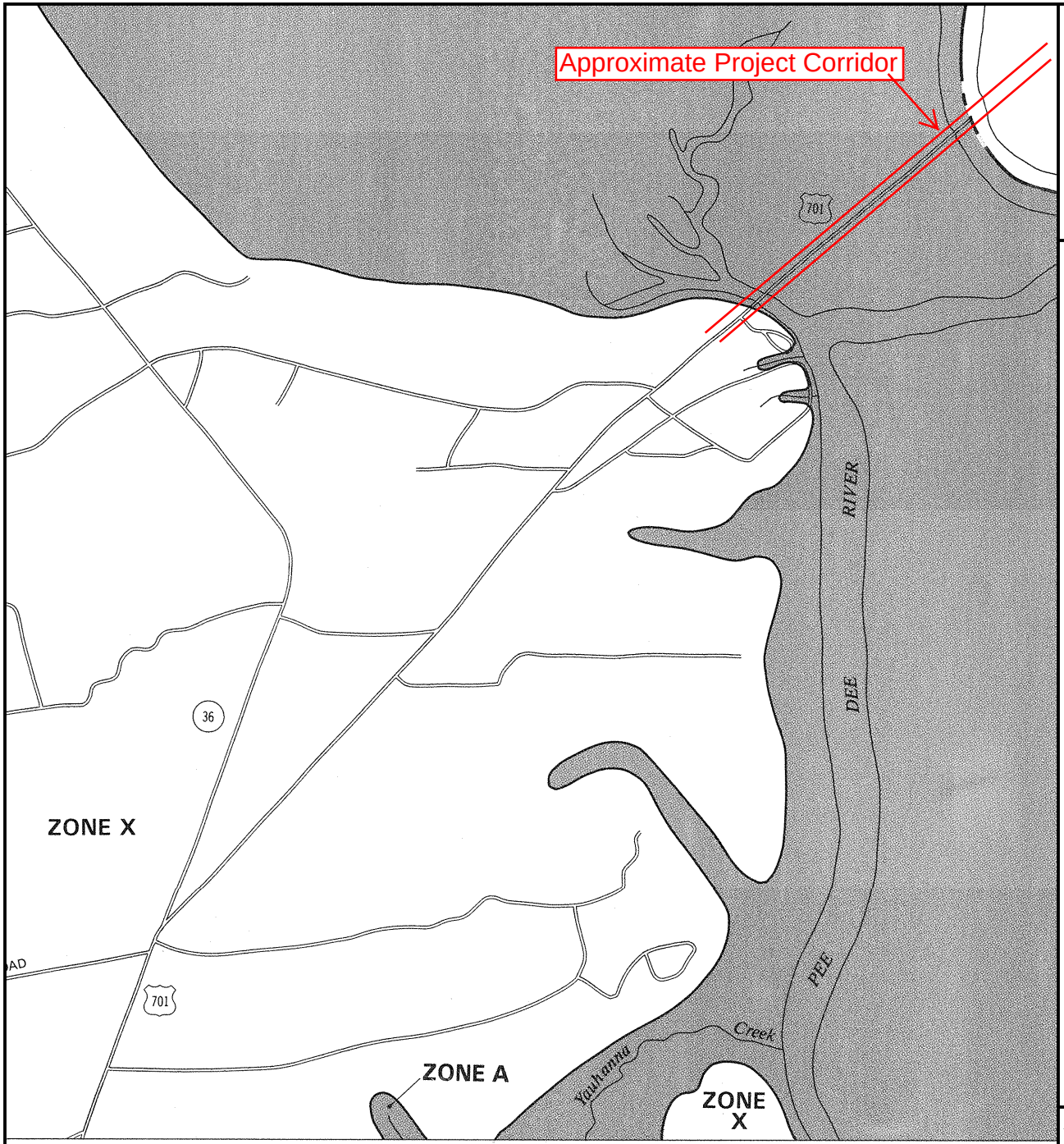
Reported STKI Sightings March - April 2008

Map Provided By Craig Sasser, Waccamaw NWR Manager, May 2008



Appendix E

Floodplains



N

APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

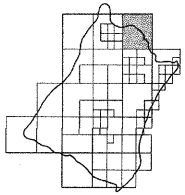
FIRM

FLOOD INSURANCE RATE MAP

GEORGETOWN COUNTY, SOUTH CAROLINA
(UNINCORPORATED AREAS)

PANEL 75 OF 490

PANEL LOCATION



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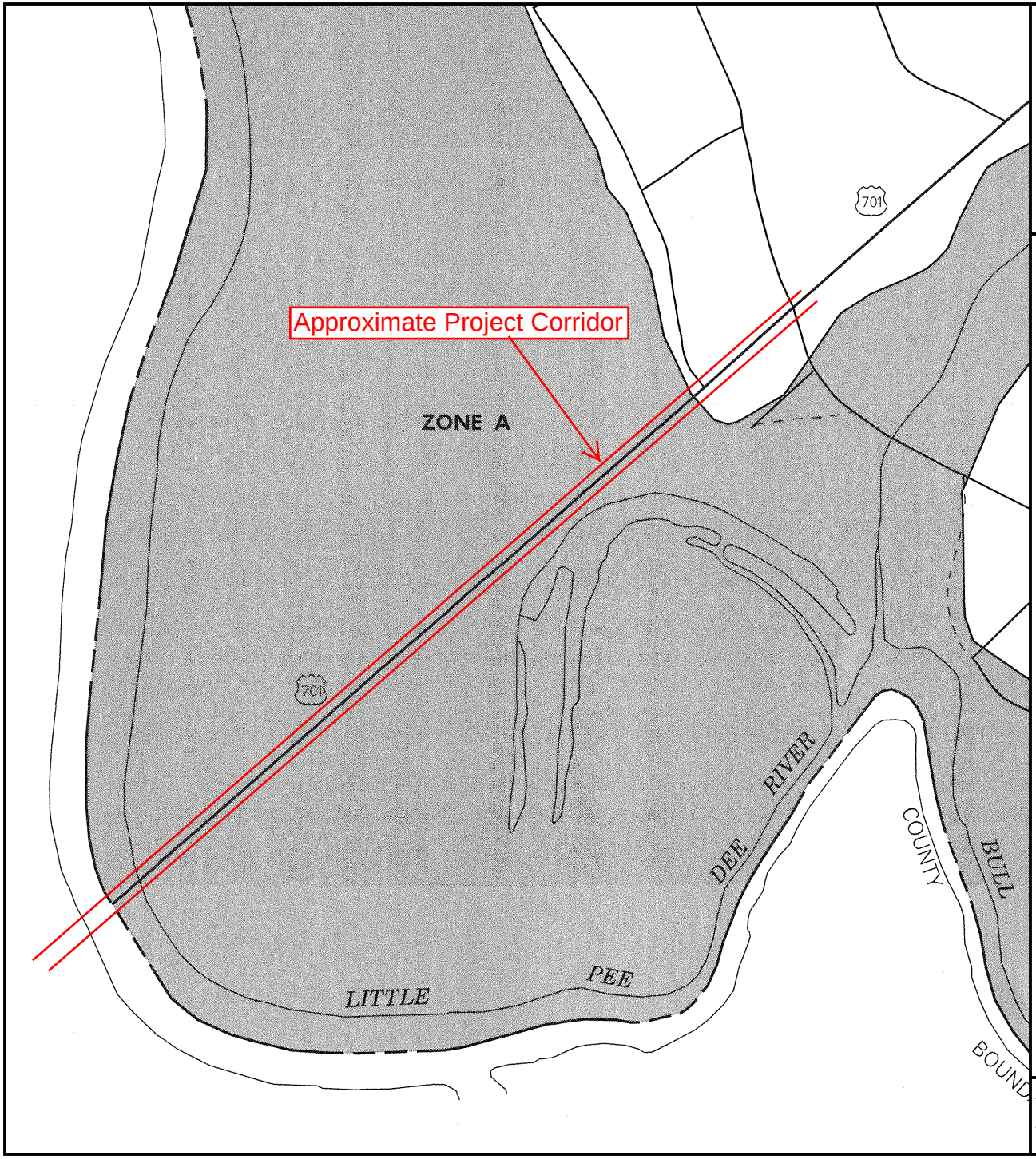
MAP REVISED:
MARCH 16, 1989

Federal Emergency Management Agency



APPROXIMATE SCALE

1000 0 1000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

HORRY COUNTY,
SOUTH CAROLINA
AND INCORPORATED AREAS

PANEL 645 OF 753

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HORRY COUNTY	450104	0645	H

Notice to User: The MAP NUMBER shown below should be used when placing map orders; the COMMUNITY NUMBER shown above should be used on insurance applications for the subject community.

MAP NUMBER
45051C0645 H

MAP REVISED:
AUGUST 23, 1999

Federal Emergency Management Agency

Appendix F

Air Quality

Memorandum

U.S. Department of Transportation
Federal Highway Administration

SENT BY ELECTRONIC MAIL

Subject: **INFORMATION:** Interim Guidance on Air Toxic Analysis in NEPA Documents

Date: **February 3, 2006**

Original Signed by:

From: Cynthia J. Burbank
Associate Administrator for Planning, Environment and Realty

Reply to Attn. of : HEPN-10

To: Division Administrators

PURPOSE

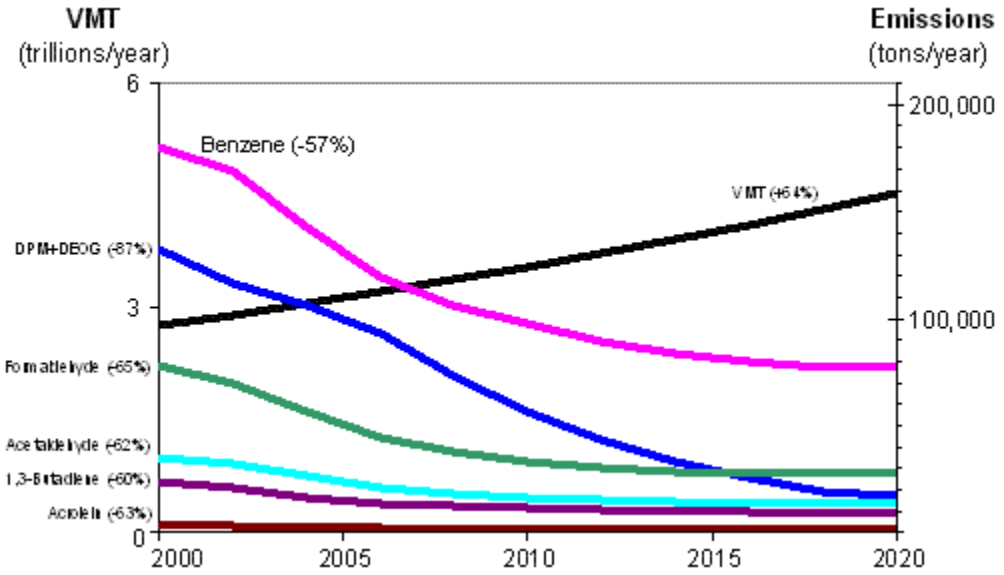
The purpose of this guidance is to advise FHWA Division offices on when and how to analyze Mobile Source Air Toxics (MSAT) in the NEPA process for highways. This guidance is interim, because MSAT science is still evolving. As the science progresses, FHWA will update the guidance.

BACKGROUND

The Clean Air Act identified 188 air toxics, also known as hazardous air pollutants. The Environmental Protection Agency (EPA) has assessed this expansive list of toxics and identified a group of 21 as mobile source air toxics, which are set forth in an EPA final rule, *Control of Emissions of Hazardous Air Pollutants from Mobile Sources (66 FR 17235)*. The EPA also extracted a subset of this list of 21 that it now labels as the six priority MSATs. These are *benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene*. While these MSATs are considered the priority transportation toxics, the EPA stresses that the lists are subject to change and may be adjusted in future rules.

The EPA has issued a number of regulations that will dramatically decrease MSATs through cleaner fuels and cleaner engines. According to an FHWA analysis, even if VMT increases by 64 percent, reductions of 57 percent to 87 percent in MSATs are projected from 2000 to 2020, as shown in the following graph:

U.S. Annual Vehicle Miles Traveled (VMT) vs. Mobile Source Air Toxics Emissions, 2000-2020



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. VMT distribution is held constant, at 50%.

Gasoline RVP and oxygenate content are held constant. VMT: Highway Statistics 2000, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns.

National trend information is provided as background. For specific locations, the trend lines may be different, depending on local parameters defining vehicle mix, fuels, meteorology and other factors.

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health impacts from MSATs are limited, as discussed in Appendix C. These limitations impede FHWA's ability to evaluate how mobile source health risks should factor into project-level decision-making under the National Environmental Policy Act (NEPA). In addition, EPA has not established regulatory concentration targets for the six relevant MSAT pollutants appropriate for use in the project development process.

Nonetheless, air toxics are being raised more frequently on transportation projects during the NEPA process. As the science emerges, we are increasingly expected by the public and other agencies to address MSAT impacts in our environmental documents. We have several research projects underway to try to more clearly define potential risks from MSAT emissions associated with transportation projects. However, while this research is ongoing, we are issuing this interim guidance on how MSATs should be addressed in NEPA documents for highway projects. The FHWA will continue to monitor the developing research in this emerging field.

ANALYSIS OF MSATs IN NEPA DOCUMENTS

Given the emerging state of the science and of project-level analysis techniques, there are no established criteria for determining when MSAT emissions should be considered a significant issue in the NEPA context. Therefore, a range of responses may be appropriate for addressing this issue in NEPA documentation. The response may involve quantitative analysis of emissions to compare or differentiate among proposed project alternatives, qualitative analysis to explore the general nature of the project and inform interested parties, or no analysis depending on the circumstances as set out in this interim guidance. For projects warranting MSAT analysis, the six priority MSATs should be analyzed.

The FHWA has developed a tiered approach for analyzing MSATs in NEPA documents. Depending on the specific project circumstances, FHWA has identified three levels of analysis:

- No analysis for projects with no potential for meaningful MSAT effects;
- Qualitative analysis for projects with low potential MSAT effects; or
- Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

(1) Exempt Projects or Projects with No Meaningful Potential MSAT Effects.

The types of projects included in this category are:

- Projects qualifying as a categorical exclusion under 23 CFR 771.117(c);
- Projects exempt under the Clean Air Act conformity rule under 40 CFR 93.126; or
- Other projects with no meaningful impacts on traffic volumes or vehicle mix

For projects that are categorically excluded under 23 CFR 771.117(c), or are exempt under the Clean Air Act pursuant to 40 CFR 93.126, no analysis or discussion of MSATs is necessary. Documentation sufficient to demonstrate that the project qualifies as a categorical exclusion and/or exempt project will suffice. For other projects with no or negligible traffic impacts, regardless of the class of NEPA environmental document, no MSAT analysis is required[1]. However, the project record should document the basis for the determination of "no meaningful potential impacts" with a brief description of the factors considered. Prototype language that could be included in the record is attached as Appendix A.

(2) Projects with Low Potential MSAT Effects

The types of projects included in this category are those that serve to improve operations of highway, transit or freight without adding substantial new capacity or without creating a facility that is likely to meaningfully increase emissions. This category covers a broad range of projects.

We anticipate that most highway projects will fall into this category. Any projects not meeting the threshold criteria for higher potential effects set forth in subsection (3) below and not meeting the criteria in subsection (1) should be included in this category. Examples of these types of projects are minor widening projects and new interchanges, such as those that replace a signalized intersection on a surface street or where design year traffic is not projected to meet the 140,000 to 150,000 AADT criterion[2].

For these projects, a qualitative assessment of emission impacts should be conducted. This qualitative assessment would describe, in narrative form, the expected effect of the project on traffic volumes, vehicle mix, or routing of traffic, and the associated changes in MSATs for the project alternatives, based on VMT, vehicle mix, and speed. It would also discuss national trend data projecting substantial overall reductions in emissions due to stricter engine and fuel regulations issued by EPA. Because the emission effects of these projects are low, we expect there would be no appreciable difference in overall MSAT emissions among the various alternatives. In addition, quantitative emissions analysis of these types of projects will not yield credible results that are useful to project-level decision-making due to the limited capabilities of the transportation and emissions forecasting tools.

Appendix B includes prototype language for a qualitative assessment, with specific examples for four types of projects: (a) a minor widening project; (b) an interchange with a new connector road; (c) an interchange without a new connector road; and (d) minor improvements or expansions to intermodal centers or other projects that affect truck traffic.

In addition to the qualitative assessment, a NEPA document for this category of projects must include a discussion of information that is incomplete or unavailable for a project specific assessment of MSAT impacts, in compliance with CEQ regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information. This discussion would explain how air toxics analysis is an emerging field and current scientific techniques, tools, and data are not sufficient to accurately estimate human health impacts that would result from a transportation project in a way that would be useful to decision-makers. Also in compliance with 40 CFR 150.22(b), it should contain a summary of current studies regarding the health impacts of MSATs. Prototype language for this discussion is contained in Appendix C.

(3) Projects with Higher Potential MSAT Effects

This category includes projects that have the potential for meaningful differences among project alternatives. We expect only a limited number of projects to meet this two-pronged test. To fall into this category, projects must:

- Create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of diesel particulate matter in a single location; or
- Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000[3], or greater, by the design year;

And also

- be proposed to be located in proximity to populated areas or in rural areas, in proximity to concentrations of vulnerable populations (i.e., schools, nursing homes, hospitals).

Projects falling within this category should be more rigorously assessed for impacts. If a project falls within this category, you should contact Michael Koontz or Pamela Stephenson in the Office of Planning, Environment, and Realty in FHWA for assistance in developing a specific approach for assessing impacts. This approach would include a quantitative analysis that would attempt to measure the level of emissions for the six priority MSATs for each alternative, to use as a basis of comparison. This analysis also may address the potential for cumulative impacts, where appropriate, based on local conditions. How and when cumulative impacts should be considered would be addressed as part of the assistance outlined above. The NEPA document for this project would also include relevant prototype language on unavailable information included in Appendix C.

If the analysis for a project in this category indicates meaningful differences in levels of MSAT emissions, mitigation options should identified and considered. See Appendix E for information on mitigation strategies.

You should also consult with the Office of Planning, Environment and Realty if you have a project that does not fall within any of the types of projects listed above, but you think has the potential to substantially increase future MSAT emissions. Although not required, projects with high potential for litigation on air toxics issues may also benefit from a more rigorous quantitative analysis to enhance their defensibility in court.

CONCLUSION

The guidance presented in this memorandum is interim. The guidance will be revised when FHWA completes studies underway to develop and evaluate better analytical tools for MSAT analysis and to better assess the health impacts of MSATs. The FHWA will continue to revise and update this guidance as the science on air toxic analysis continues to evolve. Additional background information on MSATs is attached to this memorandum as Appendix D.

The FHWA recognizes that some projects already are moving through the environmental analysis process and that immediate application of this interim guidance would be impractical. All future approvals of projects in "Category 1" (no meaningful MSAT effects) should include the information in Appendix A, commencing as soon as practicable after the date of this guidance. For projects already underway that would require qualitative or quantitative analysis of MSAT emissions (categories 2 and 3), the FHWA Division Offices should work to incorporate the appropriate analysis into the NEPA document if practicable, given the amount of resources already invested, the need for the project, and the stage of completion of the document. We expect that this guidance can be incorporated into any NEPA documents for which the completion of the DEIS, FEIS, or EA is more than 6 months from the date of this guidance. We recognize that in some cases this may not be possible for a variety of reasons (e.g., lack of necessary traffic data or emissions modeling expertise) and will rely on the

Headquarters and Resource Center staff is available to provide guidance and technical assistance during this phase-in period to support any necessary analysis and limit project delays.

Attachment 1
Attachment 2
Attachment 3
Attachment 4
Attachment 5

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[1] The types of projects categorically excluded under 23 CFR 771.117(d) or exempt from conformity under 40 CFR 93.127 do not warrant an automatic exemption from an MSAT analysis, but they usually will have no meaningful impact.

[2] This guidance does not specifically address the analysis of construction-related emissions because of their relatively short duration. We will be considering whether more guidance is needed on construction activities in future versions of this guidance. We have also included a discussion of mitigation strategies for construction related activities in Appendix E.

[3] Using EPA's MOBILE6.2 emissions model, FHWA technical staff determined that this range of AADT would be roughly equivalent to the CAA definition of a major HAP source, i.e. 25 tons per year (tpy) for all HAPs or 10 tpy for any single HAP. Significant variations in conditions such as congestion or vehicle mix could warrant a different range for AADT; if this range does not seem appropriate for your project please consult with the contacts from the Office of Planning, Environment and Realty identified in this memorandum.

D H E C

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Fact Sheet

South Carolina Department of Health and Environmental Control • www.scdhec.gov

National Ambient Air Quality Standards (NAAQS)

What are the National Ambient Air Quality Standards (NAAQS)?
The National Ambient Air Quality Standards (NAAQS) are air quality standards set by the U.S. Environmental Protection Agency (EPA) for six "criteria pollutants" which are among the most harmful to public health and the environment.

Since the amendment of the Clean Air Act (CAA) in 1990, EPA is required to set NAAQS for the criteria pollutants. The law requires EPA to review these standards once every five years to determine if they are appropriate or if new standards are needed to protect public health. In South Carolina, DHEC is the agency responsible for monitoring air quality and reporting to EPA the levels of each of these pollutants in our air.

What are the "criteria pollutants" and where do they come from?

Ground-level **ozone** forms in the air when two other types of pollutants, volatile organic compounds (VOCs) and **nitrogen oxides,** react in the presence of sunlight. The VOCs that form ozone come from vehicle and industrial exhaust as well as evaporated gasoline, solvents, paints and many other sources.

Particulate matter and **nitrogen oxides** come from diesel cars, trucks and buses, power plants, industries and many other sources.

Carbon monoxide results from the incomplete burning of fuels from cars, buses, trucks, small engines, boilers and some industrial processes.

Sulfur dioxide is generated by coal-fired power plants, industrial sources, residential heating and motor vehicles.

The main sources of **lead** in humans and other animals are tainted foods and beverages, airborne lead and non-food substances such as paint chips containing lead.

More information on each of the criteria pollutants can be found online at http://www.epa.gov/air/airpollutants.html

What kinds of NAAQS do we have, and what do they mean?
The 1990 CAA amendments established two types of standards for each criteria pollutant:

- ***Primary standards:*** these protect public health, including the health of "sensitive" populations such as asthmatics, children and the elderly.
- ***Secondary standards:*** these protect public welfare and include protection against lower visibility and damage to animals, crops, vegetation and buildings.

What are the standards for each of the criteria pollutants?

The NAAQS for each of the six criteria pollutants are listed on the next page of this fact sheet. Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$). (1 ppm = 1 drop of water diluted into 50 liters or 1 second of time in roughly 11.5 days.)

National Ambient Air Quality Standards		
POLLUTANT	**STANDARD VALUE**	**STANDARD TYPE**
Carbon Monoxide (CO)		
8-hour Average[1]	9 ppm (10 mg/m^3)	Primary
1-hour Average[1]	35 ppm (40 mg/m^3)	Primary
Nitrogen Dioxide (NO_2)		
Annual Average	0.053 ppm (100 $\mu g/m^3$)	Primary & Secondary
Ozone (O_3)		
8-hour Average[2]	0.075 ppm	Primary & Secondary
1-Hour Average[3]	0.12 ppm (235 $\mu g/m^3$)	Primary & Secondary
Lead (Pb)		
Quarterly Average[4]	0.15 $\mu g/m^3$	Primary & Secondary
Fine Particulate ($PM_{2.5}$)		
Annual Average[5]	15 $\mu g/m^3$	Primary & Secondary
24-hour Average[6]	35 $\mu g/m^3$	Primary & Secondary
Coarse Particulate (PM_{10})		
Annual Average[7]	Revoked	Primary & Secondary
24-hour Average[8]	150 $\mu g/m^3$	Primary & Secondary
Sulfur Dioxide (SO_2)		
Annual Average	0.03 ppm	Primary
24-hour Average[1]	0.14 ppm	Primary
3-hour Average[1]	0.50 ppm	Secondary

(1) This standard cannot be exceeded more than once per year.

(2) To meet this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone levels measured at each monitor within an area each year cannot exceed 0.075 ppm.

(3) The standard is met when there are no days in a calendar year with maximum hourly average levels above 0.12 ppm.

(4) The standard is met when the maximum 3-month mean concentration for a 3-year period is less than or equal to 0.15 $\mu g/m^3$.

(5) To meet this standard, the 3-year average of the weighted annual average $PM_{2.5}$ levels from samplers must not exceed 15.0 $\mu g/m^3$. Daily $PM_{2.5}$ levels are averaged by calendar quarter. Each quarterly average is then averaged to determine the weighted average.

(6) To meet this standard, the 3-year average of the 98^{th} percentile of 24-hour levels at each population-oriented sampler within an area cannot exceed 35 $\mu g/m^3$. The 98^{th} percentile is what 98 percent of all levels measured in a calendar year fall below.

(7) Due to a lack of evidence linking health problems to long-term exposure to PM_{10} pollution, EPA revoked the annual PM_{10} standard effective December 17, 2006.

(8) This standard cannot be exceeded more than once per year on average over 3 years.

DHEC's Bureau of Air Quality, Education and Outreach Section provides information on environmental topics. Readers are encouraged to reproduce this material. For more information about air quality issues, please call (803) 898-4123 or visit our Web site at www.scdhec.gov/baq. Please send written correspondence to: DHEC's Bureau of Air Quality, Education and Outreach Section, 2600 Bull Street, Columbia, SC 29201.