Central Electric Power Cooperative

Macro-Corridor Study Report

for the

McClellanville 115kV Transmission Line Project

Macro-Corridor Study Report

Prepared for the

CENTRAL ELECTRIC POWER COOPERATIVE, INC.

By Mangi Environmental Group, Inc.

On the proposed

McClellanville 115kV Transmission Line Project

Table of Contents

Item **Page**

List of Tables

List of Figures

Acronyms and Abbreviations

CEPCI	Central Electric Power Cooperative Inc.
CFR	Code of Federal Regulations
DOE	Determinations of Eligibility
FEMA	Federal Emergency Management Agency
FMNF	Francis Marion National Forest
GIS	Geographic Information System
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
RCW	Red-cockaded Woodpecker
RFSS	Regional Forester Sensitive Species
ROW	Right-of-Way
RUS	Rural Utilities Service
SCDAH	South Carolina Department of Archives and History
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SCIAA	South Carolina Institute of Archaeology and Anthropology
TES	Threatened and Endangered Species
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WMA	Wildlife Management Area

1.0 Introduction

The Electric Program of USDA's Rural Utilities Service (RUS) provides leadership and capital to upgrade, expand, maintain, and replace America's vast rural electric infrastructure. Under the authority of the Rural Electrification Act of 1936, RUS makes direct loans and loan guarantees to electric utilities to serve customers in rural areas. The Electric Program makes loans and loan guarantees to finance the construction of electric distribution, transmission and generation facilities, including system improvements and replacement required to furnish and improve electric service in rural areas, and for demand side management, energy conservation programs, and on-grid and off-grid renewable energy systems.

One project under consideration by RUS is loan funding for the construction of an electric power transmission line by the Central Electric Power Cooperative Inc. (CEPCI) from existing power sources to a new Berkeley Electric substation near the town of McClellanville, SC. The need for additional reliable power and alternative means to provide that power are discussed in a separate accompanying report—the Alternative Evaluation Study.

Federal agencies are required under the National Environmental Policy Act (NEPA) and Council on Environmental Quality NEPA implementing regulations (40 CFR 1500-1508) to evaluate the environmental consequences of their actions and of alternative ways of meeting their needs before they proceed with a project that would affect the environment. RUS regulations at 7 CFR 1794 are the current agency-specific regulations implementing NEPA. Agency guidance in RUS Bulletin 1794A-603, February 2002, requires two pre-NEPA studies be prepared and approved for linear projects before the formal NEPA process is initiated—an Alternative Evaluation Study and a Macro-Corridor Study.

As required by RUS, the accompanying Alternative Evaluation Study explains the need for the project and discusses alternative methods that have been considered to meet that need. To the extent feasible and appropriate, the Alternative Evaluation Study examines providing additional electric capacity by constructing a new transmission line, constructing new generation capacity, purchase of power from other utilities, wheeling power via another utility's system, or reducing load in an area through load management or energy conservation. The Alternative Evaluation Study explains each alternative in sufficient detail so that interested agencies and the public can gain a general understanding of each alternative. The study explains which alternative is considered the best for fulfilling the need for the project and clearly explains why certain alternatives are unacceptable or less than optimal.

As required by RUS, this Macro-Corridor Study defines the project study area and shows the end points on the linear electric transmission line project. Alternative corridor routes, varying in width from a few hundred feet up to a mile, were developed based on environmental, engineering, economic, land use, and permitting constraints. The use of existing rights-of-way or double circuiting of existing electric transmission lines was addressed as appropriate.

2.0 Project Description

The McClellanville, SC community is located approximately 30 miles north of Charleston, SC along the U.S. Route 17 corridor linking Charleston with Georgetown, SC (**Figure 3-1**). This rural area has no existing transmission infrastructure. The presence of the Francis Marion National Forest, Santee River delta and other nearby environmentally sensitive areas has limited the community's growth and allowed it to remain a relatively small electrical distribution load. Berkeley Electric Cooperative, a member of the Central Electric Coop System, has served the community from a long-distance distribution system with the longest circuits reaching almost 30 miles to the Santee River delta. In recent years the community has begun to experience times of low voltage and frequent outages. The Alternative Evaluation Study determined that CEPCI's best options for addressing these reliability problems would involve construction of a transmission line that delivered power directly to the community with power distribution to be made from a newly-constructed substation in McClellanville.

This Macro-corridor study was conducted to determine what potential transmission line routing options were available for the McClellanville line, and in general terms, how they might be planned to avoid potential environmental, social, cultural, and economic effects. The results and findings of this report will serve as the foundation upon which a more detailed NEPA analysis will be conducted. For this study, three originating points for the transmission line—Charity, Jamestown, and Winyah/Belle Isle, and a single destination point—a proposed substation in McClellanville, were considered (**Figure 3-1**).

3.0 Study Area Description

3.1 Study Area Location

The McClellanville 115kV Transmission Line Project study area is located in the Atlantic coastal plain of South Carolina, within eastern Berkeley, northern Charleston, and southern Georgetown counties (**Table 3-1**). The study area encompasses approximately 1,008 square miles (645,120 acres) within a perimeter of 200 miles. The Francis Marion National Forest (FMNF) comprises 234,677 acres (36 percent) of the study area. The northern boundary of the study area is U.S. Highway 17 (Alternate); the eastern boundary follows the Sampit River; the southern boundary is the coast of the Atlantic Ocean; the western boundary is the Cooper River and the West Branch of the Cooper River.

Table 3-1. Analysis Acres by County

Counties	Total Acres	Acres of Study Area	% Of County in Study Area	FMNF Acres
Berkeley	786,236	290,741	37.0	168,433
Charleston	630,235	200,510	31.8	66,244
Georgetown	541,745	153,821	28.4	0
Williamsburg*	599,375	292	0.1	0
TOTAL	2,557,591	645,363	-	234,677

* A negligible acreage of Williamsburg County is found within the study area boundary. This acreage exists in the northwest corner of the study area, and is found within the 300-foot buffer of Highway 17 (Alt.).

Source: USFS, 2004

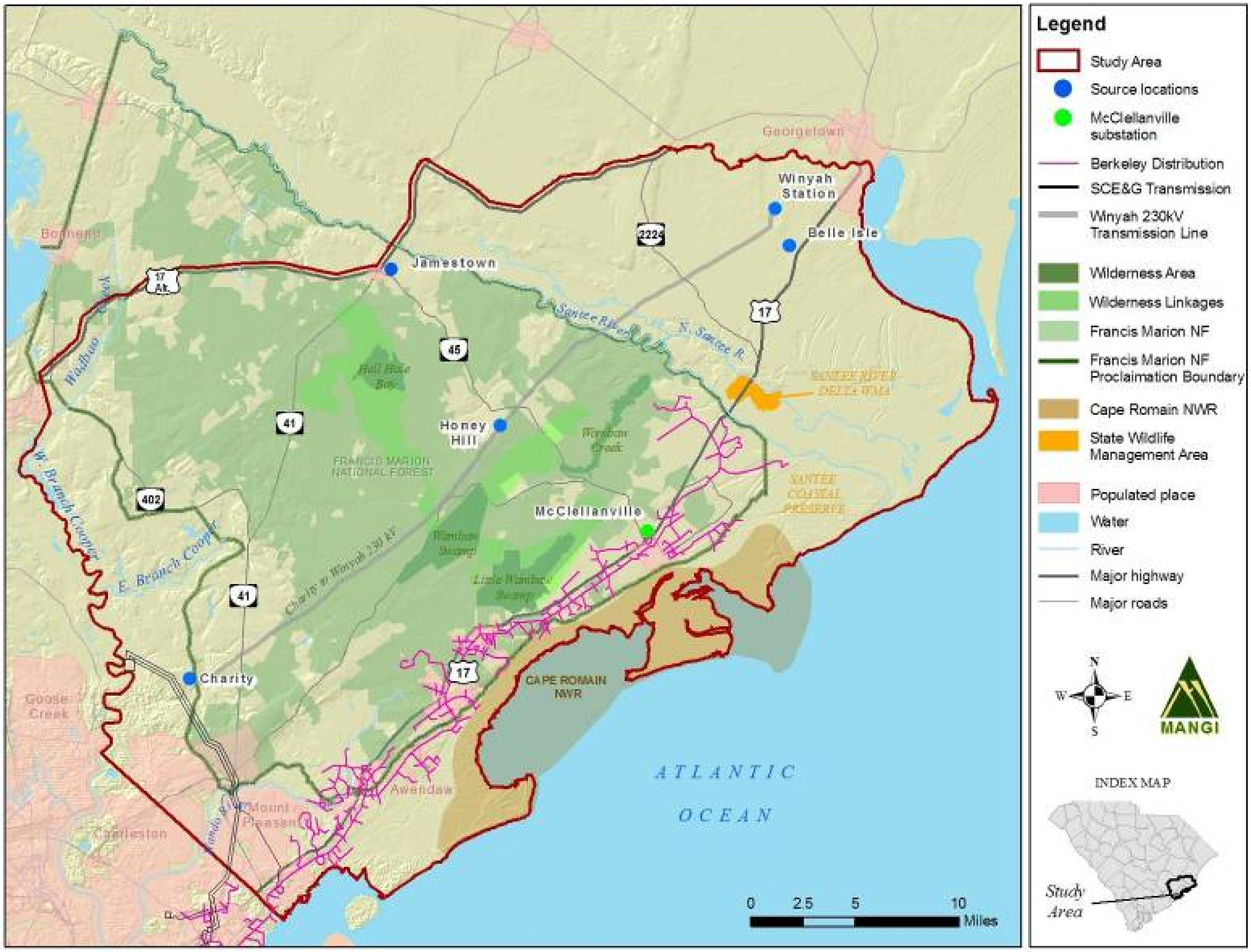


Figure 3-1. Study Area Map

3.2 Study Area Characteristics

3.2.1 Physiography

The Atlantic Coastal plain area – South Carolina's lowcountry – is comprised of extensive lowlands where elevations range from 0 to 80 feet above sea level (USFS, 1996). The terrain is characterized by a series of parallel ridges of sandy beach deposits with large areas of swamps, bays, and upland flats between the ridges. Limestone sinks are also found in the area, and are home for many rare plants, including the endangered pondberry (*Lindera melissaefolium*). Estuaries are common and are affected by tidal action and freshwater drainage from rivers and land. The winters are mild and the summers are hot, with average annual rainfall at about 48 inches (USFS, 1996).

Study Area Depression Swamp (photo by L.L Gaddy)

The Santee River flows through the northern portion of the analysis area. The Santee River Delta is one of the largest deltas on the East Coast, formed from the deposition of eroded materials transported by the Santee River, and contains meandering creeks, marshes, and islands renowned for their beauty and bountiful wildlife. The Delta includes diverse wetlands, ranging from grassy marshes to forested swamps.

3.2.2 Land Use/Land Cover

The study area is dominated by forest, with the majority of upland forested areas dominated by planted loblolly pine and some longleaf pine. On wetter sites, bottomland and swamp hardwoods dominate, with cypress also prominent. Maritime zones contain vegetation that is tolerant to wind and salt spray. Freshwater, brackish, and tidal marshes and their associated plant communities are found along coastal borders and throughout the Santee River Delta.

Managed Upland Forest on the Francis Marion NF (photo by T. Gaul)

Urban land use is concentrated in the southern portion of the study area associated with Charleston and Mount Pleasant, with some development extending northward along the Highway 17 corridor to Georgetown.

Table 3-2 lists the land cover types/land uses that are found in the project study area (see South Carolina GAP for descriptions of land cover types).

Table 3-2. Study Area Land Cover Characteristics			
Land Cover Type	**SCGAP Code***	**Acres**	**% Of Area**
Wetland	3,4,6,7	234,669	36%
Mixed Forest	16, 20, 21	100,844	16%
Grassland, cultivated land, cleared forest	12, 22, 23	100,485	16%
Evergreen forest	15, 17	80,125	12%
Scrub/shrub thicket	9, 10	39,611	6%
Maritime forest	27, 28	29,195	5%
Water (marine, fresh)	1,2	27,991	4%
Deciduous forest	18, 19	9,897	2%
Aquatic vegetation	14	5,967	1%
Urban	24,25	6,668	1%
Wet soil, sandy soil, beach	8, 11, 29	9,293	1%
Unidentified	0	374	0%
Total		645,120	**100**

* Land cover codes derived from SCDNR, 2001.

3.2.3 Socioeconomic Character

The low country of South Carolina has experienced a substantial population growth in the last decade. **Table 3-3** lists the most recent available estimates of population and populations change between 2000 and 2003.

Table 3-3. Population of the Study Area			
County	**Berkeley**	**Charleston**	**Georgetown**
Population 2000	142,651	309,969	55,797
Estimated Population 2003	146,449	321,014	58,924
Population % change	+2.7	+3.6	+5.6

Source: Census, 2000

As the area continues to grow and provide employment opportunities, people living in communities within or adjacent to the study area are becoming less economically dependent on the traditional agricultural and forest-based industries. Though agricultural and forest-based industries remain important in the region, manufacturing has become one the largest expanding employment sectors in Berkeley and Georgetown Counties. While in Charleston County leisure and hospitality has become one of their largest growing employment sectors.

Table 3-4. Percent Employment for Study Area Counties			
Industry	**Berkeley**	**Charleston**	**Georgetown**
Educational, health, and social services	17.1	22.7	16.6
Manufacturing	15.4	6.8	17.7
Retail trade	12.4	12.6	12.3
Construction	10.9	8.4	9.0
Transportation and warehousing, and utilities	7.8	4.9	3.9
Leisure and Hospitality (Arts, recreation, entertainments, accommodation and food services)	7.4	12.3	13.6
Professional, scientific, management, administrative, and waste management services	7.0	10.0	6.5
Public administration	6.5	5.6	3.5
Finance, insurance, real estate, and rental and leasing	5.0	6.0	6.1
Other services (except public administration)	4.8	5.0	4.2
Wholesale trade	3.1	2.9	2.8
Information	1.8	2.2	1.0
Agriculture, forestry, fishing and hunting, mining	0.7	0.6	2.7

Source: Census, 2000

Although portions of the City of Charleston and the Town of Mount Pleasant are within the boundaries of the study area, these urban areas are not indicative of the overall socioeconomic conditions that exist in this predominately rural study area. The following table lists the remaining three major towns located within the study area (see **Table 3-4**).

Table 3-5. Rural Towns in the Study Area		
Town	**County**	**2000 Population**
Town of Awendaw	Charleston	1,195
Town of Jamestown	Berkeley	97
Town of McClellanville	Charleston	459

Source: Census, 2000

3.2.4 Transportation

The major transportation corridors in the area include U.S. Highway 17, which parallels the Atlantic coast from Georgetown to Charleston and U.S. Highway 17A, which forms the northern boundary of the analysis area from Georgetown to the Charleston area. State highways in the area include Highway 41 from Jamestown to the Charleston area and Highway 45 from Jamestown to McClellanville. The Georgetown County Airport is located approximately 3 miles south of the Town of Georgetown and 1.5 miles northeast of the Winyah generator.

3.2.5 Water Resources

The study area includes large areas of swamps, bays, limestone sinks, tidal estuaries, and freshwater streams, lakes, and reservoirs. Numerous perennial and intermittent streams are found within the analysis area. **Table 3-6** lists the major rivers and streams that are located in the analysis area.

The Santee River traverses the northern half of the study area, and has the largest delta on the Atlantic coast. The Santee Delta includes many acres of wetlands, from forested swamps, to grassy meadows, and tidal marshes. It harbors numerous species of birds including a variety of waterfowl and migratory species, as well as many sensitive fish, amphibian, and bird species.

Table 3-6. Major Study Area Rivers

Major Rivers/Streams	Miles in Study Area
Santee River	17.5
North Santee River	11.9
Wadmacon Creek	10.0
Sampit River	9.6
South Santee River	9.4
East Branch Cooper River	8.2
Wadboo Creek	7.2
Cooper River	7.0
Nicholson Creek	6.8
Cedar Creek	6.5
West Branch Cooper River	3.6
Huger Creek	3.0
Tailrace Canal	1.2
Back River	0.4
Total Miles	**102.3**

Table 3-7. Wetland Acreage by Type

Wetland Type	Acres
Estuarine	120,013
Lacustrine	5,263
Palustrine	
Emergent	30,498
Forested	179,788
Scrub/Shrub	20,482
Other	4,003
Riverine	6,742
TOTAL	**366,790**

North Santee River, View Downriver from the Highway 17 Bridge (photo by T. Gaul)

The U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) maps were used to identify wetlands areas. The study area has 366,790 acres of wetland, comprising 57 percent of its total area. **Table 3-7** lists wetland acreage by wetland type.

3.2.7 Recreation Resources

The Francis Marion National Forest (FMNF) occupies a large portion of the study area and provides a wide range of recreational opportunities, both dispersed and developed. There are approximately 160 miles of trails for hiking, canoeing, horseback riding, bicycling and all-terrain vehicle (ATV) riding. Recreational facilities include boat ramps, horse camps, campgrounds, target shooting ranges, and canoe access areas. The public can also use the Forest for hunting, fishing, bird watching, or simply enjoying nature. The Sewee Environmental Education and Visitor Center is a joint venture between the Cape Romain National Wildlife Refuge (NWR) and the FMNF, and provides interpretive and environmental education programs.

Wildlife Management Areas (WMAs) managed by the South Carolina Department of Natural Resources (SCDNR) are also available for public recreational use. Two WMAs, the Santee River Delta and Santee Coastal Reserve are located in the study area providing opportunities for hunting, camping, and wildlife viewing.

The Santee River itself is a popular local recreational recourse, which provides fishing, canoeing, and waterfowl hunting opportunities.

3.2.8 Cultural Resources

The study area is rich in history with preserved coastal plantation properties dating back to the 18th century and numerous historical sites related to early colonization. Many of these sites are listed on the National Register of Historic Places (NRHP) and include buildings, structures, and archaeological sites.

3.2.9 Federal and State Lands

The FMNF is managed by the USFS and serves many uses, including timber production, watershed protection and improvement, habitat for wildlife and fish species (including threatened and endangered species), wilderness area management, minerals leasing, and outdoor recreation (USFS, 2004). Almost the entire Forest is located within the boundaries of the analysis area.

Cape Romain National Wildlife Refuge (NWR), managed by the US Fish and Wildlife Service (USFWS), is located entirely within the analysis area, in northeast Charleston County. Part of the Carolinian-South Atlantic Biosphere Reserve, the 64,229-acre Cape Romain NWR extends for 20 miles along the Atlantic Coast. It consists of 34,229 acres of beach and sand dunes, salt marsh, maritime forests, tidal creeks, fresh and brackish water impoundments, and 30,000 acres of open water. Headquarters for the NWR are located on 7 acres of permitted lands within the FMNF (USFWS, No date).

Table 3-8 lists Federal and State lands within the analysis area, along with their acreage within the analysis area.

Table 3-8. State and Federal Land Ownership in the Study Area

Management Area	Managing Agency	Acreage in Analysis Area	% Of Analysis Area
FMNF	USFS	234,677	36.4%
Santee River Delta WMA	SCDNR	1,722	0.3%
Santee Coastal Reserve WMA	SCDNR	24,000	3.7%
Cape Romain NWR	USFWS	34,229	5.3%

Sources: SCDNR, 2004; USFS, 2004; GIS data

Wilderness Areas

Four wilderness areas are located on the FMNF: Hell Hole Bay, Little Wambaw Swamp, Wambaw Creek, and Wambaw Swamp, and approximately 11,450 acres of designated wilderness linkages (Management Area 29) that connect the wilderness areas. About 28,000 acres of the Cape Romain NWR refuge are preserved within the National Wilderness Preservation System. **Table 3-9** presents their acreage within the analysis area.

Table 3-9. Wilderness Areas in the Study Area

Wilderness	Acres
Hellhole Bay	2,125
Little Wambaw Swamp	5,047
Wambaw Creek	1,825
Wambaw Swamp	4,815
Cape Romain NWR Wilderness	28,000
Wilderness Linkages (MA 29)	11,446
TOTAL	53,258

Source: USFS, 1996

3.2.10 Sensitive Wildlife Resources

The FMNF is home to one of the largest populations of the endangered red-cockaded woodpecker (RCW) in the United States. Poorly drained areas, such as swamps, floodplains, upland flats and coastal marshes provide wintering and breeding habitat for many species of waterfowl, osprey, and wading birds. These areas also provide foraging and nesting habitats for the bald eagle *(Haliaeetus leucocephalus)* and support viable populations of many amphibians, such as the flatwoods salamander *(Ambystoma cingulatum)* and gopher frog *(Rana areolota).* Also found in this area is the northernmost established nesting population of the American swallow-tailed kite *(Elanoides forficatus).*

Red-cockaded Woodpecker Nest Tree
(Photo T. Gaul)

Since 1971, most of the FMNF has been cooperatively managed as the Francis Marion WMA (USFS, 1996). The Forest offers the largest and most consolidated area available for public hunting in the State. Wild turkeys *(Meleagris gallopavo)* found on the Forest are considered the purest strain of eastern wild turkey found in the United States. The FMNF provides many of the wild turkeys used for restocking other areas in the State.

The Santee River traverses the northern half of the study area, and has the largest delta on the Atlantic Coast. The Santee Delta includes many acres of wetlands, from forested swamps, to grassy meadows, and tidal marshes. It harbors numerous species of birds, including waterfowl, migratory birds, and some sensitive species (e.g., bald eagles (federally threatened), wood storks (federally endangered), and swallow-tailed kites (State-listed endangered)). Other sensitive species inhabiting the Delta include the federally endangered short nosed sturgeon (*Acipenser brevirostrum*) and federally threatened flatwoods salamander (*Ambystoma cingulatum*).

Cape Romain NWR habitat is barrier island/salt marsh, which consists of 34,229 acres of beach and sand dunes, salt marsh, maritime forests, tidal creeks, fresh and brackish water impoundments, and 30,000 acres of open water. The refuge provides habitat for over 337 species of birds, including waterfowl, shore birds, wading birds, and raptors. Cape Romain NWR boasts the largest nesting rookery for brown pelicans, terns, and gulls on the coast of South Carolina, as well as the largest nesting population of the federally threatened loggerhead sea turtle (*Caretta caretta*) outside the State of Florida. In addition, the NWR plays an integral role in the recovery of the federally endangered red wolf (*Canis rufus*) (USFWS, No date).

4.0 Suitability Analysis

4.1 Suitability Maps

Planning and routing a transmission line requires consideration of a wide range of environmental, social, and cultural resources, as well as economic factors. These concerns are commonly addressed during the planning of a transmission line by correlating the likelihood of impacts on these different resources with specific locations on a set of maps. These maps, referred to as 'suitability maps', associate georeferenced features, land cover types, or land uses with the likelihood of potential impacts from the proposed project, in this case, the construction and operation of the 115 kV McClellanville transmission line.

Creating a suitability map begins with identifying study area resources that would likely be affected by transmission line construction, maintenance, and operation. Forested wetlands, for instance, may be affected by vegetation removal, resulting in modification of wetland structure, alteration of species composition, and disturbance to resident species. In many cases, impacts may affect multiple resources at the same location. For example, if an area is occupied by both a wetland and a recreational trail, there may be effects from construction on both the wetland community and the recreation value of the trail through the area.

In addition to identifying areas of potential adverse effects, a suitability map may also identify areas of opportunity, that is, where activities of the proposed project would be more consistent with the current land use, the impacts overall are likely to be minimal, and the operation and management of the line would be more efficient. By identifying areas that are an opportunity for transmission line construction, other factors commonly considered, such as line accessibility, can be brought into the planning process. For example, constructing a transmission line within or adjacent to an existing road right of way may be anticipated to have reduced additional impacts, and would allow for easy access and the use of existing management and maintenance strategies.

4.2 Rating Suitability

This study relied extensively on the use of Geographic Information Systems (GIS) data, analysis, and modeling techniques to identify possible transmission line corridors for the McClellanville project. GIS technology links information to its location (such as people to addresses, buildings to parcels, or streams to drainage networks) in a computer environment where it can be viewed, combined, and analyzed to identify relationships from a geographic perspective. Using this technology, a wide range of siting criteria were spatially integrated and used to compile a comprehensive suitability map that took into account multiple planning factors.

A wide range of GIS data sources were collected for the purposes of this analysis. Some data sources were used directly to identify areas of potential impact risk, whereas some were used only after modification or additional analysis steps. For the purposes of this report, once compiled and prepared for use in creation of the suitability map, data layers identifying the location and spatial extent of a specific transmission line siting factor (i.e., wetlands, road rights of way, sensitive species locations, etc.) were referred to as ‘resource suitability layers’. For a complete description of the resource suitability layers included in this analysis and their sources and preparation see **Sections 4.3, 4.4,** and **4.5**.

Once a resource suitability layer was compiled, its features were rated with a numeric suitability score that characterized the level of constraint (i.e., those areas that the transmission line should avoid) or opportunity (i.e., those areas that are most appropriate for a transmission line) that it provided for planning the transmission line route. The rating system used was designed to protect the most sensitive parts of the study area by identifying areas of potential impact **risk**, while highlighting areas best suited for construction of the transmission line, i.e. areas of **opportunity**.

Areas within each individual resource suitability layer were assigned *positive* numeric values, between +1 and +50, if constructing a transmission line within that area could result in increased risk of potential impacts to that layer’s resource. For example, within the Threatened and Endangered Species resource suitability layer (*Section 4.4.3*), areas within a 200ft-1/2 mile management zone buffer zone of a known red cockaded woodpecker colony were assigned a suitability factor of +50. This risk rating reflects the high likelihood of impacts associated with locating a transmission line within management zone of a federally endangered red cockaded woodpecker colony.

In contrast, areas within a resource suitability layer were assigned *negative* numeric values, between -1 and -50, if constructing a transmission line within that area would be considered an appropriate use of that area resource, or more specifically, an opportunity for siting the proposed transmission line. For example, areas within or immediately adjacent to an existing transmission line corridor were assigned a suitability rating of -25 to identify these areas as a potential opportunity for planning the proposed transmission line corridor.

Areas within a given resource suitability layer that had no sensitive features, were assigned a suitability value of zero. A rating of zero indicated that, for that specific resource, no sensitive features were identified in that area. For example, areas of upland in the wetland resource data layer, were attributed a value of zero because no impacts to wetlands would be anticipated in these areas. Although other impacts may occur in upland areas, these areas would be identified, and accounted for in other resource suitability layers, such as in the threatened and endangered species habitat resource layer.

Lastly, certain features within the study area were excluded from consideration for transmission line routing, and were removed from the transmission line path analysis and macro-corridor delineation. These areas were excluded because of either regulatory restrictions or because adverse impacts associated with locating a transmission line through them would result in likely and potentially significant impacts on area resources.

The following graphic summarizes the rating system. A list of the ratings for each layer is summarized in Table 4.1.

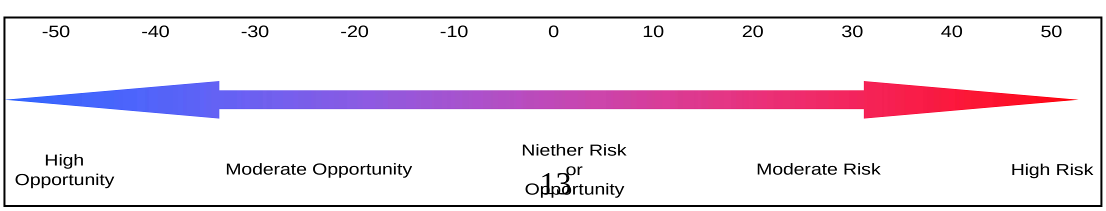


Table 4-1 Summary of Suitability Ratings	
Suitability Layers	**Rating**
Historic /Archeological Districts	Excluded
Known Cultural Sites (Listed or Eligible for Listing on the NRHP)	Excluded
Airports	Excluded
Wilderness Areas	Excluded
Wilderness Linkages (MA 29)	Excluded
Santee-Delta Wildlife Management Area	+50
Cultural Site Probability	+25
Known Cultural Sites (Potentially Eligible for Listing on the NRHP)	+25
Conservation Easements	+50
Threatened, Endangered, and Sensitive Species	
RCW Colony (200 ft Buffer)	Excluded
RCW Management Area (200ft- 1/2 mi)	+50
Bald eagle Primary Management Area (0-1,500ft)	Excluded
Flatwoods salamander (1/4 mile Buffer)	Excluded
State Listed Species (200 ft Buffer)	+50
Recreation	
Recreation Areas and Trails (with 300 ft Buffer)	+50
North and South Santee Rivers	+25
Wetlands	
Palustrine Forested, Lacustrine, and Estuarine	+50
Palustrine Emergent and Riverine	+30
Palustrine scrub shrub	+15
Migratory Bird Area	+25
Vistas	
Cultural Site Foreground (0-300ft)	+50
Delta Foreground (0-300ft)	+50
Delta Midground (300ft-1/2 mi)	+30
Delta Background (Beyond 1/2 mile)	+15
Structures (with 300 ft Buffer)	+50
Existing Transmission ROWs	-25
Road ROWs	
Major, Minor and Local Road "buildable areas"	-25
Major and Minor Road central "non-buildable areas"	+50

4.3 Exclusionary Resource Suitability Layers

The following data layers were used to identify areas that are considered unsuitable for transmission line construction. These areas were excluded from consideration for modeling potential transmission line paths and corridors. Brief descriptions of their origin and any additional modifications are provided below. A simplified graphic displaying the distribution and extent of the resource described is provided for each description.

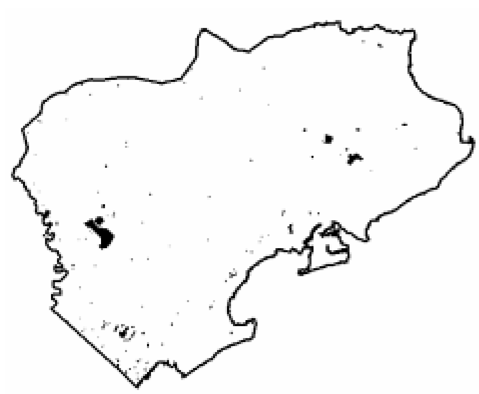
4.3.1 Historic/Archaeological Districts - *Excluded*

All areas within the boundaries of designated Historic or Archaeological Districts were excluded from consideration for transmission line corridor planning. Transmission line siting in these areas has a high potential to adversely impact cultural resources and/or the historic character being preserved in these areas.

Historic/Archeological District boundaries were obtained from Mr. Chad Long of the South Carolina Department of Archives and History (SCDAH) in Columbia, SC by Brockington and Associates, Inc. in January, 2005.

4.3.2 Known Cultural Sites (Listed or Eligible for the NRHP) - *Excluded*

All areas within which transmission line construction could potentially impact known cultural site locations were excluded from consideration for transmission line corridor planning. For the purposes of this analysis, linear architectural features (historic roads or trails) and architectural structure sites (point locations) were buffered by 300 feet. All areas within these buffers were given **exclusionary** status. Cemeteries, archeological locations, and architectural property boundaries were also **excluded.**



Cultural sites identified in this data layer included sites listed on the National Register of Historic Places (NRHP) and sites on the Determination of Eligibility (DOE) list that were designated as eligible, potentially eligible, or those that have not yet been assessed for eligibility. Only sites designated as listed or eligible for the NRHP were included in this layer. Sites that were not eligible for the NRHP were not included, and were not excluded from consideration or otherwise considered for planning purposes. Potentially eligible sites are discussed in *Section 4.4.1.*

Literature review and data acquisition for historic and archeological site locations was conducted by Brockington and Associates, Inc. in January, 2005. Known site locations and there eligibility were obtained from the South Carolina Institute of Archaeology and Anthropology (SCIAA) and the SCDAH in Columbia, SC. Information concerning all currently digitized above ground resources housed at the SCDAH was provided by Mr. Chad Long, SCDAH GIS Coordinator. This information included all above ground resources including their eligibility recorded after 1989, all cultural resources studies conducted since 1989, and all archaeological sites and structures listed on the NHRP. All other recorded archaeological sites not on the NHRP were digitized from locations hand drawn on USGS topographic maps stored at the SCIAA. Eligibility status for digitized sites was obtained from DOE lists maintained by the SCDAH and the USFS-Witherbee Ranger District, as well as individual site forms and reports at the SCIAA for sites not included in the SCDAH's DOE list. Approximately 640 site forms were reviewed at the SCIAA.

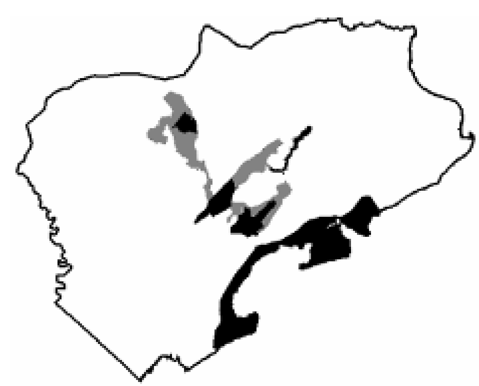
4.3.3 Threatened and Endangered Species - *Excluded*

Threatened and Endangered Species (TES) locations for federally listed species were provided by the South Carolina State Natural Heritage Office and the USFS. On National Forest lands, the most recent locations (2004) for red cockaded woodpecker (*Picoides borealis*) colonies were also identified and mapped. All red cockaded woodpecker colonies were buffered by 200 feet and given **exclusionary** status.

Locations of known Bald eagle (*Haliaeetus leucocephalus)* nest trees were buffered by 1,500 feet to protect the eagle's primary management zone (PMZ). Due to the risk of eagles abandoning nests if tree cutting were to occur with in the PMZ, the PMZ was given **exclusionary** status (USFWS, 2005).

All known Flatwoods salamander (*Ambystoma cingulatum)* breeding ponds and a ¼ mile surrounding them were **excluded** because is it is a critically imperiled species in South Carolina.

4.3.4 Wilderness Areas – *Excluded*



Four areas on the FMNF have been designated as wilderness areas: Hellhole Bay, Wambaw Swamp, Wambaw Creek, and Little Wambaw Swamp. In addition, 28,000 acres of the Cape Romain NWR is under wilderness area protection. These areas were removed from consideration for transmission line construction in this analysis. Any proposed transmission line development within a designated wilderness area requires Presidential approval.

Forest Service Management Area (MA) 29 provides wilderness linkages between existing Wilderness Areas. The FMNF *Land and Resource Management Plan* emphasizes the minimization of breaks in the forest canopy, road constriction and limits issuance of special use permits. For this reason, MA 29 was **excluded** except for existing openings, such as existing roads and ROWs.

4.4 Risk Resource Suitability Layers

The following data layers were used to identify areas where there would be a risk of adverse impacts from transmission line construction and operation, i.e. areas of low suitability for transmission line planning. Brief descriptions of the origin of these data layers and their preparation are provided below.

4.4.1 Known Cultural Sites (Potentially Eligible for the NRHP) - *Risk*

Cultural sites that have been designated as potentially eligible for the NRHP are included as a conservative measure and given a rating of **+25**. Sites that were not eligible for the NRHP were not included, and were not excluded from consideration or otherwise considered for planning purposes.

Literature review and data acquisition for historic and archeological site locations was conducted by Brockington and Associates, Inc. in January, 2005. Known site locations and their eligibility were obtained from the South Carolina

4.4.2 Cultural Site Probability – *Risk*

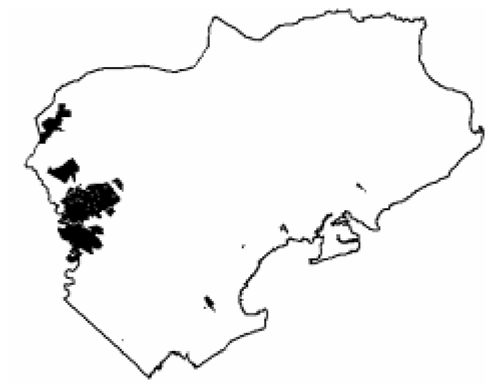
In addition to excluding areas with known cultural site locations, areas with a high potential for finding as yet unidentified sensitive cultural sites were also considered in the analysis. Construction of a transmission line within these areas would represent a potential risk to as yet unidentified cultural resources. Therefore, these areas were assigned a risk rating of **+25**.

A model developed by the USFS and other archaeologists was used to identify areas with a high potential for finding cultural resource sites (historic and prehistoric). The model is based on the premise that most prehistoric archaeological sites in the area occur near the interface between moderate to well drained soils and poorly drained soils or near permanent water sources (swamps, creeks, large bays and ponds), and most historic sites occur along current or abandoned travelways. The following criteria were used to identify these areas:

- Areas at a distance of zero to 160 meters from the interface of moderate to well drained soils with poorly drained soils.

- Areas of somewhat poorly drained to well drained soils within 160 meters of permanent water sources.
- Areas within 70 meters of small ponds or bays.
- Areas of moderate to well drained soils within 70 meters of current or abandoned roads.

4.4.3 Conservation Easements - *Risk*



Construction of a transmission line through a conservation easement may brcontrary to the intent of the conservation easement[1]. For this reason, conservation easement locations were assigned a risk rating of **+50**.

Conservation easement boundaries/locations were obtained from Berkeley, Georgetown, and Charleston Counties. Easement locations provided by Berkeley County represented the actual delineated boundary of the easement within its associated land parcel, whereas, only the easement parcel number was provided for Charleston and Georgetown Counties. To be conservative, the entire parcel was considered to be under conservation easement for easements located in Charlestown and Georgetown Counties.

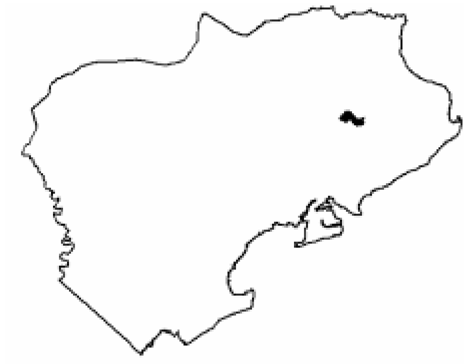
4.4.4 Recreation - *Risk*

Construction of a transmission line within or adjacent to a developed recreation area on the FMNF may impact the recreational use and value of the site. For this reason, areas within 300 feet of developed recreation sites and trails were assigned a risk rating of **+50**.

Location information for developed recreation areas was provided by the USFS. A total of 23 developed recreation sites were identified within the study area and approximately 155 miles of designated trails. The North and South Santee rivers are used locally for boating, fishing, and waterfowl hunting therefore, the rivers were included in the recreation layer with a risk rating of **+25.**

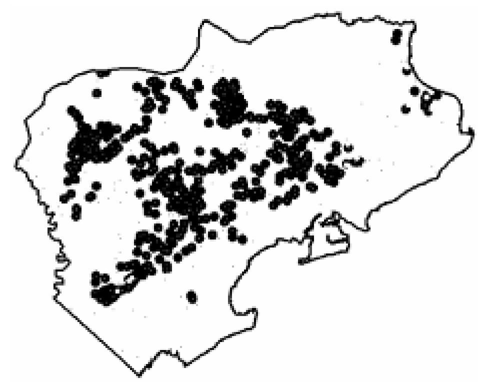
[1] It should be noted that this is not always the case, however, and depends on the language set forth in the conservation easement agreement. Assigning a risk rating to easement locations is applied in this analysis as a conservative measure.

4.4.5 State Wildlife Management Area – *Risk*



The South Carolina Department of Natural Resources (SCDNR) owns and manages a 1,722 acre area between the North Santee as South Santee called the Santee-Delta Wildlife Management Area (WMA.) This WMA is provided by the state for the enjoyment of all wildlife enthusiasts for hunting and recreation. Deer, hog and waterfowl hunting are the main uses of this WMA. The Santee-Delta WMA, excluding the Highway 17 right of way passing through it, was rated **+50** due to its unique character and state status.

4.4.6 Threatened, Endangered, and Sensitive Species - *Risk*



Threatened and Endangered Species (TES) locations for both state and federally listed species were provided by the South Carolina State Natural Heritage Office and the USFS. All state listed species were buffered by 200 ft and given a rating of **+50**.

On National Forest lands, locations of Regional Forest Sensitive Species (RFSS) and the most recent locations (2004) for red cockaded woodpecker (*Picoides borealis*) colonies were also identified and mapped. In addition to the 200 ft exclusion area for each red cockaded woodpecker colony, a buffer of ½ mile was added to locations and the zone between 200 feet and ½ mile of the colony site was assigned a risk rating of **+50**. This ½ mile zone is an approximation of the normal foraging range of the red cockaded woodpecker, within which, special restrictions are in place for operations requiring tree removals (USFWS, 2003).

4.4.7 Wetlands - *Risk*

Construction of a transmission line within a wetland area may result in alterations to the structural character and vegetative composition of the wetland, and may disturb resident species and their habitats. For this reason, wetland areas identified in the National Wetlands Inventory were assigned a risk rating.

Since different types of wetlands would likely be affected by transmission line construction in different ways and to different degrees, risk ratings varied by wetland type.

Forested, lacustrine, and estuarine wetlands were all given risk ratings of **+50**. Forested wetlands were given this risk rating because clearing the forest canopy to construct a right of way would result in the conversion of these areas from a forested wetland type to a scrub shrub wetland type. Lacustrine wetlands (consisting of larger open water wetlands, such as lakes or reservoirs) were given a risk rating of +50 because construction of a transmission line through these wetlands may require poles at one or more points in the lake or reservoir, resulting in lake bed disturbance and alterations in the visual character of the site. Estuarine wetlands were rated as +50, due to the importance of these wetlands in the area for nesting waterfowl and migratory birds. Emergent and riverine wetlands in the analysis area were both assigned a risk rating of **+30**. The lower rating assigned to these wetlands is due to the fact that, for the majority of these wetlands, the transmission line could be constructed to span the wetland without pole construction within the wetland boundary. For larger riverine and emergent wetlands, however, impacts on sediments, vegetation, and aquatic biota may be observed. Lastly, palustrine scrub shrub wetlands were given a risk rating of **+15.** This rating was assigned due to the anticipation that the majority of these wetlands, typically smaller in size in the study area, would be able to be spanned by transmission line construction with little or no vegetation disturbance required.

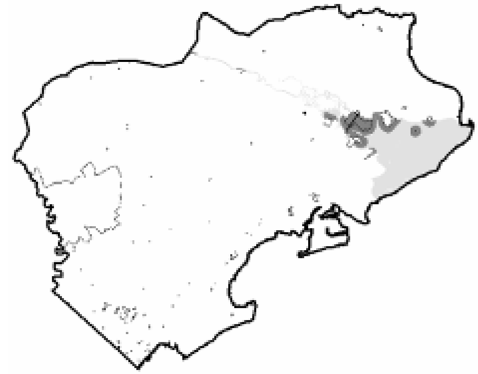
4.4.8 Santee River Migratory Bird Area – *Risk*

The Santee River Delta has been identified as a critical area for migratory birds, particularly large concentrations of over wintering waterfowl. Construction of a transmission line within this area may impact migratory species that utilize wetland habitats in this area. For this reason, areas within the southern portion of the Santee River Delta were assigned a risk rating of **+25**.

The extent of the area of concern for migratory bird habitat was identified for the purposes of this modeling effort as the lower portion of the delta, which is dominated by herbaceous, riverine, and estuarine wetland types. With further progression northwest along the Santee River, forested wetlands become the dominant wetland cover type.

4.4.9 Vistas – *Risk*

The Santee River crossing, Santee-Delta WMA, and listed or eligible cultural sites are considered scenic resources. Construction of a transmission line through these areas may obstruct or degrade the quality of the scenic vista or cultural landscape. For this reason, areas within the immediate foreground of these scenic resources (within 300 feet) were assigned a risk rating of **+50**.



The Santee-Delta WMA, Santee River crossing, and cultural sites along the delta were also given areas between the immediate foreground and the midground (to 1/2 mile) were assigned a risk rating of **+30**, and areas in the background, beyond ½ mile, were assigned a risk rating of **+15**.

The location of the scenic vista was determined from aerial imagery interpretation of the Santee River and GIS analysis measures (buffers).

4.4.10 Roads - *Risk*

Transmission lines can be constructed along existing roads allowing for overlap between the two rights of way; however constructing the line within the road bed or between a divided highway can be considered a risk. To account for this risk, the central "non-buildable" portions of major and minor roads were assigned a risk rating of **+50**. Local roads were not assigned this risk rating. The "buildable" sections of a road are discussed in Section 4.5.1

4.4.11 Existing Structures – *Risk*

Utility companies are required to condemn and pay fair market value for structures over which transmission lines are constructed. To avoid this, existing structure locations were identified, buffered by 300 feet, and assigned a risk rating of **+50**.

The structure location information compiled was a composite of information provided by Charleston County, Georgetown County, and manually digitized locations from aerial imagery (Photo years 1994 and 1999) for the rest of the study area. Aerial images were used to verify and revise structure locations identified in data provided by Georgetown County.

4.5 Opportunity Resource Suitability Layers

The following data layers were used to identify areas within which transmission line construction would have a reduced likelihood of additional impacts. Brief descriptions of the origin of these data layers, their preparation for use in the model, and rationale for inclusion are provided below.

4.5.1 Existing Transmission ROWs - *Opportunity*

Construction of a transmission line within, or immediately adjacent to an existing transmission line right of way avoids or limits: the level of additional forest clearing necessary, new forest fragmentation effects, the creation of edge habitat, and conversion of areas to new land uses (i.e., to a utility corridor). For these reasons, areas within or immediately adjacent to an existing major transmission line corridor were assigned a suitability rating of **-25**.

Transmission line corridor location information was obtained from the Census Bureau's TIGER database, and improved through correlation with available satellite imagery (imagery acquisitions in 1994 and 1999). Only those utility rights of way that were available from the TIGER database, or immediately identifiable from satellite imagery sources (1994 and 1999 capture dates) were included. As a result, many smaller corridors were not included in this data layer.

Transmission line location data was only available as linear feature data, and therefore only identified the centerline of the right of way and not its width. To account for the corridor width, all linear features were buffered by 75 feet to account for an estimated 150 foot width of the right of way[2]. The resultant 150 foot right of way was then buffered again by 70 feet on each side (for a total corridor width of 290 feet) to identify areas immediately adjacent to the right of way which could potentially be used to widen the existing right of ways to accommodate the additional proposed transmission line.

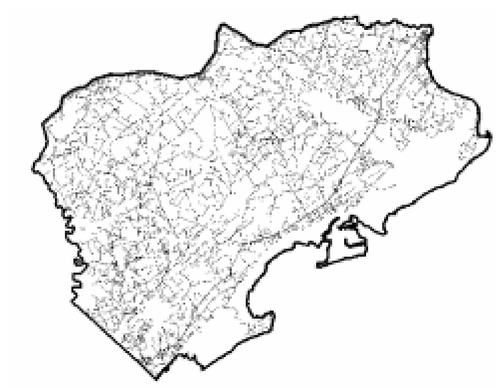
4.5.2 Road ROWs - *Opportunity*

Transmission lines can be constructed along existing roads allowing for overlap between the two rights of way. Construction of a transmission line within or immediately adjacent to an existing road right of way: reduces the amount of forest clearing necessary for corridor construction, limits increases in forest fragmentation effects, limits increases in the creation of edge habitat, reduces the overall amount of land converted to a new land use (i.e., to a utility corridor), and

[2] The 150 foot width, is an approximation derived from aerial imagery assessment of the majority of identifiable corridors in the study area.

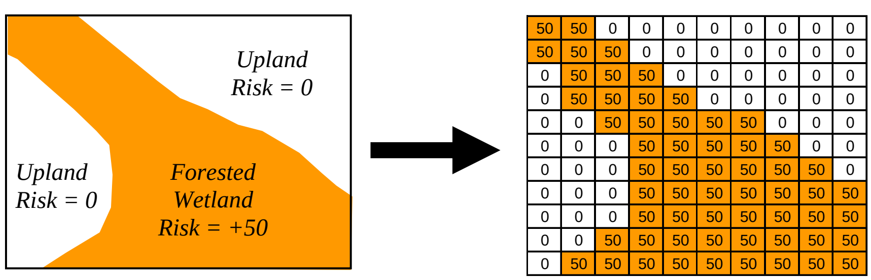
allows for ease and efficiency when accessing the line for maintenance or repairs. For the above reasons, road rights of way were assigned an opportunity rating of **-25**.

Road locations were obtained from the Census Bureau's TIGER line database. Census Feature Class Code's (CFCC) for each road in the database provided a means to roughly identify major, minor, and local roads and approximate the width of the road's right of way. Major roads, such as Highway 17, were buffered by 75 feet to account for a an estimated 150 foot right of way, minor roads, such as State Route 46, were buffered by 25 feet to account for an estimated 50 foot right of way, and local roads were buffered by 15 feet to account for an estimated 30 foot right of way. All of the road rights of way were then buffered again by 70 feet to account for the potential for constructing the proposed transmission line adjacent to, and overlapping with, the existing road ROW. Together, these buffers resulted in a 290 foot, 190 foot, and 170 foot buffer zones for major, minor, and local roads (respectively) in the study area.



4.6 Compiling the Suitability Map

Once all of the resource suitability layers were compiled and features within assigned their respective risk/opportunity ratings they were converted from polygon format to a grid-based format (10 x 10 meter cells). Through this conversion, all features in the resource data layers were converted to individual cells, the values of which denoted the risk/opportunity rating assigned to that resource. This conversion is commonly performed for GIS modeling efforts, and allowed for easier manipulation and combination of the suitability layers into one overall lands suitability map. The following graphic illustrates this process.



50	50	0	0	0	0	0	0	0	0
50	50	50	0	0	0	0	0	0	0
0	50	50	50	0	0	0	0	0	0
0	50	50	50	50	0	0	0	0	0
0	0	50	50	50	50	50	0	0	0
0	0	0	50	50	50	50	50	0	0
0	0	0	50	50	50	50	50	50	0
0	0	0	50	50	50	50	50	50	50
0	0	0	50	50	50	50	50	50	50
0	0	50	50	50	50	50	50	50	50
0	50	50	50	50	50	50	50	50	50

The resultant raster (grid) based resource layers were then summed in the GIS environment. This process resulted an overall 'composite suitability map', within which, each grid cell represented the composite score of all risk and opportunity ratings for that particular location. The following graphic depicts a simplified version of this process with examples from three of the suitability criteria data layers.

50	50	0	0	0	0	0	0	0	0
50	50	50	0	0	0	0	0	0	0
0	50	50	50	0	0	0	0	0	0
0	50	50	50	50	0	0	0	0	0
0	0	50	50	50	50	50	0	0	0
0	0	0	50	50	50	50	50	0	0
0	0	0	50	50	50	50	50	50	0
0	0	0	50	50	50	50	50	50	50
0	0	0	50	50	50	50	50	50	50
0	0	50	50	50	50	50	50	50	50
0	50	50	50	50	50	50	50	50	50

Wetlands

\+

0	0	0	0	0	0	0	0	-35	-35
0	0	0	0	0	0	0	-35	-35	-35
0	0	0	0	0	0	-35	-35	-35	0
0	0	0	0	0	-35	-35	-35	0	0
0	0	0	0	-35	-35	-35	0	0	0
0	0	0	-35	-35	-35	0	0	0	0
0	0	-35	-35	-35	0	0	0	0	0
0	-35	-35	-35	0	0	0	0	0	0
-35	-35	-35	0	0	0	0	0	0	0
-35	-35	0	0	0	0	0	0	0	0
-35	0	0	0	0	0	0	0	0	0

Roads

\+

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	50
0	0	0	0	0	0	0	0	50	50
0	0	0	0	0	0	0	50	50	50
0	0	0	0	0	0	0	50	50	50
0	0	0	0	0	0	0	50	50	50
0	0	0	0	0	0	0	0	50	50
0	0	0	0	0	0	0	0	0	50
0	0	0	0	0	0	0	0	0	0

T & E Habitat

=

50	50	0	0	0	0	0	0	-35	-35
50	50	50	0	0	0	0	-35	-35	-35
0	50	50	50	0	0	-35	-35	-35	0
0	50	50	50	50	-35	-35	-35	0	50
0	0	50	50	15	15	15	0	50	50
0	0	0	15	15	15	50	100	50	50
0	0	-35	15	15	50	50	100	100	50
0	-35	-35	15	50	50	50	100	100	100
-35	-35	-35	50	50	50	50	50	100	100
-35	-35	50	50	50	50	50	50	50	100
-35	50	50	50	50	50	50	50	50	50

Composite Suitability

The composite suitability map compiled for all of the data layers described in **Section 4** is presented in **Figure 4-1**.

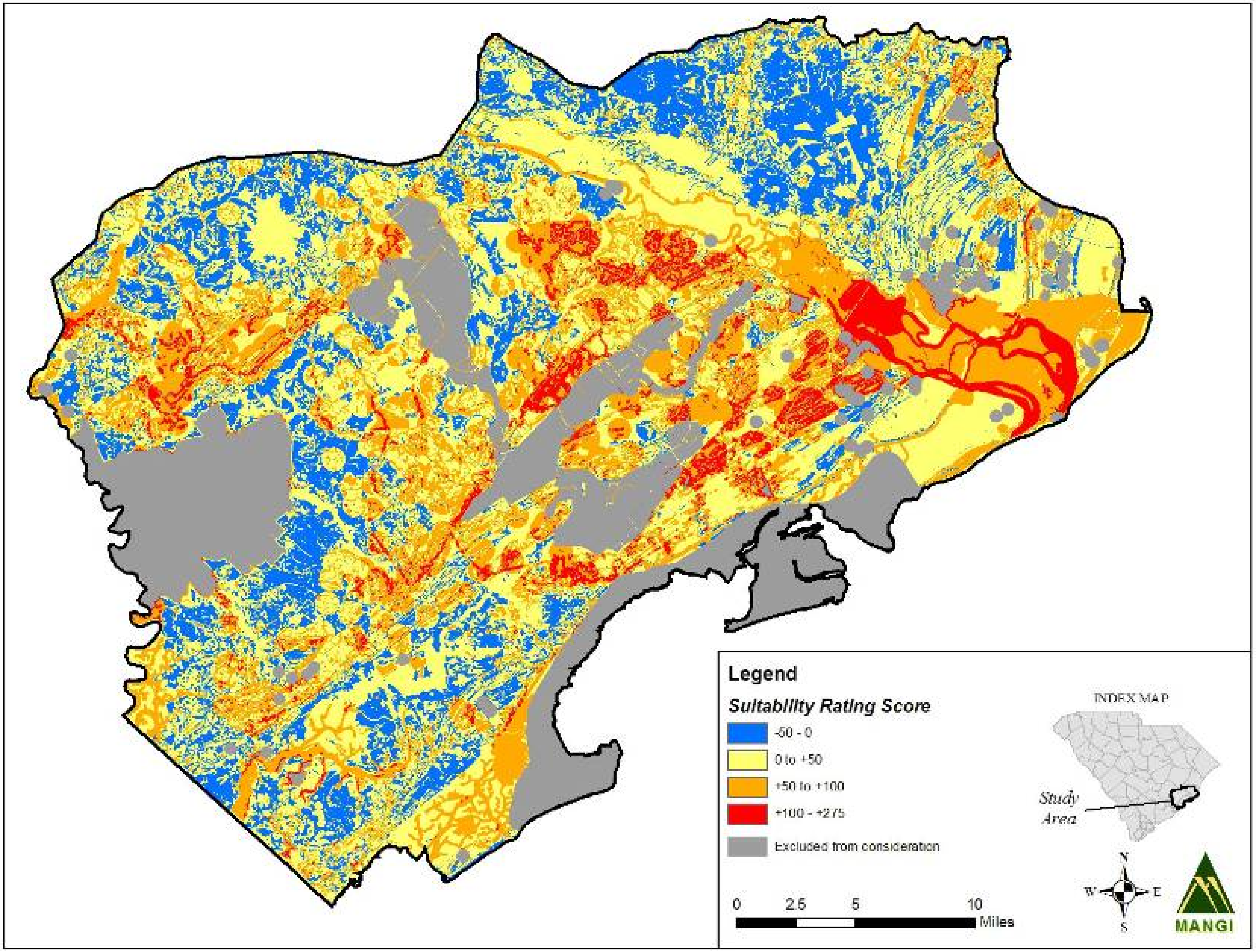


Figure 4-1. Composite Suitability Map

4.7 Modeling Paths and Identifying Macro-Corridors

4.7.1 Modeling Least Risk Paths

Once the composite suitability map was compiled, potential paths for the proposed transmission line were identified. This was done by using least risk path analysis algorithms included in ESRI's ArcGIS software (v. 9.1) to model paths between various proposed source points and the proposed McClellanville substation site.

Least risk path analysis methods utilize mathematical algorithms to identify a path of least accumulated risk from one point in the suitability map to the next. In simple terms, the process involves starting from one point in the suitability map (a grid cell representing the transmission line source location) and moving cell by cell toward a destination point (a grid cell representing the location of McClellanville) by following those cells that result in the lowest accumulation of risk scores along the way.

It is with this process in mind, that all risk ratings were assigned *positive* values and opportunities were assigned *negative* values. Cells with high cumulative risk ratings - the result of multiple resources data layers with positive risk ratings for that cell - would result in a higher accumulated risk if included in the path and would less likely be included in the least risk path. In contrast, cells with lower ratings (the result of either few resource data layers with positive risk ratings or a layer with opportunity value for that cell) would reduce the overall accumulated risk if included in the path, and have a greater likelihood of being included within the least risk path.

In reality, this process is not as mathematically or conceptually simplistic as presented here. For clarity and simplicity, a description of the algorithms used and various intermediate steps of this process (accumulated risk layer creation, backlink directional layer creation, etc.) are not presented here, but are available upon request. For a more thorough review of these concepts, see (Berry, 2005).

Least risk paths were calculated from the various proposed starting point substations, including Belle Isle (both the Belle Isle and Winyah substations), Jamestown, and Charity, to their endpoint at the McClellanville substation (**Figure 5-1**). Paths were also generated from the Winyah substation, Jamestown, and Charity substations to McClellanville via a routing point near Honey Hill. In addition, a set of least risk paths were calculated for the Belle Isle to McClellanville route to account for the possibility for using either a directional bore or overhead line along the Highway 17 right of way to cross the Santee River Delta. For this route two paths were generated, one from Belle Isle to a point next to the north end of the Highway 17 bridge, while the other was generated from a point on the south end of Highway 17 bridge to the McClellanville substation. In total, 7 least cost paths were modeled, their descriptions and modeled paths are presented in **Section 5**.

4.7.2 Macro-Corridor Delineation

Because the suitability map only takes into account a limited number of variables and treats these variables in a generalized manner, it is not anticipated or advised that the modeled paths be used directly as the proposed paths for the McClellanville transmission line. They do, however, serve as a useful guide for planning the general corridor within which the proposed transmission line might be constructed, i.e., the macro-corridor.

Typically, a rough estimate of a proposed transmission line path is drawn on a map and buffered by ½ mile on either side to create a 1 mile wide corridor for macro-corridor analysis. Though simple, this manner of corridor delineation does not take into account the suitability of the areas included within the buffer of the proposed path, and as a result, areas that should be excluded from consideration or large areas of high risk for potential impacts are once again included in the macro-corridor boundary and brought to the next planning level.

To avoid this problem for the McClellanville 115 kV transmission line macro-corridor delineations, the extents of the macro-corridor study areas for each of the modeled pathways were determined from the suitability map. By using the suitability map instead of a simple ½ mile buffer, areas that were considered exclusionary for transmission line construction were also excluded from the macro-corridor boundary, and areas with the highest composite risk ratings were generally avoided.

As with the methods used for calculation of the least risk paths, for clarity and simplicity, a description of the algorithms used and various intermediate steps involved in the calculation of the macro-corridor boundaries are not included in this report, but are available upon request (see Berry, 2005 for more information on corridor calculation methods). Some general concepts, however, should be mentioned for interpretation of the results presented in Section 5:

- For each least cost path, a corridor was calculated with a square mile area roughly equal to the linear length (in miles) of the path. This was done for two reasons. First, as described above, utility planners typically use a ½ mile buffer on each side of the proposed line to identify the macro-corridor study boundary. This results in a corridor with 1 square mile of area for every linear mile. Second, because each modeled path has a different length, comparisons between corridors concerning land use breakdowns and suitability rankings would not be appropriate without some form of normalization.
- Calculating corridors derived from the suitability map with a unit area equivalent to the unit length of the least risk path is not exact. In most cases, there is a small difference between the length of the least risk path (in miles) and the area of the macro-corridor (in square miles). This error is due to the distribution of the suitability ratings across the suitability map and is unavoidable.
- Because the delineation of the macro-corridor boundaries was dynamically responsive to the suitability scores in the composite suitability map, the corridor boundaries do not parallel the least risk path. Instead, the corridor boundaries expand and contract in response to the absolute value of the suitability score and the relative distribution of risk ratings within the area of the modeled paths.

5 Description of the Modeled Macro-Corridors

The locations and paths of the seven modeled macro-corridors (one has two options for crossing the Santee River Delta; two corridors split into primary and secondary portions) are described in the following sections and mapped in **Figures 5-2, 5-3,** and **5-4**. Specific characteristics of the corridors, including wetland acreage percentage, risk rating statistics, and land use/land cover are provided in **Table 5-1**.

5.1 Belle Isle to McClellanville #1

The Belle Isle to McClellanville #1 corridor begins at the Belle Isle delivery point located approximately two miles southeast of the Winyah generator. From here, the corridor splits into two parts, identified below as the "primary" corridor and "secondary" corridor. **Figure 5-1** displays the ridge of high risk ratings that cause the corridor to split.

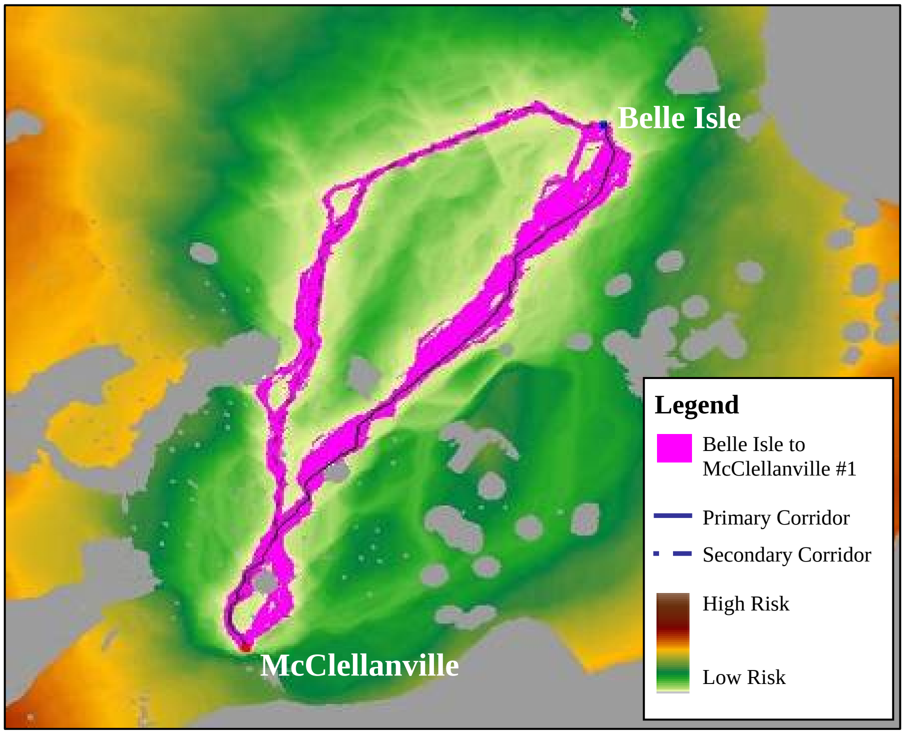


Figure 5-1 3D Image of the Belle Isle to McClellanville #1 Corridor

Primary Corridor
From the Belle Isle delivery point, it follows a path along Highway 17 for approximately 2.5 miles, then shifts westward approximately 2 ½ miles, crosses SR 2224 before the reaching the North Santee River. The corridor crosses the Santee River approximately 1 – 2 miles northwest of the Highway 17 bridge and continues to the proposed McClellanville substation along a path roughly parallel to Highway 17 (See **Figure 5-2**).

Secondary Corridor
From the Belle Isle delivery point, this corridor travels 1.5 miles due west to the Charity to Winyah 230 kV transmission line. It parallels the transmission line, for about 4 miles to SR 2224m where it heads due south. It crosses the Santee River where the River branches into the North Santee and South Santee. From there is passes through the northeast cornor of the Francis Marion National Forest to McClellanville.

5.2 Belle Isle to McClellanville #2

The Belle Isle to McClellanville #2 corridor also begins at the Belle Isle delivery point and follows the primary corridor path listed above to the North Santee River. From this point, there were two options considered for crossing the Santee River Delta.

Option A: Directional Bore

The two mile wide Santee River Delta would be crossed under this option by using directional boring technology to tunnel the transmission line under the Santee Delta. The bore would start along the northern bank of the North Santee River in the pole yard east of Highway 17, and end on the southern bank of the South Santee River in a small clearing on the west of Highway 17.

Option B: Overhead Line

The Santee River Delta would be crossed under this option using an overhead transmission line that followed the existing Highway 17 right of way. Detailed starting and ending points for this crossing would depend on NEPA and engineering analysis.

Once past the Santee River Delta, the corridor veers west and parallels Highway 17 all the way to the proposed McClellanville Substation (**Figure 5-2**).

5.3 Winyah to McClellanville via Honey Hill Junction

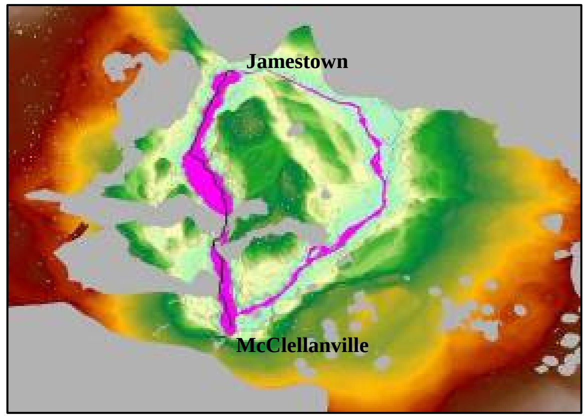
The Winyah to McClellanville via Honey Hill corridor begins at the Winyah Generating Station and follows an existing 230 kV right of way to a routing point approximately 1 mile southwest of its crossing with State Highway 45. From this point, the corridor traverse southeast, joining State Highway 45 to cross the wilderness linkage management area (MA29), then passing just south of the Wambaw Creek Wilderness before continuing on to the proposed McClellanville substation(**Figure 5-2**).

5.4 Honey Hill Junction to McClellanville

The Honey Hill Junction to McClellanville path begins at point along the Winyah to Charity 230 kV right of way approximately 1 mile southwest of the crossing with State Highway 45. From this point, the corridor traverse southeast, joining State Highway 45 to cross the wilderness linkage management area (MA29), then passing just south of the Wambaw Creek Wilderness before continuing on to the proposed McClellanville substation(**Figure 5-3**).

5.5 Jamestown to McClellanville

The Jamestown to McClellanville corridor begins at a point tapped near the 115 kV Jamestown delivery point. Like the Belle Isle to McClellanville #1 corridor, there is a split in the corridor because of a ridge of high values; however since the secondary corridor was so narrow and followed a path similar to the Belle Isle to McClellanville #1 secondary corridor, the Jamestown secondary corridor was removed from further analysis.



3D Image of the Jamestown corridor

Primary corridor
The primary corridor begins at the Jamestown delivery point and travels southeast, paralleling State Highway 45 to the west. It crosses the 230 kV transmission line near Honey Hill. One mile southeast of the transmission line, the corridor then follows State Highway to cross the wilderness linkage management area (MA29), then passing just south of the Wambaw Creek Wilderness before continuing on to the proposed McClellanville substation(**Figure 5-3**).

5.6 Charity to McClellanville #1

The Charity to McClellanville #1 corridor begins at the Charity delivery point and traverses northeast along the existing Winyah to Charity to 230 kV corridor for 4 miles. The corridor then diverts slightly southeast passing Bates Pond. About 3 miles past Bates pond it shifts to a more northeasterly path to Awendaw. It crosses US Highway 17, and then turns north and parallels US Highway 17 north to the proposed McClellanville substation (**Figure 5-4**).

5.7 Charity to McClellanville #2 via Honey Hill

The Charity to McClellanville #2 corridor begins at the Charity delivery point and traverses northeast along the existing Winyah to Charity to 230 kV corridor approximately 4 miles. It then turns north passing through the wilderness linkage (MA 29) along Yellow Jacket Road. It continues northeast to Honey Hill Junction. From this point, the corridor traverse southeast, joining State Highway 45 to cross the wilderness linkage management area (MA29), then passing just south of the Wambaw Creek Wilderness before continuing on to the proposed McClellanville substation(**Figure 5-4**).

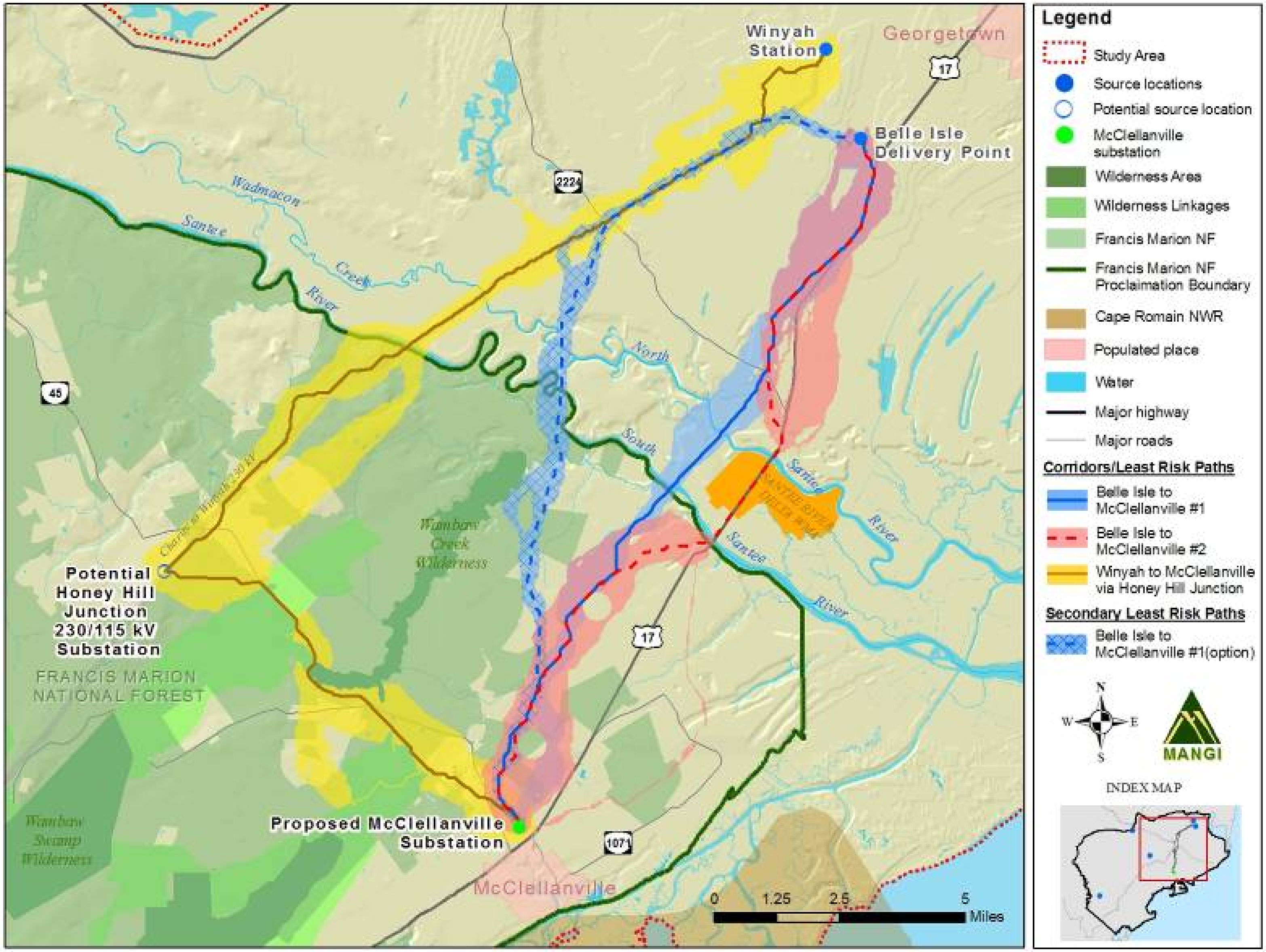


Figure 5-2. Winyah to McClellanville Macro-Corridors and Least Risk Paths

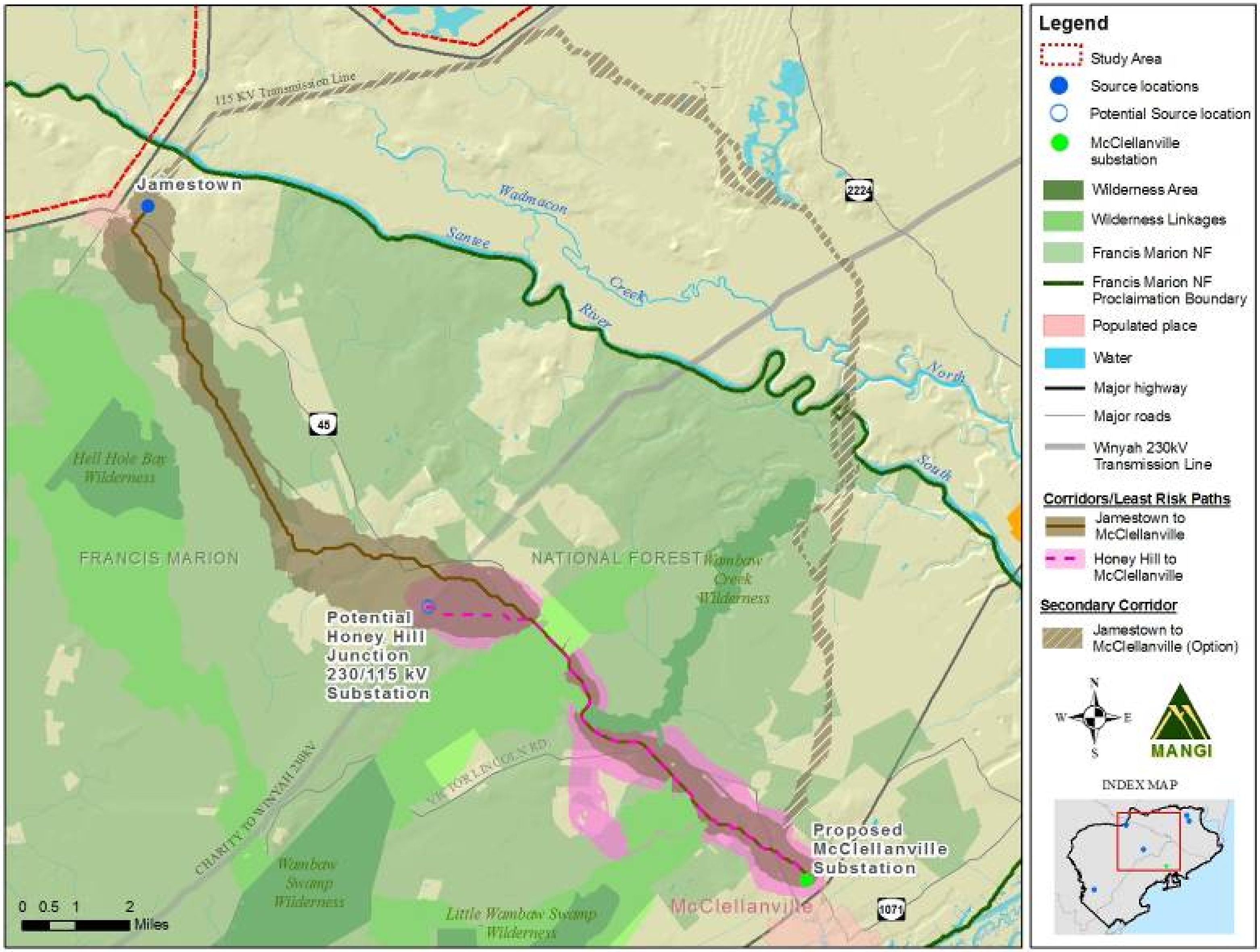


Figure 5-3. Jamestown to McClellanville Macro-Corridors and Least Risk Paths

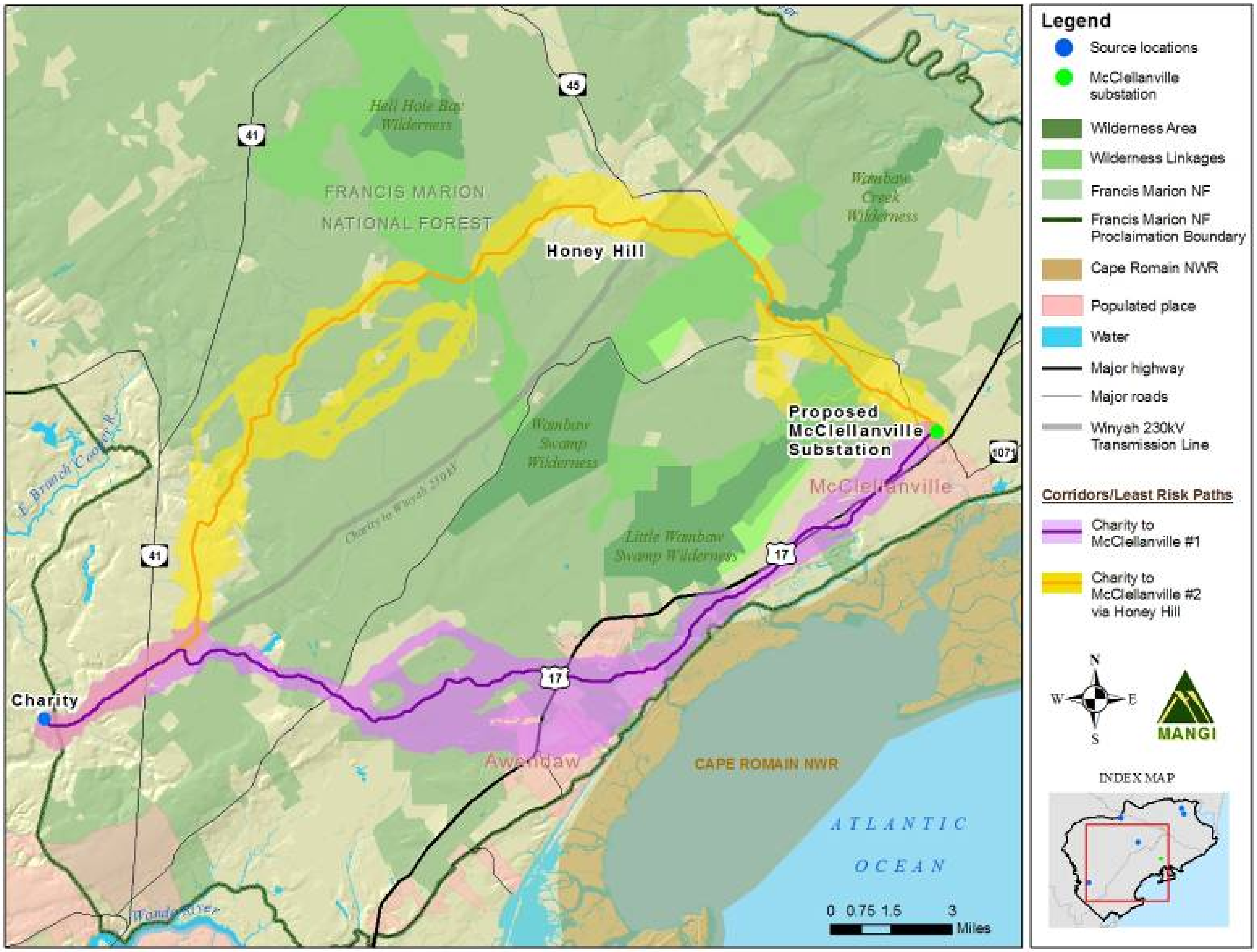


Figure 5-4. Charity to McClellanville Macro-Corridors and Least Risk Path

Table 5-1. General Characteristics, Land Use, and Wetland Macro-Corridors Comparison Table

	Belle Isle to McClellanville #1 (total)	Belle Isle to McClellanville #1A (primary)	Belle Isle to McClellanville #1B (secondary)	Belle Isle to McClellanville #2	Winyah to McClellanville via Honey Hill Junction	Jamestown to McClellanville #1 (total)	Jamestown to McClellanville #1A (primary)	Charity to McClellanville #1	Charity to McClellanville #2 via Honey Hill	Honey Hill 230/115 to McClellanville
GENERAL CHARACTERISTICS										
Miles of Least Risk Path	17.6	17.6	19.7	16.0	27.0	20.9	20.9	28.9	34.8	10.0
Area (sq. mi) of Modeled Corridor*	17.6	11.7	7.0	16.2	27.7	21.2	15.7	28.6	34.4	10.1
Area NF (Sq. Mi.)	2.2	0.6	2.0	1.2	11.3	8.9	7.8	14.3	19.3	6.0
Percent NF Land	12.5%	5.3%	28.4%	7.7%	41.0%	42.1%	49.9%	49.9%	56.1%	59.1%
Corridor Risk Score[1]	**16.5**	**12.0**	**6.2**	**18.2**	**37.9**	**22.3**	**19.0**	**26.0**	**36.8**	**18.3**
Risk Score[1] per Square Mile	**0.9**	**1.0**	**0.9**	**1.1**	**1.4**	**1.0**	**1.2**	**0.9**	**1.1**	**1.8**
LAND USE/LAND COVER[2]										
Agricultural (square miles/% of corridor)	0.1 *0.3%*	0.1 *0.5%*	0.0 *0.0%*	0.1 *0.7%*	0.2 *0.6%*	0.4 *2.1%*	0.4 *2.5%*	1.1 *3.8%*	0.7 *1.9%*	0.1 *1.1%*
Forested (square miles/% of corridor)	9.9 *56.3%*	6.7 *57.2%*	4.1 *59.2%*	11.2 *69.5%*	17.5 *63.2%*	13.1 *61.6%*	9.9 *63.4%*	13.7 *47.8%*	19.8 *57.7%*	5.8 *57.2%*
Grassland/ Pasture (square miles/% of corridor)	0.0 *0.0%*	0.0 *0.0%*	0.0 *0.0%*	0.0 *0.1%*	0.0 *0.1%*	0.0 *0.0%*	0.0 *0.0%*	0.1 *0.4%*	0.1 *0.4%*	0.0 *0.2%*

Table 5-1. General Characteristics, Land Use, and Wetland Macro-Corridors Comparison Table

	Belle Isle to McClellanville #1 (total)		Belle Isle to McClellanville #1A (primary)		Belle Isle to McClellanville #1B (secondary)		Belle Isle to McClellanville #2		Winyah to McClellanville via Honey Hill Junction		Jamestown to McClellanville #1 (total)		Jamestown to McClellanville #1A (primary)		Charity to McClellanville #1		Charity to McClellanville #2 via Honey Hill		Honey Hill 230/115 to McClellanville	
Urban/ Residential (square miles/% of corridor)	0.1	*0.7%*	0.1	*1.0%*	0.0	*0.2%*	0.2	*1.2%*	0.1	*0.4%*	0.1	*0.3%*	0.0	*0.3%*	0.5	*1.7%*	0.1	*0.2%*	0.0	*0.1%*
Other (square miles/% of corridor)	7.5	*42.5%*	4.8	*41.3%*	2.8	*40.5%*	4.6	*28.5%*	9.9	*35.8%*	7.6	*35.9%*	5.3	*33.8%*	13.2	*46.3%*	13.7	*39.8%*	4.2	*41.3%*
NATIONAL WETLAND INVENTORY (NWI) WETLAND TYPES[1]																				
Total Wetland Acreage[3]	9.7	*55.2%*	7.2	*61.7%*	3.5	*50.5%*	9.9	*61.3%*	19.3	*69.9%*	12.1	*57.0%*	10.1	*64.6%*	14.5	*50.6%*	17.6	*51.3%*	9.1	*89.9%*
Estuarine (square miles/% of corridor)	1.6	*9.3%*	1.6	*13.6%*	0.5	*7.5%*	3.8	*23.4%*	10.8	*38.8%*	5.5	*25.7%*	5.2	*33.1%*	5.1	*18.0%*	6.7	*19.4%*	5.8	*57.8%*
Lacustrine (square miles/% of corridor)	0.1	*0.6%*	0.0	*0.4%*	0.1	*0.9%*	0.1	*0.6%*	0.1	*0.4%*	0.0	*0.0%*	0.0	*0.0%*	0.0	*0.0%*	0.0	*0.0%*	0.0	*0.0%*
Unidentified (square miles/% of corridor)	0.6	*3.2%*	0.6	*4.8%*	0.0	*0.2%*	0.3	*2.1%*	0.1	*0.3%*	0.5	*2.4%*	0.5	*3.2%*	0.1	*0.3%*	0.8	*2.4%*	0.1	*0.8%*
Palustrine Emergent (square miles/% of corridor)	0.5	*2.6%*	0.4	*3.7%*	0.0	*0.5%*	0.1	*0.8%*	0.2	*0.6%*	0.1	*0.3%*	0.0	*0.1%*	0.1	*0.4%*	0.1	*0.2%*	0.0	*0.0%*

Table 5-1. General Characteristics, Land Use, and Wetland Macro-Corridors Comparison Table

	Belle Isle to McClellanville #1 (total)		Belle Isle to McClellanville #1A (primary)		Belle Isle to McClellanville #1B (secondary)		Belle Isle to McClellanville #2		Winyah to McClellanville via Honey Hill Junction		Jamestown to McClellanville #1 (total)		Jamestown to McClellanville #1A (primary)		Charity to McClellanville #1		Charity to McClellanville #2 via Honey Hill		Honey Hill 230/115 to McClellanville	
Palustrine Forested (square miles/% of corridor)	5.7	*32.2%*	3.7	*31.8%*	2.5	*35.6%*	4.7	*29.1%*	7.2	*26.0%*	5.6	*26.2%*	4.1	*26.5%*	6.7	*23.3%*	9.7	*28.2%*	3.0	*29.7%*
Palustrine Other (square miles/% of corridor)	0.0	*0.1%*	0.0	*0.2%*	0.0	*0.0%*	0.0	*0.2%*	0.0	*0.1%*	0.4	*1.8%*	0.2	*1.5%*	0.1	*0.3%*	0.0	*0.1%*	0.2	*1.5%*
Palustrine Scrub/Shrub (square miles/% of corridor)	0.9	*5.4%*	0.7	*6.0%*	0.3	*3.6%*	0.8	*4.9%*	0.8	*2.9%*	0.0	*0.1%*	0.0	*0.1%*	1.0	*3.3%*	0.3	*0.9%*	0.0	*0.1%*
Riverine (square miles/% of corridor)	0.3	*1.7%*	0.1	*1.3%*	0.2	*2.1%*	0.0	*0.1%*	0.2	*0.8%*	0.1	*0.4%*	0.0	*0.0%*	1.5	*5.1%*	0.0	*0.0%*	9.1	*89.9%*
Upland (square miles/% of corridor)	7.9	*44.8%*	4.5	*38.3%*	3.5	*49.5%*	6.3	*38.7%*	8.3	*30.1%*	9.1	*43.0%*	5.5	*35.4%*	14.1	*49.4%*	16.7	*48.7%*	1.0	*10.1%*

[1] 'Corridor Risk Scores' were calculated by summing the suitability scores of each individual 10 x 10 meter cell that fell within the corridor boundary. Due to the large number created by this summation, it was then divided by 1,000,000 for the purposes of display.
[2] Land Use/Land Cover categories are derived from the South Carolina GAP analysis land use assessment. Additional data concerning land use categories can be found at http://www.dnr.state.sc.us/gisdata/gap/landcover.htm
[3] Wetland acreages were calculated based on the most recent and updated National Wetland Inventory analysis. This is likely an over exaggeration of actual wetland acreage. Note: South Carolina GAP analysis land use information was not used for this calculation.

5.8 Estimated Corridor Costs

Engineering and Construction

Engineering and construction costs estimates were developed for each corridor (**Table 5-2**). All began with a common base cost per mile derived from CEPCI Power Supply Department's tabulation of Construction Cost Projections. The projections were calculated based on historic data from all construction projects since 1980.

Due to developments following the establishment of the cost projections adjustments were made for this project. Considering the unique land values of the area, the right of way acquisition component of the cost projections (historically averaging 25%) was removed and was calculated separately (see below). Recent changes to the National Electric Safety Code dramatically increased the wind speeds used in calculating extreme wind loading resulting in shorter spans between supporting structures and increased strength requirements for poles. The engineering and construction components remaining after removal of right of way acquisition were increased by 20% to reflect this. Construction through wetlands and National Forest land also required additions to the base cost per mile of the estimated cost and both were quantified for each corridor.

Right of Way Acquisition and Wetland Mitigation Costs

Right of way acquisition costs estimated for each corridor (**Table 5-2**) were based on the following information sources/investigations:

1) Review of county and local economic trends
2) Review of land use patterns, zoning and land use plans
3) Examination of public records for deeds and plans relating to the area
4) Interviews with realtors and appraisers familiar with the area
5) Consideration of Realtor's listings and expertise in specific areas

Land use and assigned cost estimates for the associated use were developed for the following general categories:

- Urban Development: those properties with development potential $25,000/ acre
- Urban Residential: residential development potential or use 7,500/acre
- Wetland Type Properties: limited use due to wetland characteristics 1,500/acre
- Forest/Timber-Recreation: in timber production/recreational assets 4,500/acre
- Agricultural: pasture lands or lands in cultivation 3,500/acre
- River Influenced: properties influenced by the Santee River 60,000/acre

Wetland mitigation estimates are based on CEPCI's previous experience with other projects as to credits per acre and costs of credits.

Table 5-2. Economic Macro-corridor Comparison Table

	Belle Isle to McClellanville #1 (total)	Belle Isle to McClellanville #1A (primary)	Belle Isle to McClellanville #1B (secondary)	Belle Isle to McClellanville #2A	Belle Isle to McClellanville #2B	Winyah to McClellanville via Honey Hill Junction	Jamestown to McClellanville #1 (total)	Jamestown to McClellanville #1A (primary)	Charity to McClellanville #1	Charity to McClellanville #2 via Honey Hill Junction	Honey Hill Junc. 230/115 to McClellanville
Line length (miles)	17.6	17.6	19.7	16.0	16.0	27.0	20.9	20.9	28.9	34.8	10.0
Engineering and Construction Cost per Mile (1)	$138,154	$138,154	$136,865	$139,332	$139,332	$133,733	$136,060	$136,060	$133,172	$132,000	$147,576
Base Engineering and Construction Costs	$2,917,807	$2,917,807	$3,229,203	$2,675,174	$2,675,174	$4,332,957	$3,412,379	$3,412,379	$4,618,388	$5,512,320	$1,770,912
Total Length in Wetlands (miles)	9.7	10.9	9.9	9.8	9.8	18.9	11.8	13.5	14.6	17.9	9.0
Additional Costs for Construction in Wetlands (2)	$203,922	$228,075	$208,580	$205,963	$205,963	$396,365	$247,541	$283,602	$307,546	$375,218	$188,998
Total Length on National Forest Lands	1.5	1.5	1.5	0.0	1.5	14.0	12.8	12.8	13.9	20.4	7.7
Additional Costs for Construction on National Forest Lands (3)	$40,581	$40,581	$40,203	$0	$40,927	$374,557	$347,380	$347,380	$370,544	$538,225	$225,974
Additional Cost of 230/115 switching / substation (4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	$5,700,000
Additional Cost of 2 Miles Directional Bored Cable (5)	NA	NA	NA	$10,000,000	NA	NA	NA	NA	NA	NA	NA
Additional Cost of 2 Miles Overhead Crossing Santee Delta (6)	NA	NA	NA	NA	$400,000	NA	NA	NA	NA	NA	NA
Total estimated engineering & construction cost	**$3,162,310**	**$3,186,463**	**$3,477,985**	**$12,881,137**	**$3,322,064**	**$5,103,880**	**$4,007,300**	**$4,043,360**	**$5,296,478**	**$6,425,763**	**$7,885,884**
Estimated Right of Way Acquisition Costs	$671,985	$671,985	$752,175	$610,920	$610,920	$1,159,825	$797,785	$797,785	$777,000	$1,328,715	$265,000
Estimated Wetland Mitigation Costs	$593,625	$593,625	$743,875	$493,875	$493,875	$804,875	$580,750	$580,750	$710,625	$1,040,875	$324,000
TOTAL COST	**$4,427,920**	**$4,452,073**	**$4,974,035**	**$13,985,932**	**$4,426,859**	**$7,068,580**	**$5,385,835**	**$5,421,895**	**$6,784,103**	**$8,795,353**	**$8,474,884**

(1) - Taken from Power Supply Construction Cost Projections. Cost reduced by 25% to remove R/W cost, then increased by 20% for hurricane wind loading cost to arrive at base engineering and construction cost/mile. (2) - Based on most recent unit cost of wetlands clearing. (3) - Estimated increase in base cost due to USFS restrictions on access and timing of activities. (4) - Station cost provided by Santee Cooper for a step down station with high side distance relays and circuit breakers integrated in the station. (5) - Estimate based on recent directional bore installations. (6) - Estimated cost of overhead installation with 35% increase over base cost due to requirement of self supporting angle structures.

6.0 List of Preparers

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7.0 References

(BCOC, 2004). Berkeley County Chamber of Commerce. 2004. Web page. Demographics and Economy. Accessed at: http://bcoc.com/visitors/about_berkeley_county/demographics.htm

(Berry, 2004). Joseph K. Berry. Map Analysis: Procedures and Applications in GIS Modeling. 2004. Online publication, Spatial Information Systems, Inc. Accessed at: http://www.innovativegis.com/basis/MapAnalysis/Default.htm

(Census, 2000). United States Census Bureau. GCT-PH1. Population, Housing Units, Area, and Density: 2000, Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data, South Carolina –Place. Accessed on 04 March 2005.

(SCDNR, 2001). South Carolina Department of Natural Resources. 2001. The South Carolina GAP Analysis Project.

(SCDNR, 2004). South Carolina Department of Natural Resources. 2004. SCDNR Rules & Regulations, 2004-2005. Accessed at: http://www.dnr.state.sc.us/etc/rulesregs/pdf/wmas.pdf

(USFS, 1996). United States Department of Agriculture, Forest Service, Francis Marion National Forest. February 1996. Revised Land and Resource Management Plan.

(USFS, 2004). United States Department of Agriculture, Forest Service, Francis Marion National Forest. 6 October 2004. Web page. Francis Marion and Sumter National Forests: About Us. Accessed at: http://www.fs.fed.us/r8/fms/forest/aboutus/history.html

(USFWS, 2003) United States Department of the Interior, Fish and Wildlife Service. 2003. Recovery plan for the red-cockaded woodpecker (*Picoides borealis*): second revision. U.S. Fish and Wildlife Service, Atlanta, GA. 296 pp.

(USFWS, No date). United States Department of the Interior, Fish and Wildlife Service. No date provided. Web page. Cape Romain National Wildlife Refuge. Accessed on 03 June 2005. Accessed at: http://www.fws.gov/caperomain/