State and Federal Legislation

Details are found in Appendix C and Appendix D

(Note: we will start working on this section at the next meeting in January 2007)

Management Goals and Objectives

Proposed Management Actions and Legislative Initiatives

Implementation Table

Monitoring and Evaluation

Literature Cited

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APPENDIX A. MEMBERS OF THE SOUTH CAROLINA AQUATIC INVASIVE SPECIES TASK FORCE

Tom Abrahamsen	US Geological Survey - SC Water Science Center
Wayne Boykin	Congaree National Park
Stephen Compton	Clemson University Department of Plant Industry
Jason Crichton	South Carolina Aquarium
Steve deKozlowski	SC Department of Natural Resources
Rick DeVoe	SC Sea Grant Consortium
Ed DieBold	Riverbanks Zoo and Garden
Jeannie Eidson	SC Dept of Health and Env. Control
Ed EuDaly	US Fish and Wildlife Service
Larry Feller	SC Landscape and Turf Grass Association
Donna Foster	SC Nurseryman's Association
Ken Glenn	US Dept. of Agriculture - APHIS-PPQ
John Hensel	SCDHEC-Office of Coastal Res Mgt
Bill Hulslander	Congaree National Park
Stan Hutto	SC Dept of Parks, Rec, and Tourism
John Inabinet	Santee Cooper
Darryl Jones	SC Forestry Commission
David Knott	SCDNR - Marine Resources Research Institute
Cam Lay	Clemson University Dept. of Pesticide Regulation
Billy Lempesis	SC State Ports Authority
Robin Mackie	US Forest Service - Francis Marion and Sumter National Forest
Ken Manuel	Duke Energy- Lake Services Environmental Ctr.
Keith Nell	State Ports Authority
Matt Nespeca	The Nature Conservancy
Marilyn O'Leary	Southeast Aquatic Resources Partnership
Jennifer Rawlings	Riverbanks Zoo and Garden
Alan Shirey	US Army Corps of Engineers, Charleston District
Brandon Stutts	South Carolina Electric and Gas Co.
Kelly Jo Swygert	SC Department of Transportation
Chris Thomason	SC Dept. of Natural Resources
David Tompkins	SC Dept. of Agriculture
Angela Viney	SC Wildlife Federation
Jack Whetstone	SC Sea Grant Consortium/Clemson University Ext.
Susan Wilde	USC / SCDNR Marine Resources
David Wilkins	South Carolina Aquarium
Dick Yetter	USDA- Natural Res Conservation Service

APPENDIX B. INVASIVE AQUATIC SPECIES IN SOUTH CAROLINA

Comment [dmk2]: is this supposed to be a comprehensive list of species that are INVASIVE or just non-native? it looks like all non-native aquatic plants are listed, but not all fish are. I've added what I think should be included for non-native marine/estuarine taxa, assuming it is supposed to include all, regardless of status as invasive, established, reported, etc. There are good published arguments that any species that becomes established (i.e. reproduces and persists) alters ecological function, as is therefore invasive, regardless of economic or social impacts.

Aquatic Plants

African oxygen weed *	*Lagarosiphon major*
Alligatorweed	*Alternanthera philoxeroides*
Ambulia *	*Limnophila sessiliflora*
Arrowhead *	*Sagittaria sagittifolia*
Arrow-leaved monochoria *	*Monochoria hastata*
Brazilian elodea	*Egeria densa*
Caulerpa *	*Caulerpa taxifolia*
Common reed	*Phragmites australis*
Duck-lettuce *	*Ottelia alismoides*
Eurasian watermilfoil	*Myriophyllum spicatum*
Exotic bur reed *	*Sparganium erectum*
Giant salvinia *	*Salvinia molesta S. biloba. S. herzogii. S. auriculata*
Hydrilla*	*Hydrilla verticallata*
Melaleuca *	*Melaleuca quinquenervia*
Miramar weed *	*Hygrophila polysperma*
Monochoria *	*Monochoria vaginalis*
Mosquito fern *	*Azolla pinnata*
Purple loosestrife	*Lythrum salicaria*
Rooted water hyacinth *	*Eichhornia azurea*
Slender naiad	*Najas minor*
Water chestnut	*Trapa natans*
Water hyacinth	*Eichhornia crassipes*
Water lettuce	*Pistia stratiotes*
Water primrose	*Ludwigia hexapetala*
Water spinach *	*Ipomoea aquatica*
Wetland nightshade *	*Solanum tampicense*

Comment [dmk3]: what does the * mean?

Finfish

Carnero or candiru catfish	*Vandellia cirrhosa*
Freshwater electric eel	*Electrophorus electricus*
White amur or grass carp	*Ctenopharyngodon idella*
Walking catfish or a member of the clariidae family	Clarias, Heteropneustea, Gymnallabes, Channallabes, or Heterobranchus genera.
Piranha	All members of Serrasalmus, Rooseveltiella, and Pygocentrus genera
Stickleback	

Mexican banded tetra	
Sea lamprey	
Rudd	*Scardinius erythrophtalmu-Linneaus*
Red-bellied pacu	*Piaractus brachypomus*
Lionfish	*Pterois volitans*
Cnidarians	
hydrozoan	*Blackfordia virginica*
hydrozoan	*Cordylophora caspia*
hydrozoan	*Maeotias marginata*
hydrozoan	*Moerisia lyonsi*
hydrozoan	*Garvia franciscana*
jellyfish	*Drymonemia dalmatinum*
anemone	*Nematostella vectensis*
anemone	*Haliplanella lineate*
Annelids	
polychaete	*Fabricia sabella*
Mollusks	
pulmonate snail	*Microtralia ovula*
pulmonate snail	*Creedonia succinea*
pulmonate snail	*Myosotella myosotis*
Japanese mysterysnail	*Bellamya japonica*
Banded mysterysnail	*Viviparus georgianus*
Olive mysterysnail	*Viviparus subpurpurea*
Asian clam	*Corbicula fluminea*
Atlantic rangia	*Rangia cuneata*
Asian green mussel	*Perna viridis*
Crustaceans	
cladoceran	*Daphnia lumhotzi*
barnacle	*Balanus Amphitrite*
barnacle	*Balanus trigonus*
barnacle	*Megabalanus coccopoma*
parasitic barnacle	*Loxothylacus panopaei*
copepod	*Eurytemora affinis*
copepod	*Skistodiaptomus pallidus*
copepod	*Elaphiodella bidens bidens*
tanaid	*Sinelobus stanfordi*
isopod	*Ligia exotica*
isopod	*Synidotea laticauda (S. laevidorsalis?)*
isopod	*Paradella dianae*

isopod	*Sphaeroma terebrans*
amphipod	*Stenothoe gallensis*
amphipod	*Caprella scaura*
crayfish	*Cambarus longirostris*
Red swamp crayfish	*Procambarus clarkii*
Asian tiger shrimp	*Penaeus monodon*
Blue shrimp	*Litopanaeus stylirostris*
Pacific white shrimp	*Litopanaeus vannamei*
Bristled river shrimp	*Macrobrachium olfersii*
Green porcelain crab	*Petrolisthes armatus*
Bocourt swimming crab	*Callinectes bocourti*
rugose swimming crab	*Callinectes exasperatus*
spiny hands crab	*Charybdis hellerii*
blue landcrab	*Cardisoma guanhumi*
Ascidians	
rough sea squirt	*Styela canopus* (= *S. partita*)
Lister's encrusting tunicate	*Diplosoma listerianum*
sea grapes	*Molgula manhattensis*
Insects	
mosquito	*Aedes albopictus*
mosquito	*Ochlerotatus japonicus*
Mammals	
Nutria	*Myocastor coypus*

APPENDIX C. SUMMARY OF SOUTH CAROLINA STATE LAWS, PROGRAMS, AND REGULATIONS RELEVANT TO AQUATIC INVASIVE SPECIES

Title 46, Chapter 23 - South Carolina Noxious Weed Act

Provides far reaching powers to seize, quarantine, treat, destroy, apply other remedial measures, to export, return to shipping point, or otherwise dispose of in such a manner as (it) deems appropriate, any noxious weed or any product or article of any character whatsoever or any means of conveyance which (it) has reason to believe contains or is contaminated with any noxious weed, offered for movement, moving, or has moved into or through the state or intrastate. To further deter persons from spreading nuisance aquatic weeds the law includes fines not exceeding $500 and/or imprisonment not exceeding one year.

Title 46, Chapter 9 - State Crop Pest Act
The State Crop Pest Commission is authorized by law (Section 46-9-40) to promulgate and enforce reasonable regulations to eradicate or prevent the introduction, spread or dissemination of plant pests. Plant pests are by definition (Section 46-9-15(5)) any living state of insects, mites, nematodes, slugs, animals, protozoa, snails or other invertebrate animals, bacteria, weeds, fungi, other parasitic plants...which directly or indirectly may injure or cause disease or damage in plants...and which may be a serious agricultural threat to the State, as determined by the Director. The State Crop Pest Commission is responsible for control of plant pests which constitute a threat to production agriculture. In so doing, the Commission is the primary contact point for cooperation with the Animal and Plant Health Inspection Service (APHIS), U. S. Department of Agriculture. The Commission has designated certain organisms as plant pests. These organisms are already designated as noxious weeds by state and/or federal authorities or are under domestic federal quarantine. Once a plant pest has been designated, the Commission has the authority to impose control measures, up to and including, quarantine of the premises. However, the Director, as the Commission's designee, retains the discretion to determine that a plant pest has become so widespread that further control measures are not warranted.

Title 49, Chapter 6 - Aquatic Plant Management Act
SECTION 49-6-10. Purpose; administering agency. There is hereby created the South Carolina Aquatic Plant Management Program for the purpose of preventing, identifying, investigating, managing, and monitoring aquatic plant problems in public waters of South Carolina. The program will coordinate the receipt and distribution of available federal, state, and local funds for aquatic plant management activities and research in public waters. The Department of Natural Resources (department) is designated as the state agency to administer the Aquatic Plant Management Program and to apply for and receive grants and loans from the federal government or such other public and private sources as may be available for the Aquatic Plant Management Program and to coordinate the expenditure of such funds.

SECTION 49-6-20. Aquatic Plant Management Trust Fund.
There is created the South Carolina Aquatic Plant Management Trust Fund which must be kept separate from other funds of the State. The fund must be administered by the department for the purpose of receiving and expending funds for the prevention, management, and research of aquatic plant problems in public waters of South Carolina. Unexpended balances, including interest derived from the fund, must be carried forward each year and used for the purposes specified above. The fund shall be subject to annual audit by the Office of the State Auditor. The fund is eligible to receive appropriations of state general funds, federal funds, local government funds, and funds from private entities including donations, grants, loans, gifts, bond issues, receipts, securities, and other monetary instruments of value. All reimbursements for monies expended from this fund must be deposited in this fund.

SECTION 49-6-30. Aquatic Plant Management Council; membership; duties. There is hereby established the South Carolina Aquatic Plant Management Council, hereinafter referred to as the council, which shall be composed of ten members as follows: The council shall include one representative from each of the following agencies, to be appointed by the chief executive officer of each agency:

- Water Resources Division of the Department of Natural Resources;
- South Carolina Department of Health and Environmental Control;
- Wildlife and Freshwater Fish Division of the Department of Natural Resources;
- South Carolina Department of Agriculture;
- Coastal Division of the Department of Health and Environmental Control;
- South Carolina Public Service Authority;
- Land Resources and Conservation Districts Division of the Department of Natural Resources;
- South Carolina Department of Parks, Recreation and Tourism;
- Clemson University, Department of Fertilizer and Pesticide Control.
- The council shall include one representative from the Governor's Office, to be appointed by the Governor.

The representative of the Water Resources Division of the Department of Natural Resources shall serve as chairman of the council and shall be a voting member of the council. The council shall provide interagency coordination and serve as the principal advisory body to the department on all aspects of aquatic plant management and research. The council shall establish management policies, approve all management plans, and advise the department on research priorities.

SECTION 49-6-40. Aquatic Plant Management Plan.
The department, with advice and assistance from the council, shall develop an Aquatic Plant Management Plan for the State of South Carolina. The plan shall describe the procedures for problem site identification and analysis, selection of control methods, operational program development, and implementation of operational strategies. The plan shall also identify problem areas, prescribe management practices, and set management priorities. The plan shall be updated and amended at appropriate intervals as necessary; provided, however, problem site identification and allocation of funding shall be conducted annually. In addition, the department shall establish procedures for public input into the plan and its amendments and priorities. The public review procedures shall be an integral part of the plan development process. When deemed appropriate, the department may seek the advice and counsel of persons and organizations from the private, public, or academic sectors. The council shall review and approve all plans and amendments. Approval shall consist of a two-thirds vote of the members present. The department shall have final approval authority over those sections that do not receive two-thirds approval of the council.

SECTION 50-13-1415 -Importation, possession, or placing water hyacinth and hydrilla in waters of the state.
No person shall possess, sell, offer for sale, import, bring, or cause to be brought or imported into this State, or release or place into any waters of this State any of the following plants:
(1) Water Hyacinth

(2) Hydrilla
Provided, however, that the department may issue special import permits to qualified persons for research purposes only.
The department shall prescribe the methods, control, and restrictions which are to be adhered to by any person or his agent to whom a special permit under the provisions of this section is issued. The department is authorized to promulgate such regulations as may be necessary to effectuate the provisions of this section and the department, by regulation, is specifically authorized to prohibit additional species of plants from being imported, possessed, or sold in this State when, in the discretion of the department, such species of plants are potentially dangerous.

SECTION 50-13-1630. Importing, possessing or selling certain fish unlawful; special permits for research; Department shall issue rules and regulations.
No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into this State or release into the waters of this State the following fish:

1.carnero or candiru catfish (Vandellia cirrhosa);
2.freshwater electric eel (Electrophorus electricus);
3.white amur or grass carp (Ctenopharyngodon idella);
4.walking catfish or a member of the clariidae family (Clarias, Heteropneustea, Gymnallabes, Channallabes, or Heterobranchus genera);
5.piranha (all members of Serrasalmus, Rooseveltiella, and Pygocentrus genera);
6.stickleback;
7.Mexican banded tetra;
8.sea lamprey;
9.rudd (Scardinius erythrophtalmu-Linneaus).

The department may issue special import permits to qualified persons for research and education only..
The department may issue special permits for the stocking of nonreproducing white amur or grass carp hybrids in the waters of this State.
It is unlawful to take grass carp from waters stocked as permitted by this section. Grass carp caught must be returned to the water from which it was taken immediately.
The department must prescribe the qualifications, methods, controls, and restrictions required of a person or his agent to whom a special permit is issued. The department must condition all permits issued under this section to safeguard public safety and welfare and prevent the introduction into the wild or release of nonnative species of fish or other organisms into the waters of this State. The department may promulgate regulations necessary to effectuate this section and specifically to prohibit additional species of fish from being imported, possessed, or sold in this State when the department determines the species of fish are potentially dangerous.

APPENDIX D. SUMMARY OF FEDERAL LAWS, PROGRAMS, AND REGULATIONS RELEVANT TO AQUATICINVASIVE SPECIES

P.L. 104-332 - National Invasive Species Act of 1996
http://uscode.house.gov/download/pls/16C67.txt

P.L. 101-646 - Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
Title 7, Chapter 61- Federal Noxious Weed Act of 1974
http://uscode.house.gov/download/pls/07C61.txt
This US code expressly prohibits the interstate commerce of noxious weeds and allows for the warrant less search and seizure of said weeds. This law also deals with the required management of noxious weeds on Federal lands.
(Note the Federal Noxious Weed Act was superseded by the Plant Protection Act of 2000)
The Plant Protection Act (PPA, 7 U.S.C. 7701 et seq.) authorizes the Secretary of Agriculture to prohibit or restrict the importation, entry, exportation, or movement in interstate commerce of any plant, plant product, biological control organism, noxious weed, article, or means of conveyance if the Secretary determines that the prohibition or restriction is necessary to prevent the introduction of a plant pest or noxious weed into the United States or the dissemination of a plant pest or noxious weed within the United States. The PPA defines ''noxious weed'' as ''any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.'' The PPA also provides that the Secretary may publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or that are subject to restrictions on interstate movement within the United States. Under this authority, the Animal and Plant Health Inspection Service (APHIS) administers the noxious weeds regulations in 7 CFR part 360, which prohibit or restrict the importation and interstate movement of those plants that are designated as noxious weeds in § 360.200.

Title 18, Part 1, Chapter 3, Section 46- Transportation of Water Hyacinths
http://uscode.house.gov/download/pls/18C3.txt
(a) Whoever knowingly delivers or receives for transportation, or transports, in interstate commerce, alligator grass (*alternanthera philoxeroides*), or water chestnut plants (*trapa natans*) or water hyacinth plants (*eichhornia crassipes*) or the seeds of such grass or plants; or
(b) Whoever knowingly sells, purchases, barters, exchanges, gives, or receives any grass, plant, or seed which has been transported in violation of subsection (a); or
(c) Whoever knowingly delivers or receives for transportation, or transports, in interstate commerce, an advertisement, to sell, purchase, barter, exchange, give, or receive alligator grass or water chestnut plants or water hyacinth plants or the seeds of such grass or plants
- Shall be fined under this title, or imprisoned not more than six months, or both.

The Lacey Act (P.L. 97-79, 16 U.S.C. 3371-3378)
This law is triggered by interstate transport in conjunction with any violations of state law.
Lacey Act Amendments of 1981 (P.L. 97-79, 95 Stat. 1073, 16 U.S.C. 3371-3378, approved November 16, 1981, and as amended by P.L. 100-653, 102 Stat. 3825, approved November 14, 1988, and P.L. 98-327, 98 Stat. 271, approved June 25, 1984)

These amendments repealed the Black Bass Act and sections 43 and 44 of the Lacey Act of 1900 (18 U.S.C. 43- 44), replacing them with a single comprehensive statute.

Under this law, it is unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants taken, possessed, transported, or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.

The law covers all fish and wildlife and their parts or products, and plants protected by the Convention on International Trade in Endangered Species and those protected by State law. Commercial guiding and outfitting are considered to be a sale under the provisions of the Act.

Felony criminal sanctions are provided for violations involving imports or exports, or violations of a commercial nature in which the value of the wildlife is in excess of $350. A misdemeanor violation was established, with a fine of up to $10,000 and imprisonment of up to 1 year, or both. Civil penalties up to $10,000 were provided. However, the Criminal Fines Improvement Act of 1987 increased the fines under the Lacey Act for misdemeanors to a maximum of $100,000 for individuals and $200,000 for organizations. Maximum fines for felonies were increased to $250,000 for individuals and $500,000 for organizations.

Rewards are authorized for information leading to arrests, criminal convictions, civil penalties, or the forfeitures of property, and for payment of costs of temporary care for fish, wildlife, or plants regarding a civil or criminal proceeding. Strict liability is established for forfeiture of illegal fish, wildlife or plants, and marking requirements for shipments of fish and wildlife must conform to modern commercial practices.

Those enforcing the Act are authorized to carry firearms, make qualified warrantless arrests for felony and misdemeanor violations of any law of the U.S. when enforcing the Act, search and seize under Attorney General guidelines, issue subpoenas and warrants, inspect vessels, vehicles, aircraft, packages, crates, and containers on arrival in the United States from outside the United States or prior to departure from the United States.

Amendments to the humane shipment provisions of Title 18 required the Secretary of the Interior to issue regulations governing such activity.

As amended May 24, 1949, 18 U.S.C. 42 (63 Stat. 89, September 2, 1960; P.L. 86-702; 74 Stat. 753; and November 29, 1990, P.L. 101-646, 104 Stat. 4772) prohibits importation of wild vertebrates and other animals listed in the Act or declared by the Secretary of the Interior to be injurious to man or agriculture, wildlife resources, or otherwise, except under certain circumstances and pursuant to regulations.

APPENDIX E. SECTION 1204 OF THE NATIONAL INVASIVE SPECIES ACT OF 1996

Section 1204:

State or Interstate Invasive Species Management Plans. Invasive species management plans may be prepared by state, interstate, or Indian tribal governments for technical, enforcement, or financial assistance to reduce the risk of nonindigenous species invasions. The Department of Interior is authorized to receive $4 million/year for 6 years for state management plans.

APPENDIX F. EXECUTIVE ORDER 13112 OF FEBRUARY 3, 1999 12.1

Executive Order 13112

On Feb 3, 1999, Executive Order 13112 was signed establishing the National Invasive Species Council. The Executive Order requires that a Council of Departments dealing with invasive species be created. Currently there are 13 Departments and Agencies on the **Council.**

Executive Order 13112 of February 3, 1999 - Invasive Species (PDF | 67 KB)
Federal Register: Feb 8, 1999 (Volume 64, Number 25)

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq.*), Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C. 4701 *et seq.*), Lacey Act, as amended (18 U.S.C. 42), Federal Plant Pest Act (7 U.S.C. 150aa *et seq.*), Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 *et seq.*), Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), and other pertinent statutes, to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause, it is ordered as follows:

- **Section 1. Definitions**
- **Section 2. Federal Agency Duties**
- **Section 3. Invasive Species Council**
- **Section 4. Duties of the Invasive Species Council**
- **Section 5. Invasive Species Management Plan**
- **Section 6. Judicial Review and Administration**

Section 1. Definitions.
(a) "Alien species" means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.
(b) "Control" means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.
(c) "Ecosystem" means the complex of a community of organisms and its environment.

(d) "Federal agency" means an executive department or agency, but does not include independent establishments as defined by 5 U.S.C. 104.
(e) "Introduction" means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.
(f) "Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.
(g) "Native species" means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.
(h) "Species" means a group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.
(i) "Stakeholders" means, but is not limited to, State, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests, and private landowners.
(j) "United States" means the 50 States, the District of Columbia, Puerto Rico, Guam, and all possessions, territories, and the territorial sea of the United States.

Section 2. Federal Agency Duties.
(a) Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law,
(1) identify such actions;
(2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and
(3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.
(b) Federal agencies shall pursue the duties set forth in this section in consultation with the Invasive Species Council, consistent with the Invasive Species Management Plan and in cooperation with stakeholders, as appropriate, and, as approved by the Department of State, when Federal agencies are working with international organizations and foreign nations.

Section 3. Invasive Species Council.

(a) An Invasive Species Council (Council) is hereby established whose members shall include the Secretary of State, the Secretary of the Treasury, the Secretary of Defense, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Transportation, and the Administrator of the Environmental Protection Agency. The Council shall be Co-Chaired by the Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Commerce. The Council may invite additional Federal agency representatives to be members, including representatives from subcabinet bureaus or offices with significant responsibilities concerning invasive species, and may prescribe special procedures for their participation. The Secretary of the Interior shall, with concurrence of the Co-Chairs, appoint an Executive Director of the Council and shall provide the staff and administrative support for the Council. (b) The Secretary of the Interior shall establish an advisory committee under the Federal Advisory Committee Act, 5 U.S.C. App., to provide information and advice for consideration by the Council, and shall, after consultation with other members of the Council, appoint members of the advisory committee representing stakeholders. Among other things, the advisory committee shall recommend plans and actions at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order. The advisory committee shall act in cooperation with stakeholders and existing organizations addressing invasive species. The Department of the Interior shall provide the administrative and financial support for the advisory committee.

Section 4. Duties of the Invasive Species Council.
The Invasive Species Council shall provide national leadership regarding invasive species, and shall:
(a) oversee the implementation of this order and see that the Federal agency activities concerning invasive species are coordinated, complementary, cost-efficient, and effective, relying to the extent feasible and appropriate on existing organizations addressing invasive species, such as the Aquatic Nuisance Species Task Force, the Federal Interagency Committee for the Management of Noxious and Exotic Weeds, and the Committee on Environment and Natural Resources;
(b) encourage planning and action at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order, in cooperation with stakeholders and existing organizations addressing invasive species;
(c) develop recommendations for international cooperation in addressing invasive species;
(d) develop, in consultation with the Council on Environmental Quality, guidance to Federal agencies pursuant to the National Environmental Policy Act on prevention and control of invasive species, including the procurement, use, and maintenance of native species as they affect invasive species;
(e) facilitate development of a coordinated network among Federal agencies to document, evaluate, and monitor impacts from invasive species on the economy, the environment, and human health;

(f) facilitate establishment of a coordinated, up-to-date information-sharing system that utilizes, to the greatest extent practicable, the Internet; this system shall facilitate access to and exchange of information concerning invasive species, including, but not limited to, information on distribution and abundance of invasive species; life histories of such species and invasive characteristics; economic, environmental, and human health impacts; management techniques, and laws and programs for management, research, and public education; and

(g) prepare and issue a national Invasive Species Management Plan as set forth in section 5 of this order.

Section 5. Invasive Species Management Plan.

(a) Within 18 months after issuance of this order, the Council shall prepare and issue the first edition of a National Invasive Species Management Plan (Management Plan), which shall detail and recommend performance-oriented goals and objectives and specific measures of success for Federal agency efforts concerning invasive species. The Management Plan shall recommend specific objectives and measures for carrying out each of the Federal agency duties established in section 2(a) of this order and shall set forth steps to be taken by the Council to carry out the duties assigned to it under section 4 of this order. The Management Plan shall be developed through a public process and in consultation with Federal agencies and stakeholders.

(b) The first edition of the Management Plan shall include a review of existing and prospective approaches and authorities for preventing the introduction and spread of invasive species, including those for identifying pathways by which invasive species are introduced and for minimizing the risk of introductions via those pathways, and shall identify research needs and recommend measures to minimize the risk that introductions will occur. Such recommended measures shall provide for a science-based process to evaluate risks associated with introduction and spread of invasive species and a coordinated and systematic risk-based process to identify, monitor, and interdict pathways that may be involved in the introduction of invasive species. If recommended measures are not authorized by current law, the Council shall develop and recommend to the President through its Co-Chairs legislative proposals for necessary changes in authority.

(c) The Council shall update the Management Plan biennially and shall concurrently evaluate and report on success in achieving the goals and objectives set forth in the Management Plan. The Management Plan shall identify the personnel, other resources, and additional levels of coordination needed to achieve the Management Plan's identified goals and objectives, and the Council shall provide each edition of the Management Plan and each report on it to the Office of Management and Budget. Within 18 months after measures have been recommended by the Council in any edition of the Management Plan, each Federal agency whose action is required to implement such measures shall either take the action recommended or shall provide the Council with an explanation of why the action is not feasible. The Council shall assess the effectiveness of this order no less than once each 5 years after the order is issued and shall report to the Office of Management and Budget on whether the order should be revised.

Section 6. Judicial Review and Administration.

(a) This order is intended only to improve the internal management of the executive branch and is not intended to create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by a party against the United States, its agencies, its officers, or any other person.
(b) Executive Order 11987 of May 24, 1977, is hereby revoked.
(c) The requirements of this order do not affect the obligations of Federal agencies under 16 U.S.C. 4713 with respect to ballast water programs.
(d) The requirements of section 2(a)(3) of this order shall not apply to any action of the Department of State or Department of Defense if the Secretary of State or the Secretary of Defense finds that exemption from such requirements is necessary for foreign policy or national security reasons.

WILLIAM J. CLINTON
THE WHITE HOUSE,
February 3, 1999.

APPENDIX G. SUMMARY OF INTERNATIONAL LAWS AND TREATIES RELEVANT TO AQUATIC INVASIVE SPECIES

International Laws

Codex Alimentarius Commission

The United Nations' Food and Agricultural Organization (FAO) and the World Health Organization
(WHO) created the Codex Alimentarius Commission (Codex) in 1962.1 The purpose of the Codex is to encourage fair international trade in food while promoting the health and economic interests of consumers.2 In the United States, Codex activities are coordinated by the USDA, EPA, and Food and Drug Administration.3 Volume 1A of the Codex empowers the Commission to created specialized committees. One such committee that relates to invasive species is the Committee on Import/Export Inspection and Certification Systems.4 To fulfill its goal of protecting consumer health in the area of food safety. The Codex has formulated standards for specific food commodities, pesticide and drug residues, food contaminants and additives, labeling, and food safety.5 Invasive species are relevant to the
Codex if they threaten food safety or the international food trade.

Convention on Biological Diversity

The Convention on Biological Diversity (CBD) recognizes the importance of "ecological, genetic, social, economic, scientific, educational, cultural, recreational, and aesthetic" values of biological diversity throughout the world.6 Countries have rights over their own biological resources, but also have the responsibility of conserving them and using them in a sustainable manner.7 A fundamental requirement for the conservation of biological diversity is In-Situ conservation. 8 The CBD recognizes the need to "prevent the introduction of and control or eradicate those alien species which threaten ecosystems, habitats, or species."9 The CDB has a program to target introduction of invasive species.10 The Global Invasive Species Programme works with the CBD to provide expertise through the CBD's Subsidiary Body on Science, Technology, and Technical Assistance.11 The United States has not ratified the agreement.

Convention on International Trade in Endangered Species of Wild Flora and Fauna

The purpose of The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) is to foster international cooperation in order to protect certain species of flora and fauna from over-exploitation through international trade.12 CITES divides species of wild flora and fauna into three appendices. Trade of any species in Appendices I, II, or III is prohibited, except in accordance with provisions set forth in CITES.13 Trade of species included in Appendices I, II, and III are regulated through a system of import, export, and re-export permits.14

1 *See* Food Safety and Inspection Service U.S. Codex Office, Codex Alimentarius Commission. Retrieved 17 February 2003 from
www.fsis.usda.gov/OA/codex/.
2 *See id.*
3 *See id.*
4 *See* FAO/WHO Food Standards, Codex Alimentarius. Retrieved 17 February 2003 from www.codexalimentarius.net/.
5 *See id.*
6 Convention on Biological Diversity, June 5, 1002, Preamble.
7 *See id.*
8 In-Situ conservation means "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties." *Id.* Article 2.
9 *Id.* Article 2(h).
10 *See* Convention on Biological Diversity, Alien Species Introduction. Retrieved 17 February 2003 from
www.biodiv.org/programmes/cross-cutting/alien/.
11 *See* Convention on Biological Diversity, Alien Species Introduction. Retrieved 17 February 2003 from
www.biodiv.org/programmes/cross-cutting/alien/gisp.asp.
12 *See* Convention on International Trade of Endangered Species of Wild Flora and Fauna, March 3, 1973, Preamble.
13 *See id.* Article II.4.
14 *See id.* Article III.2, III.3, and III.4. See also Article IV.2, IV.3, IV.4, and IV.5 and Article V.2, V.3, and V.4.

Appendix I includes species threatened with extinction that are or may be affected by trade.

Trading members of these species are the most strictly regulated in order not to further endanger their survival.15 For these species, trade is authorized in only "exceptional" circumstances.16 Appendix II includes species that currently are not threatened with extinction, but would become so threatened without strict regulation.17 Appendix II also recognizes that trade in other species also must be regulated in order to effectively protect species included in Appendix II.18

Appendix III includes all species that any Party to CITES declares to be subject to regulation within its jurisdiction to prevent or restrict exploitation, and "as needing cooperation of other parties in the control of trade."19

Office of International Epizootics

The Office of International Epizootics (OIE) is an international organization created by agreement in 1924. Its purposes are to guarantee the transparency of animal diseases worldwide; to collect, analyze, and disseminate veterinary scientific information; to provide expertise and promote international solidarity for the control of animal diseases; and to guarantee the sanitary safety of world trade by developing sanitary rules for international trade in animals and animal products.20 The OIE collects and disseminates information through cooperation between Member Countries. Each Member reports to the OIE animal diseases that it identifies within its territory.21 The OIE thereby disseminates this information to other Members so that each may act upon this information accordingly.22 The OIE provides technical support to Member Countries that request assistance in controlling and eradicating animal diseases.23 The OIE also creates "normative documents relating to rules that Member Countries can use to protect themselves from diseases without setting unjustified sanitary barriers."24 Such normative documents include the International Animal Health Code25 and Manual Standards for Diagnostic Tests and Vaccines.26 While the OIE generally focuses on issues such as livestock diseases and developing standards for diagnostic tests and vaccines, it recently has started to focus on diseases affecting wildlife, including aquatic species, by publishing its International Aquatic Animal Health Code.27

International Plant Protection Convention

The purpose of the International Plant Protection Convention (IPPC) is to prevent the introduction and spread of pests of plants and plant products and to promote appropriate control measures.28 The IPPC was adopted in 1951 and was revised in November 1997. However, the 1997 revision, while adopted, is not yet in force.29 Under the IPPC, each contracting party agrees to cooperate with each other to prevent the introduction of plant pests and diseases and prevent their spread across national boundaries.30 The Food and Agriculture Organization of the United Nations

15 *See id.* Article II.1.

16 *Id.*

17 *See id.* Article II.2(a).

18 *See id.* Article II.2(b).

19 *See id.* Article II.3.

20 *See* Office of International Epizootics, What is the OIE?. Retrieved 17 February 2003 from www.oie.int/eng/OIE/en_oie.htm.

21 *See id.*

22 *See id.*
23 *See id.*
24 *See id.*
25 *See* Office of International Epizootics, Terrestrial Animal Health Code 2003. Retrieved 25 July 2003 from www.oie.int/eng/normes/mcode/A_summry.htm.
26 *See* Office of International Epizootics, Manual Standards for Diagnostic Tests and Vaccines 2000. Retrieved 28 February 2003 from www.oie.int/eng/normes/mmanual/A_summry.htm.
27 *See* Office of International Epizootics, International Aquatic Animal Health Code 2002. Retrieved 28 February 2003 from www.oie.int/eng/normes/fcode/A_summry.htm.
28 *See* International Plant Protection Convention, December 6, 1951, current text adopted in 1979, Article I.1.
29 *See* International Phytosanitary Portal, Documents and Publications. Retrieved 3 March 2003 from www.ippc.int/cds_ippc_prod/IPP/En/publications.htm.
30 *See* International Plant Protection Convention, December 5, 1951, current text adopted in 1979, Preamble. disseminates information on import restrictions, requirements, prohibitions, and regulations to all contracting parties and regional plant protection organizations.
31 Each contracting party is responsible for creating a national plant organization to carry out the provisions of the IPPC, such as inspection of consignments of plants and plant products moving in international traffic that may carry pests and diseases and protecting endangered areas.
32 If necessary for phytosanitary conditions, contracting parties may regulate the entry of plants into their territories by setting requirements of importation; prohibiting importation of specific plants; inspecting and detaining specific plants; and treating, destroying, or refusing entry to specific plants.
33 However, contracting parties shall not take measure more stringent than necessary to accomplish the goals of the IPPC in order to minimize interference with international trade.
34

North American Free Trade Agreement

The main objectives of the North American Free Trade Agreement (NAFTA) are to eliminate trade barriers and to promote fair competition between the Parties to the Agreement.35 NAFTA requires that each Party to the greatest extent practicable, participate in international and North American standardizing organizations, such as the Codex, OIE, IPPC, and North American Plant Protection Organization, to promote the "development and periodic review of international standards, guidelines and recommendations."
36 Chapter 7 relates to invasive species. It allows each Party to adopt sanitary or phytosanitary measures necessary for the protection of human, animal, or plant life or health in its territory.37 Such measures may be more stringent than international standards, guidelines, or recommendations.38 Such measures should be based on research and risk assessment.39 However, measures should not arbitrarily or unjustifiably discriminate against another Party's goods.40 Furthermore, in conducting risk assessments in order to determine appropriate measures of protection, one of the factors

that the Parties must take into account is "the prevalence of relevant diseases or pests, including the existence of pest-free or disease-free areas or areas of low pest or disease prevalence."41

World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures

The Sanitary and Phytosanitary Measures Agreement (SPS Agreement) is a supplement to the World Trade Organization Agreement. It encourages Members to adopt measures necessary to protect human, animal or plant life or health.42 However, such measures should not arbitrarily or unjustifiably discriminate against Members that experience the same conditions in their territories or be disguised as a restriction on international trade.43 The SPS Agreement also encourages Members to use other international guidelines, such as the Codex, OIE, and IPPC44 to promote within these organizations the development and periodic review of standards, guidelines, and recommendations with respect to all aspects of sanitary and phytosanitary measures.45 The SPS Agreement Members should conduct scientific research and collect evidence in order to set appropriate levels of sanitary and phytosanitary protection with the least impact on international

31 *See id.* Article VI.4.
32 *See id.* Article IV.1(a)(i), (ii).
33 *See id.* Article VI.1.
34 *See id.* Article VI.2.
35 *See* North American Free Trade Agreement, 17 December 1992, Article 102.
36 *Id.* Chapter 7, § B, Art. 713(5).
37 *See id.* Chapter 7, § B, Art. 712(1).
38 *See id.*
39 *See id.* Chapter 7, § B, Art. 715(1).
40 *See id.* Chapter 7, § B, Art. 712(4))
41 *Id.* Chapter 7, § B, Art.715(1)(e).
42 *See* Agreement on Sanitary and Phytosanitary Measures, 15 April 1994, Preamble.
43 *See id.* Article 5.5.
44 *See id.* Preamble. *See also* Article 3.4.
45 *See id.* Article 3.4.

trade.46 Such evidence includes the prevalence of specific diseases or pests, existence of pest-free or disease-free areas, relevant ecological and environmental conditions, and quarantine or other treatment.47

APPENDIX H. PUBLIC COMMENTS RECEIVED AND RESPONSES

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A Review of the Biology and Management of Blue Catfish

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Abstract.—Blue catfish *Ictalurus furcatus* are a big river species, native to major rivers of the Mississippi River basin and Gulf Coast streams of the central and southern United States, south into Mexico, northern Guatemala, and Belize. Blue catfish are native in 20 states and have been introduced into nine others, mostly along the Gulf, Atlantic, and Pacific slopes. Blue catfish are largest of the ictalurid catfishes, sometimes exceeding 45 kg and 165 cm, and can live over 20 years. Numbers in their native range have been greatly reduced because of alteration of riverine habitats, particularly on the periphery of their range. Blue catfish are migratory and prefer open waters of large reservoirs and main channels, backwaters, and flowing rivers with strong current where water is normally turbid. This species occurs over substrate varying from gravel/sand to silt/mud. Blue catfish are opportunistic omnivores but adults eat a variety of animal life, including fish. Sexual maturity is usually attained at 4–7 years, and rapid growth is exhibited throughout life. Estimates of total annual mortality range from 12 to 63%. Blue catfish are presently not popular with aquaculturists, but hybrids developed with channel catfish *I. punctatus* are often used in fee-fishing lakes because of their rapid growth and aggressive disposition. Blue catfish support sport fisheries in seven states, whereas 14 additional states reported that they support both sport and commercial fisheries. About one-half of the 29 states reporting blue catfish as present consider them economically and recreationally valuable. Nine states reported they add diversity to existing fish populations, two manage them to develop quality or trophy fisheries, and seven manage blue catfish for both.

Blue catfish *Ictalurus furcatus* are native to the Mississippi, Missouri, and Ohio River basins of central and southern United States, and occupy Gulf Coast streams from Alabama south into Mexico, and northern Guatemala (Glodek 1980), and Belize (Greenfield and Thomerson 1997). During the past 30 years they have been stocked into both Atlantic and Pacific drainages. Blue catfish are considered a big-river species. There is controversy over the physical appearance of blue catfish from various portions of their native range because early workers were confused by very large catfishes and described the same species several times (Smith 1979), and blue catfish from the Rio Grande River were considered a subspecies (Knapp 1953). Previously, two subspecies were recognized: *I. f. furcatus* in the central United States and northern Mexico, and *I. f. meridionalis* in eastern Mexico and Guatemala (Jordan and Evermann 1896), however Lundberg (1992) considers *I. f. meriionalis* conspecific with *furcatus*. Recently, angling for blue catfish has become popular and several fishing-related television shows and sporting magazines routinely address quality blue catfish sportfisheries.

This paper summarizes the general biology and life history of blue catfish, from a comprehensive literature review, and from personal knowledge gained from nearly 30 years of research on big river species, including blue catfish. As I searched for references, I was surprised at the shortage of technical reports discussing life history and biology of the species. I suspect that the shortage of information on blue catfish results from the difficulty of adequately sampling big river habitats. I also surveyed 48 state natural resource agencies about the status of blue catfish.

Description

Blue catfish are the largest catfish in the United States. The only freshwater fishes that reach larger maximum sizes are alligator gar *Lepisosteus spatula*, lake sturgeon *Acipenser fulvescens*, and white sturgeon *A. transmontanus*. The current pole and line record is 50.3 kg, from below Wheeler Reservoir, Alabama, in 1996, however several states reported that larger blue catfish have unofficially been caught. Few authors provide total lengths, however Cross (1967) reports a 139.7 cm, 40.5 kg blue catfish from the Osage River in Missouri, in 1963, and a 165.1 cm, 45.2 kg blue catfish from the Missouri River in South Dakota, in 1964. Like other catfishes, the blue catfish is often described by several common names, depending upon locality. Common names include: white cat, white fulton, fulton, humpback blue, forktail cat, and blue channel catfish. They are similar to channel catfish *Ictalurus punctatus* in appearance, but differ in never having dark spots on their

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back and sides (Pflieger 1997). Blue catfish in the Rio Grande River, Texas, reportedly differ from other blue catfish in that the juvenile and young are quite speckled and many adults retain their spots (Wilcox 1960). Knapp (1953) reported that Rio Grande River blue catfish have 35–36 anal fin rays, rather than the usual 30–35. A major difference between blue catfish and channel catfish is the configuration of the air bladder (Pflieger 1997). The air bladder of blue catfish has a definite constriction giving it a two-lobed appearance, whereas the air bladder in channel catfish is without constriction. Blue catfish can be distinguished from channel catfish by the anal fin which contains more rays (usually 30–35) and its outer margin is straight and tapered like a barber's comb. Their tail is deeply forked, hence the Latin name, *furcatus*, or forked, in reference to the tail. Pflieger (1997) describes blue catfish as displaying a distinctive wedge-shaped appearance because of the high profile of the back near the dorsal fin. Unlike the flathead catfish *Pylodictis olivaris*, which also reaches large sizes, the lower jaw of blue catfish never protrudes beyond the upper jaw. Color can be variable, depending upon water clarity, but most blue catfish larger than about 4.5 kg are pale bluish-silver on the back and sides, grading to silver-white on the sides and white on the belly. Young fish, 50–100 mm, are often nearly transparent, and immature blue catfish, 250–450 mm, are usually more silver or silver-white than adults, hence the common name, "white cat."

Distribution

Twenty-nine states reported having blue catfish and 17 did not (Figure 1). Minnesota and Pennsylvania considered the species extirpated. Pennsylvania indicated that blue catfish were last reported in the Monongahela River in 1886, and Minnesota reported that they were once present in the Mississippi and Minnesota rivers. In 1977, several thousand were stocked in Lake St. Croix, Minnesota, and two were captured the next year. Since then, no blue catfish have been reported in Minnesota, and they are currently considered a species of special concern.

The current distribution of blue catfish in the United States is within the Mississippi River Basin, and the Atlantic, Pacific, and Gulf coastal slopes (Figure 1). States not recording them are those in the northeastern United States outside of the Ohio River basin, the Great Lake states of Michigan and Wisconsin, most Rocky Mountain states, and North Dakota. During the Lewis and Clark expedition into Montana, an interesting observation was made 22 May 1805: "Game was no longer in such abundance since leaving the Musselshell and few fish were caught and these were white catfish weighing two to five pounds" (Coues 1965).

Sixteen states considered blue catfish to have restricted distribution, while 13 states reported wide distribution (Figure 1). Most of the states reporting wide distribution are in the central and southeastern United States. North Carolina reported that their

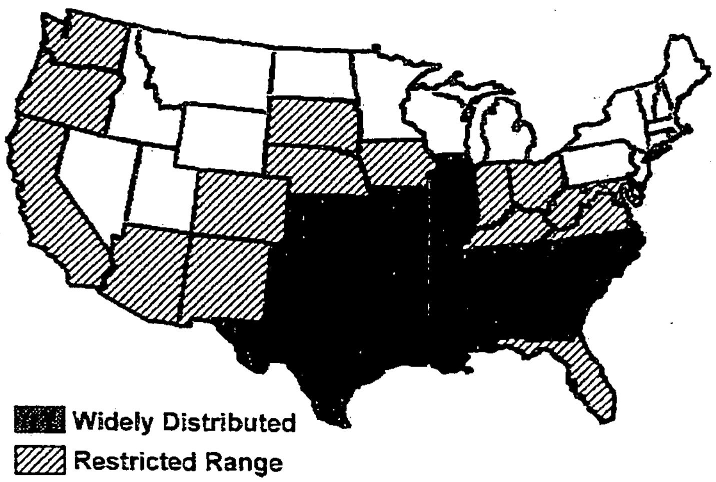

FIGURE 1. Distribution of blue catfish in the conterminous United States.

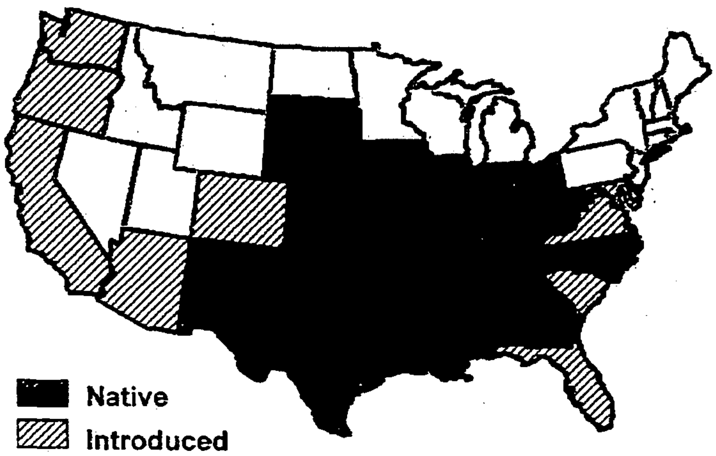

FIGURE 2. Classification of blue catfish as native or introduced in the conterminous United States.

native range of blue catfish is increasing within the state. States reporting restricted distribution are those bordering the Ohio River, upper Missouri River, west coast, and southwestern states. Many of the states reporting restricted distribution, including most of the southwestern and western states and Florida, have small populations resulting from introductions.

Virginia reported that blue catfish were introduced in 1974, and that sport anglers indicate that blue catfish may be replacing native channel catfish populations in some areas of the state. Twenty states reported blue catfish native, while nine indicated that blue catfish in their respective states were introduced (Figure 2). Most of the central, southern, and southeastern states report native populations of blue catfish. Western and southwestern states of Washington, Oregon, California, Arizona, Colorado, and eastern and southeastern states of Maryland, Virginia, South Carolina, and Florida have introduced blue catfish. Washington and Oregon apparently introduced blue catfish into the Snake River in the early 1900s, however they are presently extremely rare in both states. California stocked them into large reservoirs in the southern portion of the state in 1969. They adapted well and currently provide sport fisheries. Also, aquaculturists have developed hybrids with channel catfish and routinely stock them in fee fishing lakes. Arizona stocked blue catfish in a private pond in 1981 and report that they have never stocked them in public waters, however they are known to exist in extremely low numbers in the Colorado River system. Blue catfish were stocked into reservoirs in the eastern portion of Colorado in the Arkansas River drainage in 1982. They were also stocked into the Chesapeake Bay drainage in Virginia in 1974, in the Potomac River in Maryland sometime between 1898 and 1905, and in the Escambia River drainage in Florida, however these Florida introductions were probably the result of escapees from Alabama, rather than physical introductions. One of the most popular blue catfish fisheries is in Santee-Cooper Reservoir in South Carolina where blue catfish were introduced, beginning in 1965.

Historical perspective

Records of large catfish date back to the Lewis and Clark exploration of the Missouri River. They described large "white" catfish, undoubtedly blue catfish, reaching nearly 1.5 m in length. Heckman (1950), in his *Steamboating Sixty-Five Years on Missouri's Rivers*, provides the following account: "Of interest to fishermen is the fact that the largest known fish ever caught in the Missouri River was taken just below Portland, Missouri. This fish, caught in 1866, was a blue channel cat and weighed 315 lb. It provided the biggest sensation of those days all through Chamois and Morrison Bottoms. Another 'fish sensation' was brought in about 1868 when two men, Sholten and New, brought into Hermann, Missouri, a blue channel cat that tipped the scales at 242 lb." Heckman provides other evidence that it was common to catch catfish weighing 125–200 lb from the Missouri River during the mid 1800s. Even Mark Twain, talked about seeing "a Mississippi catfish that was more than six feet long" (Coues 1965).

In November 1879, the U.S. National Museum received a blue catfish weighing 150 lb from the Mississippi River near St. Louis. The fish was sent by Dr. J. G. W. Steedman, chairman of the Missouri Fish Commission, who purchased it in the St. Louis fish market. The following quote from a letter from Dr. Steedman to Professor Spencer F. Baird, U.S. Commissioner of Fish and Fisheries, suggests that catfish of this size were not uncommon. "Your letter requesting shipment to you of a large Mississippi catfish was received this morning. Upon visiting our market this afternoon, I luckily found two—one of 144 lbs, the other 150 lbs. The latter I shipped to you by express."

Habitat

Blue catfish prefer open waters of large reservoirs and main channels, backwaters, and embayments of large, flowing rivers where water is normally turbid and substrate varies from gravel-sand to silt-mud (Burr and Warren 1986). Many rivers and reservoirs with blue catfish populations have only mud or silt substrate. Blue catfish prefer deep, swift channels and flowing pools (Jenkins and Burkhead 1994), and large specimens were often found in tailwaters below dams where currents were swift and substrates consist of sand, gravel, and rock (Mettee et al. 1996). Fish from these habitats are extremely difficult to sample. Their affinity for swift water and deep channels explains why blue catfish life history is not well known. Although these catfish can be stocked into small reservoirs to develop specialized fisheries (Fischer et al. 1999, this volume), they are well suited to large, open-water reservoirs, especially those with gizzard shad *Dorosoma cepedianum* as forage (Graham and DeiSanti 1999, this volume). Blue catfish tolerate moderately high levels of salinity and can be grown in coastal waters which does not exceed 8 ppt salinity for any extended period of time (Perry and Avault 1970), however they can tolerate salinity in estuaries to 11 ppt (Perry 1968), and in some waters at 14 ppt (Allen and Avault 1970).

In twelve states, blue catfish are found primarily in riverine habitats (Figure 3). All of these states, except Florida and Washington, border the middle and upper Missouri River or the northern borders of the Ohio River and northeastern Atlantic slope states. In Colorado and California, blue catfish are found in reservoirs, and most of the states in the lower Mississippi River basin, Gulf slope states, and southeastern Atlantic slope states (14 states) reported that they are found in both rivers and reservoirs.

Movement

Blue catfish are the most migratory of the ictalurid catfish, moving upstream in the spring and downstream in the fall (Lagler 1961) in response to water temperature (Pflieger 1997). They move farther down the lower Mississippi River where water is warmest in winter, and upstream in summer (Jordan and Evermann 1916). These migratory movements can span several hundred km. Blue catfish moved considerably more during spring than any other season in a 97-ha reservoir in

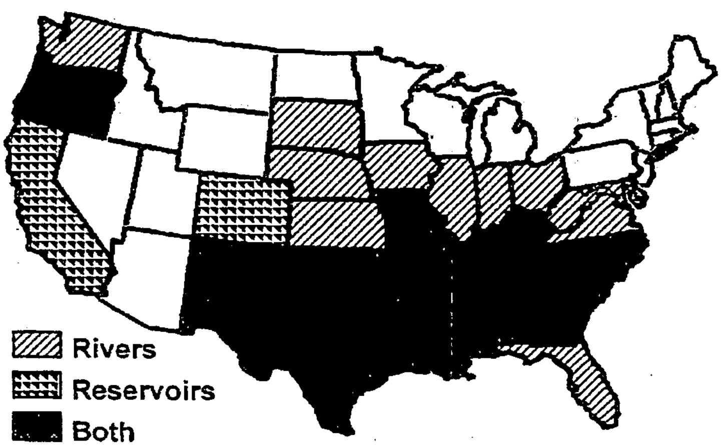

FIGURE 3. Primary waters with blue catfish in the conterminous United States.

northwestern Missouri (Fischer et al. 1999). In Lake of the Ozarks, Missouri, 75 of 1,500 (5%) stocked blue catfish emigrated and were captured downstream by anglers (Graham and DeiSanti 1999). Forty percent of nearly 3,000 tagged blue catfish moved more than 16 km from their original point of capture. In Kentucky Lake, Kentucky-Tennessee, a greater number of tagged blue catfish moved upstream than down and their mean distance traveled during the eight-year study (23.6 km) was more than twice that of channel catfish (Timmons 1999, this volume). Blue catfish in the lower Mississippi River moved 5–12 km from their release site after 363–635 d, and were more mobile than flathead catfish (Pugh and Schramm 1999, this volume). Pugh and Schramm also report that because of the fishes ability to move great distances, blue catfish management plans should consider a broad spatial scale. Long-range movements, both upstream and downstream, are common for large individuals as they seek spawning sites.

Diet and feeding

A few published studies on food habits suggest blue catfish were opportunistic and omnivorous feeders. Blue catfish consume a variety of animal life, including fishes, immature aquatic insects, crayfish, fingernail clams, and freshwater mussels (Brown and Dendy 1961; Minckley 1962; Perry 1969). In California reservoirs, they were reported to eat Asiatic clams *Corbicula fluminea* (Richardson et al. 1970). Pflieger (1997) reported that blue catfish as small as 100 mm ate some fish, but the bulk of their diet was small invertebrates. Larger individuals, about 290 mm, ate mostly fish and larger invertebrates (Perry 1969). In many large southern reservoirs, the diet of large blue catfish was mostly gizzard shad or threadfin shad *Dorosoma petenense*. Biologists along the upper Mississippi River in Missouri, reported that blue catfish were so gorged on freshwater mussels one could see and feel mussel shells protruding from the stomach wall. The senses of taste and smell are more important than sight in locating food (Robison and Buchanan 1988; Pflieger 1997); and Pflieger (1997) suggested blue catfish feed mostly on or near the bottom and to a lesser extent in the midwater. In clear-water reservoirs, or tailwaters, blue catfish capture their prey by sight. Mark Ambler (Oklahoma Department of Wildlife Conservation, personal communication) reported that blue catfish often suspend in deep water beneath schools of gizzard shad being fed upon by striped bass *Morone saxatilis*, and seek and eat wounded and dead shad. Before sophisticated fish-locating electronics, these large catfish, often suspended 20 m from the bottom, were inaccessible to anglers. Similarly, blue catfish eat wounded gizzard shad after they pass through the turbines of Harry S Truman Dam (Graham and DeiSanti 1999).

Sexual maturity and spawning

Maturity is generally reached at an earlier age in the southern portion of their range than in the north. Blue catfish mature at 4 or 5 years and at total lengths of 350–662 mm in Louisiana (Perry and Carver 1973); Texas (Henderson 1972); and Kentucky (Hale 1987; Hale and Timmons 1989). In the Mississippi River near St. Louis, blue catfish become sexually mature at about 381 mm (Barnickol and Starrett 1951). Based on lengths of blue catfish captured in upper Lake of the Ozarks, Missouri, sexual maturity is 420–480 mm, but at ages of 6–7 years (Graham and DeiSanti 1999). In Louisiana, blue catfish spawn in April through June (Perry and Carver 1973), and early July in Iowa (Harlan et al. 1987).

The genital orifices of the two sexes are distinct (Moyle 1976). He reported that in the male, the papilla is more prominent with a circular opening; in the female, it is more recessed and the opening slitlike. The testes of ictalurid catfishes are morphologically different from most warmwater fishes in that the glands are lobate and not compacted into a solid-appearing gland (Sneed and Clemens 1963). They also report that the posterior one-fourth of the testes is reduced and retains a pink color throughout the year, but the anterior three-fourths becomes progressively larger and whiter as the spawning season approaches. Brooks et al. (1982) report that when grading blue catfish (6- and 18-month-old individuals) for future broodstock use, the sex ratio was equal during simple grading for the largest individuals, whereas when grading for the largest channel catfish of the same age, the sex ratio was dominantly males. They also report that the weight-frequency distributions for 6- and 18-month-old blue catfish were similar, but channel catfish males were larger than females.

Spawning habits are relatively unknown (Lagler 1961), but are believed to be similar to those of channel catfish (Pflieger 1997; Hubert 1999, this volume). The species is a cavity nester. Blue catfish seek protected areas behind rocks, root-wads, depressions, under cut streambanks, or other areas where the currents are minimal to deposit eggs. Coker (1930) reports that mature eggs of blue catfish attain a diameter of 2.5 mm, whereas mature ova of 7–9 kg female blue catfish were 3.0–3.3 mm in diameter (R. Dunham, Auburn University, personal communication). He also stated that clutches of blue catfish fry from spawns in ponds contained between 40,000 and 50,000 individuals. Hatching of eggs occurs in 7 or 8 d at water temperatures of 21°C to 24°C (Henderson 1972; Pflieger 1997), and like most other ictalurid catfishes, the male guards the eggs and fry. Hatching success for blue catfish was estimated at 90%, and fry production per kg of female was higher for blue catfish than for channel catfish (Tave and Smitherman 1982). Fecundity estimates were from 900 to 1,350 eggs/kg of body weight (Dunham, personal communication).

Survival and mortality

There was little information documenting mortality of blue catfish, however, Kelley (1969) reported a total annual mortality of blue catfish at 39% from Tombigbee River, Alabama. In upper Lake of the Ozarks, Missouri, blue catfish began to enter the harvest at about 6 years of age and can contribute to the sportfishery until they are 18 years of age (Graham and DeiSanti 1999). Total annual mortality estimates for this population ranged from 12 to 32%. Because of rapid growth rates, these fish have the capability to reach large sizes and provide high quality fisheries. Estimates of mortality for blue catfish from Lake of the Ozarks were less than the 36–63% reported from Kentucky Lake, Tennessee (Hale 1987). Hale also reported that catfish from Kentucky Lake began entering the harvest at ages 4 and 5 and contributed to the fishery until they were 13 years of age.

Age and growth

Blue catfish growth is rapid, particularly after they become piscivorous. Blue catfish growth rates in upper Lake of the Ozarks, Missouri, were relatively consistant between ages and sizes (Graham and DeiSanti 1999). Growth of blue catfish in rivers and reservoirs can be similar, if forage is adequate. Growth rates of blue catfish in Lake Texoma, Oklahoma, were reported to be more rapid than channel catfish and nearly equal to flathead catfish (Jenkins 1956).

During the past 25 years, I have aged several blue catfish from Missouri waters that exceeded 40 kg and 20 years. I determined catfish age and growth rates by examining annual growth marks on sections cut from pectoral spines, then back-calculated annual growth (Marzolf 1955). Structures other than pectoral spines that are sometimes used for aging include: opercular bones, vertebrae, and dorsal spines (Ramsey and Graham 1991). Increased growing season, warmer water, and often times, a more diverse forage base contribute to faster growth in southern regions. Lengths at age for blue catfish from several states (Table 1)

TABLE 1. Comparison of mean lengths (mm) of aged blue catfish from various populations and locations.

State	Tennessee	Tennessee	Tennessee	Kentucky	Kentucky	Kentucky	Kentucky
Location	Tennessee River[a]	Kentucky Lake[b]	Kentucky Lake[b]	Kentucky Lake[c]	Kentucky Lake[d]	Kentucky Lake[e]	Barkley Lake[d]
Age 1	135	142	145	132	76	117	76
2	198	229	239	221	165	213	188
3	252	287	295	274	239	310	302
4	297	343	356	318	302	391	376
5	356	401	427	363	311	480	455
6	429	447	483	424	432	559	584
7	513	500	551	485	483	627	658
8	582	423	627	549	564		
9	699	551	671	584	666		
10	846	587		607			
11				693			
12				737			
13				813			
Number of fish	134	369	467	655	492	756	115

provides comparison, however caution must be used because of differences in lengths of growing seasons, ages of fish used in back-calculations, and physical and chemical characteristics of the aquatic environments. Blue catfish in the Rio Grande River, Texas, grew at a faster rate than fish in the 3-year-old Amistad Reservoir, Texas (Henderson 1972), however, fish from different sites within the reservoir grew at different rates. Jenkins (1956) attributed decreasing growth rates of blue catfish through 9 years in Lake Texoma, Oklahoma, to inter-specific competition that occurred as the fish community reached carrying capacity. Intra-specific competition caused slow growth of blue catfish in Kentucky Lake, Kentucky (Conder and Hoffarth 1965), whereas growth impairment of blue catfish in Kentucky Lake were believed to be caused by both intra- and inter-specific competition (Freeze 1977). The fastest growth rates for Kentucky Lake blue catfish are believed to be in areas where intra-specific competition was reduced by high harvest (Hale 1987).

In Oklahoma (Jenkins 1956) and Missouri (Graham and DeiSanti 1999), blue catfish typically grew faster than channel catfish after the first two years. In Missouri, growth rates remain consistant among years through age 18 (Figure 4). Porter (1969) revealed that blue catfish in Kentucky Lake, Tennessee, grew faster than channel catfish, but displayed a slow, declining growth rate. In another Kentucky Lake study, blue catfish exhibited slow growth between ages 3 and 7 (Conder and Hoffarth 1965), whereas average lengths of age 7 blue catfish in Barkley and Kentucky lakes were 12 and 4% greater, respectively, than age 7 channel catfish (Freeze 1977). No significant differences in growth patterns were found between sexes for blue catfish (Hale 1987; Hale and Timmons 1990).

Population declines

Although populations of blue catfish are present in several areas of the United States, primarily in southern and southeastern states, blue catfish num-

TABLE 1. (continued.)

State	Alabama	Louisiana	Oklahoma	Texas	South Carolina	South Carolina	Missouri
Location	Tombigbee River[f]	Mississippi River Delta[g]	Lake Texoma[h]	Rio Grande River[i]	Santee-Cooper Lake[j]	Santee-Cooper Lake[k]	Lake of the Ozarks[l]
Age 1	125	191	145	175	168		105
2	221	386	254	262	307	262	178
3	338	508	351	282	427	325	243
4	450	638	442	373	554	381	309
5	508	749	533	406	696	429	371
6	612	848	655	465	840	460	426
7	693		770		958	508	484
8	803		871		955	546	542
9	942		1,026				600
10	930		1,069				657
11	986		1,118				708
12	1,041						762
13	1,067						807
14							869
15							923
16							1,032
17							956
18							923
Number of fish	122	57	190	103	93		2,389

[a]Conder and Hoffarth (1965)
[b]Hale and Timmons (1990)
[c]Hale and Timmons (1989)
[d]Freeze (1977)
[e]Porter (1969)
[f]Kelley (1969)
[g]Kelley and Carver (1966)
[h]Jenkins (1956)
[i]Henderson (1972)
[j]White and Lamprecht (1990)
[k]White (1980)
[l]Graham and DeiSanti (1999)

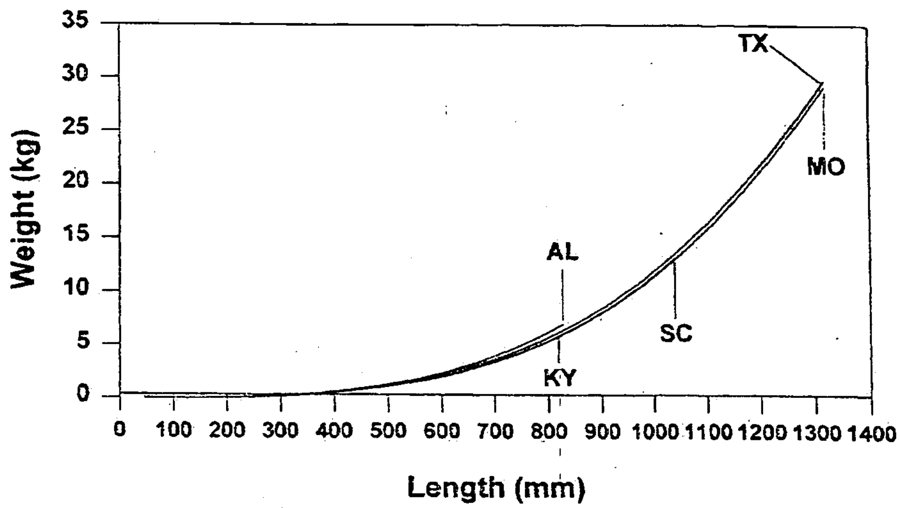

FIGURE 4. Length-weight relations for blue catfish from Alabama ($\log_{10}W = -6.000 + 3.354 \cdot \log_{10}L$, N = 1,073), Kentucky ($\log_{10}W = -5.921 + 3.342 \cdot \log_{10}L$, N = 306), Missouri ($\log_{10}W = -6.023 + 3.283 \cdot \log_{10}L$, N = 7,725), South Carolina ($\log_{10}W = -6.155 + 3.406 \cdot \log_{10}L$, N = 3,147), and Texas ($\log_{10}W = -6.279 + 3.368 \cdot \log_{10}L$, N = 10,960). Slopes for relationships from Kentucky and South Carolina overlay Missouri's. State labels designate maximum size. $r^2 \geq 0.98$ for all relations.

bers are greatly reduced in waters in the periphery of its native range. Declines are often associated with aquatic habitat modification (stream channelization), increased turbidity and siltation, changes in flow regimes, drainage of natural standing water habitats, industrial and domestic pollutants, pesticides, and construction of impoundments. Before construction of impoundments on the upper Missouri River and navigational locks and dams on the upper Mississippi and Ohio rivers, numbers of blue catfish were higher. Trautman (1981) reports, "...it is obvious that the readily-identifiable 'Mississippi' or 'White' catfish was present before 1900 in the Ohio River between the Indiana state line and Belmont County. The fishermen are in universal agreement that blue catfish were far more abundant before the Ohio River was ponded (before 1911) than it has been since, at least many more fishes were caught before than after ponding." The reduction in numbers of blue catfish is directly correlated with the effort to remove snags from the Missouri River to enhance early steamboat travel (Hesse 1987). Hesse also reports that channelization severely reduces the amount of shallow water along a river, and confines fish to a narrow, limited amount of habitat. Additionally, blue catfish are apparently more sensitive to low dissolved oxygen than channel catfish because they surface before channel catfish in fish kills resulting from low oxygen. According to sport anglers, blue catfish are found dead more often than channel catfish when harvested using trotlines in reservoirs having thermoclines (R. Dent, Missouri Department of Conservation, personal communication).

Fisheries

Because of their renowned qualities as a food fish, sport and commercial fisheries are popular in several states, and blue catfish are often found in fish markets. Forbes and Richardson (1920) reported that the flesh is of excellent quality and demands a high price. According to Pflieger (1997), blue catfish is a highly valued food fish because of its large size and firm, well-flavored flesh. Blue catfish provide sport fisheries in seven states: the four midwestern states of Nebraska, Kansas, Oklahoma, and Colorado, the two western states of Washington and California, and Florida in the southeastern United States (Figure 5). Blue catfish support both sport and commercial fisheries in 14 states, most of which are in east-central and southeastern states within the middle and lower Mississippi River and Ohio River basins. No state considered the fish as only a commercial species. Eight states on the periphery of their native range (Oregon in the west, Arizona and New Mexico in the southwest, South

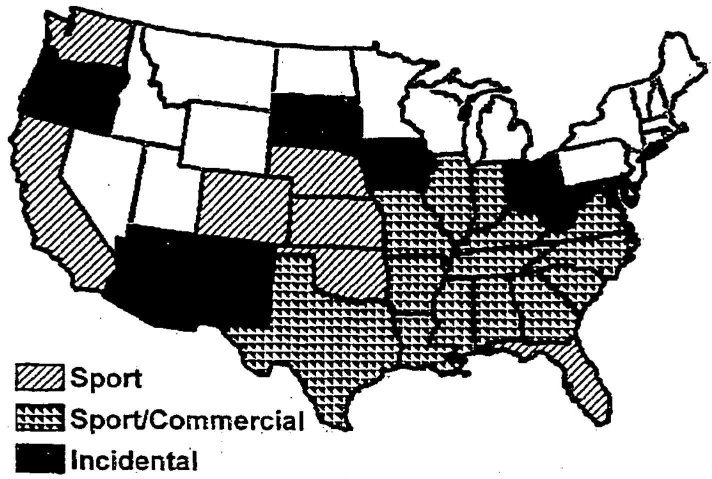

FIGURE 5. Status of sport, commercial, and incidental fisheries for blue catfish in the conterminous United States.

Dakota and Iowa in the northern midwest, and Ohio, West Virginia, and Maryland in the northeastern United States) considered blue catfish populations to be incidental in nature because their populations are too small to support dependable sport or commercial fisheries.

About one-half of the states where blue catfish occur (15) considered the species recreationally important. Blue catfish are considered recreationally valuable in most states within the lower Missouri and Ohio River basins, and the middle and lower Mississippi River basin, and in Virginia, North Carolina, South Carolina, and Texas. They are not considered important sport or commercial fish in western and southwestern states, most upper midwest states, states in the upper Ohio River basin and in Georgia and Florida.

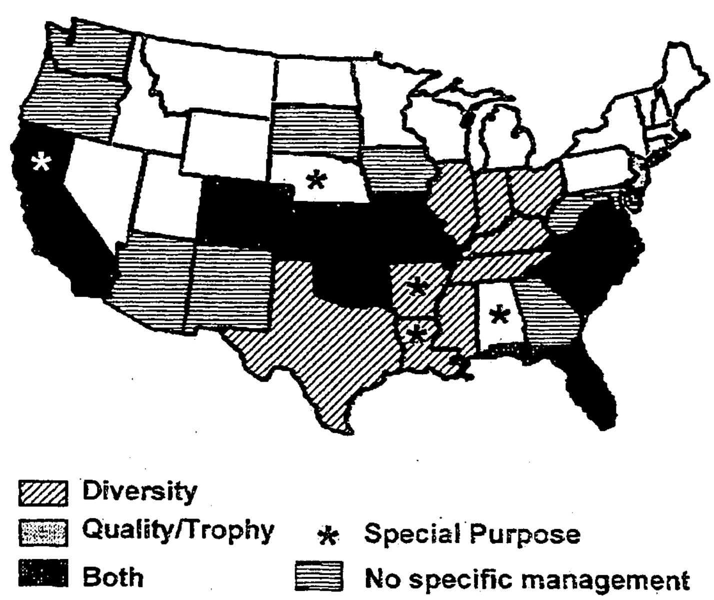

FIGURE 6. Management objectives for blue catfish in the conterminous United States.

TABLE 2. Estimates of sport and commercial harvests (kg), mean size (mm), harvested by sport anglers, and minimum sizes (mm) in the commercial harvest for blue catfish from various populations, as reported by state natural resource agencies.

State	Sport		Commercial	
	Harvest (kg)	Average sizes (mm)	Harvest (kg)	Minimum size (mm)
Alabama	NA	356–457	NA	None
Arkansas	NA	NA	905,891	406
Illinois	NA	NA	345,098	381
Indiana	NA	NA	<22,222	254
Kentucky	72,171	351	2,031,706	None
Louisiana	46,667	356–381	4,888,889	305
Mississippi	NA	NA	48,0431	305
Missouri	85,822	599	79,947	381
South Carolina	971,904	356–610	414,889	None
Tennessee	1,381,409	516	411,153	None
Virginia	NA	NA	NA	None

Nine states reported that blue catfish add only diversity to already existing fish populations (Figure 6). Two states indicated blue catfish provide only quality and/or trophy fisheries, seven reported they provide both diversity and quality and trophy aspects, five states reported that blue catfish were managed for other specific reasons, and nine states reported that although blue catfish are present in their state, they were not managed for any specific purpose. States using blue catfish to add diversity to fisheries include those states along the lower Ohio and Mississippi River basins, and Texas. Kansas and North Carolina were the only states that manage their catfish as only quality or trophy species, whereas seven states manage their blue catfish populations for both diversity and quality/trophy. Those seven states show no distributional pattern by watershed. They range from California in the west to Virginia in the east, and to Florida in the south. Five states indicated that their blue catfish populations were managed for specific reasons. Nebraska stocked blue catfish into several small public lakes to increase diversity, however they no longer stock them and their few remaining blue catfish are managed similar to channel catfish. California stocked blue catfish for Asiatic clam control and for aquaculture purposes, probably as hybrids with channel catfish, in pay lakes. Arkansas managed blue catfish for shad control, and Alabama and Louisiana managed them specifically for sport and commercial fisheries. It was not surprising that nine states, most of which are on the periphery of their native range, do not manage for them. In most cases, blue catfish numbers were low and sometimes provided only accidental or unplanned fisheries.

Commercial harvest estimates were reported from only nine states (Table 2). States with harvest estimates were those along the middle and lower Mississippi River basin, the lower Ohio River basin, and South Carolina. Sport harvest estimates were available from only five states (Table 2). These estimates were difficult to evaluate because in many cases not all blue catfish sport fisheries had creel surveys. For example, in Missouri, our sport harvest estimates were from only two large reservoirs, yet there are blue catfish sport fisheries in several mid-sized public lakes and sport angling is becoming more popular on the Missouri and Mississippi rivers. It appears that the highest sport harvests occur in Tennessee and South Carolina, and although Alabama considers blue catfish an important sport fish with high harvest, they had no estimates.

Due to self-reporting, commercial fisheries statistics were difficult to evaluate. It appears that Louisiana, Kentucky, and Arkansas had the largest blue catfish commercial harvests.

Culture

Blue catfish possess several attributes that make them desirable for culture in temperate regions (Tidwell and Mims 1990; Webster et al. 1995). Blue catfish have a similar or higher dressing percentage than channel catfish, have an aggressive nature making them suitable for pay-lakes (fee fishing) industry, and resistant to some diseases that affect channel catfish, such as enteric septicemia and channel catfish virus. Giudice (1970) and Chappell (1979) report that a major advantage to blue catfish in aquaculture was that they were relatively easy to seine from ponds and they have high individual weight gains in temperate regions (Tidwell and Mims 1990).

However, blue catfish are currently unpopular with the aquaculture industry because of reported slow maturation rates, poor food conversion, and poor spawning success in captivity. Some aquaculturists believed that blue catfish were more easily stressed and more susceptible to bacterial diseases than channel catfish, especially after handling or hauling.

Hybridization between blue catfish and channel catfish increases growth (Giudice 1966; Giudice 1970; Yant et al. 1976; Chappell 1979; Tave et al. 1981). Chappell (1979) reported that the hybrid produced by crossing male blue catfish with female channel catfish had a faster growth rate, exhibited greater feeding vigor, and had a better food conversion and dressing percentage than either parent species. Tave et al. (1981) indicated that these hybrids were more susceptible to angling than either parent, and that fishing success in pay lakes could be improved by stocking hybrids.

Summary

Blue catfish are widely distributed in the United States but restricted to states within the Mississippi River basin and Atlantic, Pacific, and Gulf coast slopes. Numbers of blue catfish generally increase southward in the United States. It is a large river species and the largest of all North American catfishes. Its ability to reach large sizes makes the blue catfish one of the most popular catfishes for pole and line anglers. Blue catfish grow rapidly, are relatively easy to catch, and the flesh is white, flakey, and of extremely good texture. Commercially, the blue catfish is a recreationally valuable species. During the past several years, it has been introduced into several states as a trophy species, to increase species diversity for anglers, and as a predator to control shad and Asiatic clams. Blue catfish populations will probably not expand their range substantially in the near future because of their apparent affinity for warmer climates, however those states where blue catfish are already popular will likely continue to manage the species a valuable sport and commercial fish.

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Sec 2.4 Ref 35

Environmental Quality Control

S.C. Department of Health and Environmental Cont

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WATERSHED WATER QUALITY ASSESSMENT -NPDES

(SCDHEC 200

BROAD RIVER BASIN, SCDHEC, 2001, TECHNICAL REPORT 001-01

- Introduction
- Body (All of the 11-digit HUCs)
- Appendix A - Enoree River Basin maps and tables (1096K)
- Appendix B - Tyger River Basin maps and tables (1117K)
- Appendix C - Broad River Basin maps and tables (2619K)
- Supplemental Literature

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Water Home

Comments
Last Update: April 02, 2003

facility. Overall, the average depth of Monticello Reservoir is 59 feet (17.9 m) and the maximum depth in the lower impoundment is approximately 126 feet (38.4 m). The lake's watershed comprises approximately 17 square miles (44 km2).

Lake Monticello is comprised of two separate impoundments, and there is a monitoring site on each impoundment. At the upper impoundment site ***(B-328)***, aquatic life uses are fully supported; however, there is a significant decreasing trend in dissolved oxygen. There is a significant decreasing trend in pH. Significant decreasing trends in five-day biochemical oxygen demand, total nitrogen concentration, and turbidity suggest improving conditions for these parameters. At the lower impoundment site ***(B-327)***, aquatic life uses are fully supported. A high concentration of zinc was measured in water in 1995. A significant decreasing trend in total nitrogen concentration suggests improving conditions for this parameter. Recreational uses are fully supported at both sites.

Parr Reservoir - Parr Reservoir is a 4400-acre impoundment on the Broad River in Fairfield and Newberry Counties, linked with Monticello Reservoir via a pumped storage hydroelectric facility. Parr Reservoir's maximum depth is approximately 25 feet (7.6 m) and the average depth is 15 feet (4.6 m). The reservoir's watershed comprises approximately 4750 square miles (12,302 km2) in North and South Carolina. There are two monitoring sites on Parr Reservoir (uplake ***B-346***, downlake ***B-345***) and aquatic life and recreational uses are fully supported at both sites.

NPDES Program

Active NPDES Facilities

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)***	***NPDES#*** ***TYPE*** ***LIMITATION***
BROAD RIVER SCE&G/PARR HYDRO STA. PIPE #: 001 FLOW: M/R	SC0001864 MINOR INDUSTRIAL EFFLUENT
MONTICELLO RESERVOIR SCE&G/SUMMER NUCLEAR STA. PIPE #: 001-013, 015, 016 FLOW: M/R PIPE #: 014 FLOW: 0.12 WQL DO,TRC; NH3N IN SUMMER & WINTER	SC0030856 MAJOR INDUSTRIAL WATER QUALITY WATER QUALITY
PARR RESERVOIR SCE&G/FAIRFIELD PUMPED STORAGE PIPE #: 001 FLOW: M/R	SC0035904 MINOR INDUSTRIAL EFFLUENT
CANNONS CREEK NCWSA/CANNONS CREEK WWTP PIPE #: 001 FLOW: 0.05	SC0048020 MINOR DOMESTIC EFFLUENT
CHARLES CREEK FOREST HILLS SD/ELBO INC. PIPE #: 001 FLOW: 0.02 WQL FOR DO,TRC,NH3N	SC0024571 MINOR DOMESTIC WATER QUALITY

ROCKY CREEK VULCAN MATERIALS CO./BLAIR QUARRY PIPE #: 001 FLOW: M/R	SCG730053 MINOR INDUSTRIAL EFFLUENT

Nonpoint Source Management Program

Land Disposal Activities

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
NEWBERRY COUNTY LANDFILL DOMESTIC	DWP-117 CLOSED
NEWBERRY COUNTY LANDFILL DOMESTIC	DWP-044 CLOSED
NEWBERRY COUNTY TRANSFER STATION DOMESTIC	361001-6001 --------

Land Application Sites

LAND APPLICATION SYSTEM ***FACILITY NAME***	***ND#*** ***TYPE***
SPRAYDIELD SHAKESPEARE PRODUCTS GROUP	ND0070033 INDUSTRIAL

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
TARMAC MID-ATLANTIC, INC. BLAIR QUARRY	0130-39 GRANITE

Water Supply

WATER USER ***STREAM***	***TOTAL PUMP. CAPACITY (MGD)*** ***RATED PUMP. CAPACITY (MGD)***
VC SUMMER NUCLEAR STATION WTP MONTICELLO RESERVOIR	3.1 1.5

Growth Potential

There is a low to moderate potential for growth in this watershed, primarily associated with residential development around the reservoirs, the Towns of Prosperity and Pomaria, and the City of Newberry. The upper portion of the watershed is effectively excluded from development by the Sumter National Forest, and the overall lack of adequate utilities to serve the remaining area will limit growth.

03050106-050

(Broad River)

General Description

Watershed 03050106-050 is located in Newberry and Fairfield Counties and consists primarily of the ***Broad River*** and its tributaries from the Tyger River to the Parr Shoals dam. The watershed occupies 146,310 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Pacolet-Wilkes series. The erodibility of the soil (K) averages 0.24, and the slope of the terrain averages 15%, with a range of 2-40%. Land use/land cover in the watershed includes: 76.6% forested land, 11.9% agricultural land, 7.5% water, 2.8% scrub/shrub land, 0.8% urban land, and 0.4% barren land.

This section of the Broad River accepts drainage from its upper reaches, together with the Tyger River Watershed, the Enoree River Watershed, Beaver Creek (McClures Creek, Chicken Creek, Storm Branch, Reedy Branch, Sandy Fork), Rocky Creek, and Terrible Creek. The Parr Shoals dam impounds the Broad River to form Parr Reservoir, which accepts drainage from Hellers Creek (Second Creek, Buck Branch) and Cannons Creek (Rocky Branch, Kerr Creek, Charles Creek, Mud Creek). Monticello Reservoir (7100 acres) is connected to Parr Reservoir by Frees Creek. There are numerous ponds and lakes (totaling 8,497.9 acres) in this watershed and a total of 243.5 stream miles, all classified FW. The Sumter National Forest and the Broad River Waterfowl Area are natural resources in the watershed.

Water Quality

Station #	Type	Class	Description
B-047	S	FW	BROAD RIVER AT SC 34, 14 MI NE OF NEWBERRY
B-151	BIO	FW	HELLERS CREEK AT SR 97
B-346	W	FW	PARR RESERVOIR 4.8 KM N OF DAM, UPSTREAM OF MONTICELLO RESERVOIR
B-751	BIO	FW	CANNONS CREEK AT US 176
B-328	P	FW	MONTICELLO RES., UPPER IMPOUNDMENT AT BUOY IN MIDDLE OF LAKE
B-327	P	FW	MONTICELLO RESERVOIR, LOWER IMPOUNDMENT BETWEEN LARGE ISLANDS
B-345	W	FW	PARR RESERVOIR IN FOREBAY NEAR DAM

Broad River (B-047) - Aquatic life uses are fully supported; however, there is a significant increasing trend in turbidity. Recreational uses are partially supported due to fecal coliform bacteria excursions.

Hellers Creek (B-151) - Aquatic life uses are partially supported based on macroinvertebrate community data.

Cannons Creek (B-751) - Aquatic life uses are fully supported based on macroinvertebrate community data.

Monticello Reservoir - Monticello Reservoir is a 7100-acre divided impoundment that floods most of Frees Creek watershed in Fairfield County. The upper impoundment is a small recreational lake. The lower impoundment is linked with Parr Reservoir on the Broad River via a pumped storage hydroelectric

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WATERSHED WATER QUALITY MANAGEMENT STRATEGY

BROAD BASIN

TECHNICAL REPORT NO. 001-98

PREPARED BY

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
BUREAU OF WATER
2600 BULL STREET
COLUMBIA SC 29201
(803) 898-4300

SCDHEC 1998 SCDHEC 1998

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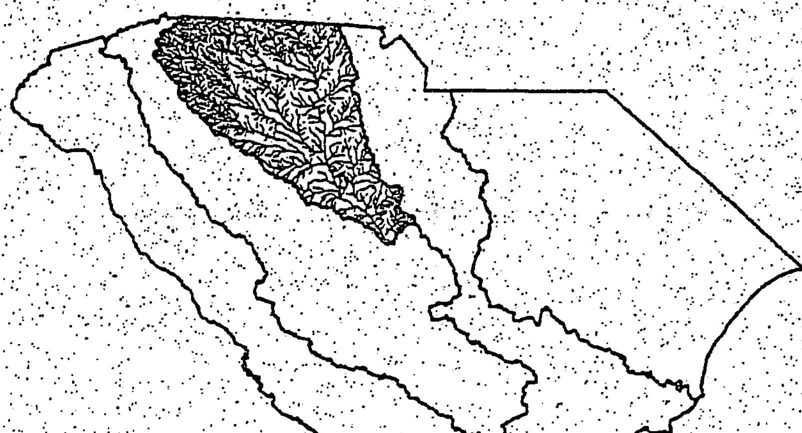
Bureau of Water

Watershed Water Quality Management Strategy

Broad Basin



DHEC

PROMOTE PROTECT PROSPER

Technical Report No. 001-98

Most Refs say 4,500-4,750

Σ = 3,937.4 mi²

3906 mi²

Broad Basin Description

The *Broad Basin* incorporates 32 watersheds within 2 Watershed Management Units (WMU) and some 2.5 million acres within the State of South Carolina (a portion of the basin resides in North Carolina). There are a total of 4,719 stream miles in the Broad Basin. Within the Department's Broad Basin are the Enoree River Basin, the Tyger River Basin, the Pacolet River Basin, and the Broad River Basin.

(1) The *Enoree River Basin* encompasses 761.6 square miles extending over the Piedmont region. The Enoree River Basin is described in WMU-0501 and encompasses 5 watersheds, some 487,405 acres of which 9.71% is urban land, 12.25% is agricultural land, 10.64% is scrub/shrub land, 0.73% is barren land, 66.39% is forested land, 0.04% is forested wetland, and 0.24% is water (SCLRCC 1990). The urban land percentage is comprised chiefly of the Greenville Metropolitan area. The Enoree River originates near the City of Travelers Rest and accepts drainage from Beaverdam Creek, Warrior Creek, and Duncan Creek before draining into the Broad River. There are 895.5 stream miles in the Enoree River Basin.

(2) The *Tyger River Basin* encompasses 841.6 square miles extending over the Piedmont region. The Tyger River Basin is described in WMU-0501 and encompasses 6 watersheds, some 538,617 acres of which 9.94% is urban land, 13.65% is agricultural land, 8.23% is scrub/shrub land, 0.53% is barren land, 66.98% is forested land, and 0.67% is water (SCLRCC 1990). The urban land percentage is comprised chiefly of the City of Greer and portions of the Cities of Spartanburg and Union. There are a total of 977.1 stream miles in the Tyger River Basin. The Tyger River is formed by the confluence of the South Tyger River, the Middle Tyger River, and the North Tyger River near the City of Woodruff and accepts drainage from Fairforest Creek before flowing into the Broad River.

(3) The *Pacolet River Basin* encompasses 489.4 square miles extending over the Piedmont region. The Pacolet River Basin is described in WMU-0502 and encompasses 7 watersheds, some 313,221 acres of which 4.52% is urban land, 18.78% is agricultural land, 5.70% is scrub/shrub land, 0.88% is barren land, 69.06% is forested land, and 1.06% is water (SCLRCC 1990). The urban land percentage is comprised chiefly of a portion of the City of Spartanburg. There are a total of 580.1 stream miles in the Pacolet River Basin. The South Pacolet River flows through Lake William C. Bowen and joins the North Pacolet River, which originates in North Carolina, to form Lake Blalock and the Pacolet river. The Pacolet River accepts drainage from Lawsons Fork Creek before flowing into the Broad River.

(4) The *Broad River Basin* is described in Watershed Management Unit 0502 and encompasses 14 watersheds and 1,844.8 square miles excluding the Enoree River, the Tyger River, and the Pacolet River Basins which all drain into the Broad River. The Broad River originates in North Carolina and flows across the Piedmont region of South Carolina. Of the 1,180,693 acres, 8.23% is urban land, 11.93% is agricultural land, 5.28% is scrub/shrub land, 0.40% is barren land, 72.24% is forested land, 0.02% is forested wetland, and 1.90% is water (SCLRCC 1990). The urban land percentage is

Grand Mean: 1-4 agricultural = 13.3% Forested = 69.4%

03050106-050

(Broad River)

General Description

Watershed 03050106-050 is located in Newberry and Fairfield Counties and consists primarily of the ***Broad River*** and its tributaries from the Tyger River to the Parr Shoals dam. The watershed occupies 156,544 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Pacolet-Wilkes series. The erodibility of the soil (K) averages 0.24; the slope of the terrain averages 15%, with a range of 2-40%. Land use/land cover in the watershed includes: 0.73% urban land, 11.17% agricultural land, 3.86% scrub/shrub land, 0.34% barren land, 76.86% forested land, and 7.03% water.

This section of the Broad River accepts drainage from its upper reaches (03050105-094, 03050106-010) together with the Tyger River Watershed, the Enoree River Watershed, Beaver Creek (McClures Creek, Chicken Creek, Storm Branch, Reedy Branch, Sandy Fork), Rocky Creek, and Terrible Creek. The Parr Shoals dam impounds the Broad River to form Parr Reservoir, which accepts drainage from Hellers Creek (Second Creek, Buck Branch) and Cannons Creek (Rocky Branch, Kerr Creek, Charles Creek, Mud Creek). Monticello Reservoir (7100 acres) is connected to Parr Reservoir by Frees Creek. There are a few ponds and lakes (10-7100 acres) in this watershed used for recreation, industry, and power supply. There are a total of 294.9 stream miles, all classified FW. The Sumter National Forest and the Broad River Waterfowl Area are natural resources in the watershed.

Water Quality

A fish consumption advisory has been issued by the Department for mercury and includes portions of the Broad River in this watershed (see Watershed Evaluations and Implementation Strategies Within WMU-0502).

Broad River (B-047) - Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in total phosphorus concentration. A significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Recreational uses are partially supported due to fecal coliform bacteria excursions. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Beaver Creek (B-143) - Aquatic life uses are fully supported based on macroinvertebrate community data.

Cannons Creek (B-751) - Aquatic life uses are fully supported based on macroinvertebrate community data.

BROAD RIVER SCE&G/PARR HYDRO STA. PIPE #: 001 FLOW: M/R	SC0001864 MINOR INDUSTRIAL EFFLUENT
MONTICELLO RESERVOIR SCE&G/SUMMER NUCLEAR STA. PIPE #: 014 FLOW: 0.12 WQL DO,TRC; NH3N IN SUMMER & WINTER	SC0030856 MAJOR INDUSTRIAL WATER QUALITY
PARR RESERVOIR SCE&G/FAIRFIELD PUMPED STORAGE PIPE #: 001 FLOW: M/R	SC0035904 MINOR INDUSTRIAL EFFLUENT
CANNONS CREEK NEWBERRY INN/BEST WESTERN PIPE #: 001 FLOW: 0.0255 WQL FOR TRC,NH3N	SC0026921 MINOR COMMUNITY WATER QUALITY
CHARLES CREEK FOREST HILLS SD/ELBO INC. PIPE #: 001 FLOW: 0.02 WQL FOR DO,TRC,NH3N	SC0024571 MINOR MUNICIPAL WATER QUALITY
KERR CREEK TOWN OF PROSPERITY PIPE #: 001 FLOW: 0.17 WQL FOR DO,TRC,NH3N	PROPOSED MINOR MUNICIPAL WATER QUALITY
ROCKY CREEK TARMAC MID-ATLANTIC, INC. PIPE #: 001 FLOW: M/R	SCG730053 MINOR INDUSTRIAL EFFLUENT

Landfill Activities

SOLID WASTE LANDFILL NAME *FACILITY TYPE*	*PERMIT #* *STATUS*
NEWBERRY COUNTY LANDFILL MUNICIPAL	DWP-117 CLOSED
NEWBERRY COUNTY COMPOSTING MUNICIPAL	361001-3001 ACTIVE
NEWBERRY COUNTY TRANSFER STATION MUNICIPAL	361001-6007 ACTIVE
SHAKESPEARE CO. LANDFILL INDUSTRIAL	IWP-159 CLOSED

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
TARMAC MID-ATLANTIC, INC. BLAIR QUARRY	0130-20 GRANITE

03050106-060

(Broad River)

General Description

Watershed 03050106-060 is located in Richland, Newberry, and Fairfield Counties and consists primarily of the ***Broad River*** and its tributaries from the Parr Shoals dam to its confluence with the Saluda River. The watershed occupies 160,922 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Tatum-Alpin-Herndon-Pacolet series. The erodibility of the soil (K) averages 0.29; the slope of the terrain averages 13%, with a range of 2-25%. Land use/land cover in the watershed includes: 15.47% urban land, 5.62% agricultural land, 1.89% scrub/shrub land, 0.46% barren land, 74.96% forested land, and 1.57% water.

This section of the Broad River accepts drainage from its upper reaches (03050105-094, 03050106-010, 03050106-050) together with Mayo Creek, Crims Creek (Rocky Creek, Summers Branch), Wateree Creek (Risters Creek), Boone Creek, Freshley Branch, Mussel Creek, and the Little River Watershed. Hollingshead Creek (Boyd Branch, Wildhorse Branch, Metz Branch, Hope Creek, Bookman Creek) enters the river next followed by the Cedar Creek Watershed, Nipper Creek, Nicholas Creek (Swygert Branch, Moccasin Branch), Slatestone Creek, and Burgess Creek. Crane Creek and Smith Branch enter the river at the base of the watershed near the City of Columbia. Sorghum Branch, Dry Branch (Crescent Lake, Stevensons Lake), Elizabeth Lake (60 acres), and Cumbess Creek drain into Crane Creek followed by North Crane Creek. North Cane Creek accepts drainage from Beasley Creek (Robertson Branch, Lot Branch, Hawkins Branch), Swygert Creek, Dry Fork Creek, and Long Branch. There are several ponds and lakes (10-60 acres) in this watershed used for recreational and irrigational purposes, and a total of 311.6 stream miles, all classified FW. The Harbison State Forest is located next to the Broad River just downstream of Nicholas Creek and a Heritage Trust Preserve is located along Nipper Creek.

Water Quality

A fish consumption advisory has been issued by the Department for mercury and includes portions of the Broad River in this watershed (see Watershed Evaluations and Implementation Strategies Within WMU-0502).

Broad River - There are three monitoring sites along this section of the Broad River. Aquatic life uses may not be supported at the upstream site (**B-236**) due to the occurrence of pesticides (P,P'DDT, P,P'DDE, endrin) and high concentrations of the PAHs benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene in sediment samples. Recreational uses are partially supported due to fecal coliform bacteria excursions. Aquatic life and recreational uses are fully supported at the midstream site (**B-337**). At the downstream site (**B-080**), aquatic life uses are not supported due to occurrences of copper and zinc in excess of the aquatic life acute standard. In addition, there is a significantly www.state.sc.us/dhec/eqc/water/pubs/broad.pdf

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WATERSHED WATER QUALITY MANAGEMENT STRATEGY

BROAD BASIN

TECHNICAL REPORT NO. 001-98

PREPARED BY

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
BUREAU OF WATER
2600 BULL STREET
COLUMBIA SC 29201
(803) 898-4300

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Introduction

The South Carolina Department of Health and Environmental Control (SCDHEC or the Department) initiated its first watershed planning activities as a result of a U.S. Environmental Protection Agency (USEPA) grant in June of 1972. These activities were soon extended by §303(e), "Federal Water Pollution Control Act Amendments of 1972", U.S. Public Law 92-500. In 1975, the SCDHEC published basin planning reports for the four major basins in South Carolina. The next major planning activity resulted from §208 of the Federal Water Pollution Control Act, which required states to prepare planning documents on an areawide basis. Areawide plans were completed in the late 1970's for the five designated areas of the State and for the nondesignated remainder of the State. To date, these plans or their updated versions have served as information sources and guides for water quality management.

During the past decade, special water quality initiatives and Congressional mandates have diverted attention and resources from comprehensive water quality assessment and protection. The Bureau of Water now emphasizes watershed planning to better coordinate river basin planning and water quality management. Watershed-based management allows the Department to address Congressional and Legislative mandates in a coordinated manner and to better utilize current resources. The watershed approach also improves communication between the Department, the regulated community, and the public on existing and future water quality issues (SCDHEC 1991a).

Purpose of the Watershed Water Quality Management Strategy

By definition, a watershed is a geographic area into which the surrounding waters, sediments, and dissolved materials drain, and whose boundaries extend along surrounding topographic ridges. Watershed-based water quality management recognizes the interdependence of water quality related activities associated with a drainage basin including: monitoring, problem identification and prioritization, water quality modeling, planning, permitting, and other activities. The Bureau of Water's Watershed Water Quality Management Program integrates these activities by watershed, resulting in watershed management plans and implementation strategies that appropriately focus water quality protection efforts. While an important aspect of the strategy is water quality problem identification and solution, the emphasis is on problem prevention.

Five major drainage basins divide the State along hydrologic lines and serve as management units. A Watershed Water Quality Management Strategy (WWQMS) will be created for each of the five basins and will be updated on a five-year rotational basis. This will allow for effective allocation and coordination of water quality activities and efficient use of available resources. The Broad Basin is divided into two watershed management units (WMU) and 32 watersheds or hydrologic units. The hydrologic units used are the USDA Natural Resource Conservation Service (1990) 11-digit codes for South Carolina. All water quality related evaluations will be made at the watershed level. The stream names used are derived from USGS topo maps.

The watershed-based strategy fulfills a number of USEPA reporting requirements including various activities under §305(b), §314, and §319 of the Clean Water Act (CWA). Section 305(b) requires that the

State biennially submit a report that includes a water quality description and analysis of all navigable waters to estimate environmental impacts. Section (§314) requires that the State submit a biennial report that identifies, classifies, describes, and assesses the status and trends in water quality of publicly owned lakes. The watershed plan is also a logical evaluation, prioritization, and implementation tool for nonpoint source (§319) requirements. Nonpoint source best management practices (BMPs) can be selected by identifying water quality impairments and necessary controls, while considering all the activities occurring in the drainage basin.

The Strategy also allows for more efficient issuance of National Pollutant Discharge Elimination System (NPDES) and State wastewater discharge permits. Proposed permit issuances within a watershed will be consolidated and presented to the public in groups, rather than one at a time, allowing the Department to realize a resource savings, and the public to realize an information advantage.

The Watershed Water Quality Management Strategy is a geographically-based document that describes, at the watershed level, all water quality related activities that may potentially have a negative impact on water quality. Each watershed in the Broad Basin is evaluated and a strategy described to address impaired streams.

The Watershed Implementation Staff investigates the impaired and threatened streams mentioned in the WWQMS to determine, where possible, the source of the impairment and recommends solutions to correct the problems. As part of this effort, the watershed staff is forging partnerships with various federal and state agencies, local governments, and community groups. In particular, the Watershed Program and the Natural Resource Conservation Service (NRCS) district offices are working together to address some of the nonpoint source (NPS) concerns in the basin. By combining NRCS's local knowledge of land use and the Department's knowledge of water quality, we are able to build upon NRCS's close relationships with landowners and determine where NPS projects are needed. These projects may include educational campaigns or special water quality studies.

Factors Assessed in Watershed Evaluations

Water Quality

Monitoring Overview

In an effort to evaluate the State's water quality, the Department operates a permanent Statewide network of primary ambient monitoring stations and flexible, rotating secondary and watershed monitoring stations (SCDHEC 1996a). The ambient monitoring network is directed towards determining long-term water quality trends, assessing attainment of water quality standards, identifying locations in need of additional attention, and providing background data for planning and evaluating stream classifications and standards.

The monitoring data are also used in the process of formulating permit limits for wastewater discharges with the goal of maintaining state and federal water quality standards and criteria in the receiving streams in accordance with the goals of the Clean Water Act. These standards and criteria define the instream chemical concentrations which provide for protection and reproduction of aquatic flora and fauna, determine support of the classified uses of each waterbody, and serve as instream limits for the regulation of wastewater discharges or other activities. In addition, these data are used in the preparation of the biennial §305(b) report to Congress (SCDHEC 1996b), which summarizes the State's water quality with respect to attainment of classified uses by comparing the ambient monitoring network data to the state water quality standards.

The SCDHEC Water Quality Monitoring Network is comprised of three station types: primary, secondary, and watershed stations. Primary stations are sampled on a monthly basis year round, and are located in high water-use areas or as background stations upstream of high water-use areas. The static primary station network is operated statewide, and receives the most extensive parameter coverage, thus making it best suited for detecting long term trends. Data for the Broad Basin are analyzed from 1980-1995 for trends in water quality and from 1991-1995 for standards compliance.

Secondary stations are sampled monthly from May through October, a period critical to aquatic life, characterized by higher water temperatures and lower flows. Secondary stations are located in areas where specific monitoring is warranted due to point source discharges, or areas with a history of water quality problems. Secondary station parameter coverage is less extensive and more flexible than primary or watershed station coverages. The number and locations of secondary stations have greater annual variability than do those in the primary station network, and during a basin's target year may have parameter coverage and sampling frequency duplicating that of primary or watershed stations.

Watershed stations are sampled on a monthly basis, year round, during a basin's target year; additional watershed stations may be sampled monthly from May through October to augment the secondary station network. Watershed stations are located to provide more complete and representative coverage within the larger drainage basin, and to identify additional monitoring needs. The parameter coverage of watershed stations includes the same basic parameters as primary stations.

The ambient monitoring network, as a program, has the capability of sampling a wide range of media and analyzing them for the presence or effects of contaminants. Ambient monitoring data from 25 primary stations, 72 secondary stations (16 with increased coverage during the basin monitoring year), 33 watershed stations, and 2 inactive stations were reviewed for the Broad Basin, along with 37 biological sites and 3 consultant sites to assess macroinvertebrate communities.

Monthly, quarterly, or annual water column grab samples (0.3m) are used to establish representative physical conditions and chemical concentrations in the waterbodies sampled. This information is considered to represent "average" conditions, as opposed to extremes, because of the inability to target individual high or low flow events on a statewide basis. The more extreme instream chemical concentrations resulting from nonpoint source inputs from rain events or from point source inputs of a variable nature are frequently missed because routine monthly sampling rarely coincides with the time of release.

Many pollutants may be components of point source discharges, but may be discharged in a discontinuous manner, or at such low concentrations that water column sampling for them is impractical. Some pollutants are also common in nonpoint source runoff, reaching waterways only after a heavy rainfall; therefore, in these situations, the best media for the detection of these chemicals are sediment and fish tissue where they may accumulate over time. Their impact may also affect the macroinvertebrate community.

Regional ambient trend monitoring is conducted to collect data to indicate general biological conditions of state waters which may be subject to a variety of point and nonpoint source impacts. In 1991, the Department began using ambient macroinvertebrate data to support the development of Watershed Water Quality Management Strategies. Ambient sampling is also used to establish regional reference or "least impacted" sites from which to make comparisons in future monitoring. Additionally, special macroinvertebrate studies, in which stream specific comparisons among stations located upstream and downstream from a known discharge or nonpoint source area, are used to assess impact.

Qualitative sampling of macroinvertebrate communities are the primary bioassessment techniques used in ambient trend monitoring. A habitat assessment of general stream habitat availability and a substrate characterization is conducted at each site. Annual trend monitoring is conducted during low flow "worst case" conditions in July - September. This technique may also be used in special studies for the purpose of determining if, and to what extent, a wastewater discharge or nonpoint source runoff is impacting the receiving stream. A minimum of two sample locations, one upstream and one downstream from a discharge or runoff area, is collected. At least one downstream recovery station is also established when appropriate. Sampling methodology essentially follows procedures described in Standard Operating Procedures, Biological Monitoring (NCDEHNR 1995).

Aquatic sediments represent a historical record of chronic conditions existing in the water column. Pollutants bind to particulate organic matter in the water column and settle to the bottom where they become part of the sediment "record". This process of sedimentation not only reflects the impact of point source discharges, but also incorporates nonpoint source pollution washed into the stream during rain events. As a result, contaminant concentrations originating from irregular and highly variable sources are recorded in the sediment. The sediment concentrations at a particular location do not vary as rapidly with time as do the water column concentrations. Thus, the sediment record may be read at a later time, unrelated to the actual release time. Lakes act as settling basins for materials entering the lake system directly from a discharge or indirectly from the land surface washed into streams. Therefore, it is not unusual for lake sediment concentrations to be higher than sediment concentrations found in streams. This is especially true for chromium, copper, and zinc.

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 (SCDHEC 1993) that apply to this basin are as follows.

Class ORW, or "outstanding resource waters", are freshwaters which 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. Streams that are not currently classified as ORW, but meet certain criteria (ie. absence of dischargers, endangered species, federal lands) will be noted as potential ORW candidates in the watershed evaluations.

Class A were freshwaters which 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 which 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 which 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.

The standards are used as instream water quality goals to maintain and improve water quality and also serve as the foundation of the Bureau of Water's program. They are used to determine permit limits for treated wastewater dischargers and any other activities that may impact water quality. Using mathematical Wasteload Allocation Models, the impact of a wastewater discharge on a receiving stream, where flow is unregulated by dams, is predicted using 7Q10 streamflows. These predictions are then used to set limits for different pollutants on the National Pollutant Discharge Elimination System (NPDES) permits issued by the Department. The NPDES permit limits are set so that, as long as a permittee (wastewater discharger) meets the established permit limits, the discharge should not cause a standards violation in the receiving stream. All discharges to the waters of the State are required to have an NPDES permit and must abide by those limits, under penalty of law.

Classifications are based on desired uses, not on natural or existing water quality, and are a legal means to obtain the necessary treatment of discharged wastewater to protect designated uses. Actual water quality may not have a bearing on a waterbody's classification. A waterbody may be reclassified if desired or existing public uses justify the reclassification and the water quality necessary to protect these uses is attainable. A classification change is an amendment to a State regulation and requires public participation, SCDHEC Board approval, and General Assembly approval.

Natural conditions may prevent a waterbody from meeting the water quality goals as set forth in the standards. The fact a waterbody does not meet the standards for a particular classification does not mean the waterbody is polluted or of poor quality. Certain types of waterbodies (ie. swamps, lakes, tidal creeks) naturally have water quality lower than the numeric standards. A waterbody can have water quality conditions below standards due to natural causes and still meet its use classification. A site specific numeric standard may be established by the Department and subjected to public participation and administrative procedures for adopting regulations. Site specific numeric standards apply only to the stream segment described in the water classification listing (SCDHEC 1993, Regulation 61-69), not to tributaries or downstream unspecified waters.

Wetlands

In the Section 401 water quality certification process, applications for wetland alterations may be denied or modified due to the special nature of a wetland or the functions that a wetland provides. Wetland impacts must be compensated through restoration, enhancement, preservation, or creation and protected in perpetuity. Future development would be prohibited in these mitigated and legally protected areas. Knowledge of areas that are restricted from development due to mitigation or special water classification is useful in planning future development in a watershed. In cooperation with the S.C. Department of Natural Resources's Division of Land Resources and Conservation Districts, Landsat Thematic Mapper (TM) satellite image data will provide an inventory of wetlands in the basin and an image-based geographical information system (GIS) for subsequent monitoring and tracking efforts.

Lake Eutrophication Assessment

The trophic condition of South Carolina lakes is monitored through SCDHEC's network of routine sampling stations and through periodic sampling of additional lakes. All lakes of at least 40 acres in area that offer public access are monitored. Large (major) lakes are those greater than 850 acres in surface area. Minor lakes are those less than 850 acres in surface area.

Beginning with the 1989 statewide lake water quality assessment, a multi-parameter percentile index has been used to quantify overall lake trophic state. The index includes the following trophic condition indicators: water clarity, total phosphorus, total inorganic nitrogen, chlorophyll *a*, and dissolved oxygen. The baseline data for this relative index are collected during the 1980-81 statewide lake water quality assessment. Use of a baseline data set permits trend detection in subsequent assessments. Percentiles for major and minor lakes are derived separately. All data, as well as the programs for deriving index values, are maintained in USEPA's STORET database. A high index value indicates a desirable trophic condition, while low values indicate the need for further study or restoration (SCDHEC 1991b).

Recreational Swimming Areas

Although all waters of the State are protected for swimming, some areas are more popular than others and may require closer monitoring. With input from agencies such as the Councils of Government the Department is identifying swimming areas (regularly used beaches and river banks with public access) where water quality monitoring may be needed. Currently monitored and suggested areas are located and discussed in the appropriate watershed evaluations.

Water Quality Indicators

MACROINVERTEBRATE COMMUNITY

Macroinvertebrates are aquatic insects and other aquatic invertebrates associated with the substrates of streams, rivers, and lakes. Macroinvertebrates can be useful indicators of water quality because these communities respond to integrated stresses over time which reflect fluctuating environmental conditions. Community responses to various pollutants (e.g. organic, toxic, and sediment) may be assessed through interpretation of diversity, known organism tolerances, and in some cases, relative abundances and feeding types.

FISH TISSUE

Many pollutants occur in such low concentrations in the water column that they are usually below analytical detection limits. Over time many of these chemicals may accumulate in fish tissue to levels that are easily measured. By analyzing fish tissue it is possible to see what pollutants may be present in waterbodies at very low levels. This information can also be used to determine if consumption of the fish pose any undue human health concerns and to calculate consumption rates that are safe.

DISSOLVED OXYGEN

Oxygen is essential for the survival and propagation of aquatic organisms. If the amount of oxygen dissolved in water falls below the minimum requirements for survival, aquatic organisms or their eggs and larvae may die. A severe example is a fish kill. Dissolved oxygen (DO) varies greatly due to natural phenomena, resulting in daily and seasonal cycles. Different forms of pollution also can cause declines in DO.

Changes in DO levels can result from temperature changes or the activity of microscopic plants (algae or phytoplankton) present in a waterbody. The natural diurnal (daily) cycle of DO concentration is well documented. Dissolved oxygen concentrations are generally lowest in the morning, climbing throughout the day and peaking near dusk, then steadily declining during the hours of darkness. Photosynthesis by phytoplankton releases oxygen during the day, which results in a rise in DO. In the dark, respiration consumes DO and lowers the concentration.

There is also a seasonal DO cycle in which concentrations are greater in the colder, winter months and lower in the warmer, summer months. Secondary stations are only sampled during summer months when water temperatures are elevated and DO concentrations are depressed. Streamflow is lower during the summer and greatly affects flushing and reaeration, which affect dissolved oxygen values.

When comparing the SCDHEC data to DO standards, it is necessary to consider several extenuating circumstances that contribute to apparent noncompliance, such as sampling bias due to season. Samples are collected as a single instantaneous grab sample, which is not truly representative of the daily average used as the criterion for most classifications. Secondary stations are sampled only during summer months and generally result in a higher rate of DO excursions as a result. It is essential to examine the data to ascertain such patterns of excursions before summarily concluding that the indicated violations constitute poor water quality. The impact of biased sampling protocols must also be weighed as a factor in instances of nonsupport of classified uses.

Biochemical Oxygen Demand

Five-day biochemical oxygen demand (BOD_5) is a measure of the amount of dissolved oxygen consumed by the decomposition of carbonaceous and nitrogenous matter in water over a five-day period. The BOD_5 test indicates the amount of biologically oxidizable carbon and nitrogen that is present in wastewater or in natural water. Matter containing carbon or nitrogen uses dissolved oxygen from the water as it decomposes, which can result in a dissolved oxygen decline. The quantity of BOD_5 discharged by point sources is limited through the National Pollutant Discharge Elimination System (NPDES) permits issued by the Department so as to maintain the applicable dissolved oxygen standard.

pH

The hydrogen ion concentration in a water sample is defined as "pH", and is used as a measure of the acidity of the water. The pH scale ranges from 0 to 14 standard units (SU). A pH of 7 is considered neutral, with values less than 7 being acidic, and values greater than 7 being basic. pH may vary from the ranges specified in the standards due to a variety of natural causes. Low pH values are found in natural waters rich in dissolved organic matter, especially in Coastal Plain swamps and black water rivers. The tannic acid released from the decomposition of vegetation causes the tea coloration of the water and low pHs.

High pH values in lakes during warmer months may be due to high phytoplankton (algae) levels. Continuous flushing in streams prevents the development of significant phytoplankton populations. Most phytoplankton are dormant during the cold winter months, and populations begin to increase as the water warms in the spring. The relationship between phytoplankton and pH is well established. Daily cycles in pH are common in waters with significant phytoplankton populations. Photosynthesis by phytoplankton consumes carbon dioxide during the day releasing carbonate, which results in a rise in pH. In the dark, respiration releases carbon dioxide and lowers pH. Soft water lakes and ponds may reach a pH of 9-10 SU during periods of intense photosynthesis when large phytoplankton populations are present.

Fecal Coliform Bacteria

Coliform bacteria are present in the digestive tract and feces of all warm-blooded animals, including humans, poultry, livestock, and wild game species. Fecal coliform bacteria are themselves generally not harmful, but their presence in surface waters may be serious due to their association with sewage or animal waste which may contain pathogenic microbes. At present, it is difficult to distinguish between waters contaminated by animal waste and those contaminated by human waste.

Diseases that can be transmitted to humans through water contaminated by improperly treated human or animal waste are the primary concern. Fecal coliform bacteria are able to survive in water and are usually more numerous than waterborne disease producing organisms (pathogens). Therefore, it is best to test for fecal coliform bacteria as an indicator of possible fecal contamination rather than to try to isolate the relatively few pathogens which may be present in water.

Public health studies have established a correlation between fecal coliform numbers in recreational and drinking waters, and the risk of adverse health effects. Based on these relationships, the USEPA and SCDHEC have developed enforceable standards for surface waters to protect against adverse health effects from various recreational or drinking water uses. Proper waste disposal or sewage treatment prior to discharge to surface waters minimizes this type of pollution.

NUTRIENTS

'Nutrients', in terms of environmental water quality, usually refer to phosphorus and nitrogen, which are primary requirements for the growth and reproduction of aquatic plants. Oxygen demanding materials and nutrients are the most common constituents discharged to the environment by man's activities, through wastewater facilities and by agricultural, residential, and stormwater runoff. In general, increasing nutrient concentrations are undesirable due to the potential for accelerated growth of aquatic vegetation and algal blooms which may, in turn, deplete dissolved oxygen and result in fish kills.

The forms of nitrogen routinely analyzed at SCDHEC stations are ammonia (NH_3+NH_4/N), total Kjeldahl nitrogen (TKN), and nitrite-nitrate nitrogen (NO_2/NO_3). TKN assays the amount of organic nitrogen and ammonia in a sample. Nitrate is the product of aerobic decomposition of ammonia, and is a primary aquatic plant nutrient. Total phosphorus (TP) is measured to determine the phosphorus concentration of surface waters. This test includes all of the various forms of phosphorus (organic, inorganic, dissolved, and particulate) present in a sample.

There are no official standards or criteria for nutrients in water. However, the USEPA has issued recommendations for total phosphate phosphorus concentrations in order to limit eutrophication. High densities of phytoplankton can cause fluctuations of pH and dissolved oxygen beyond standards. Since these are only recommendations, and not a true criterion for use in evaluating water quality, it is difficult to determine the significance of elevated TP values. Because TP includes all forms of phosphorus, including that incorporated into algal biomass, it would be necessary to consider biological data to properly assess the implications of observed concentrations.

TURBIDITY

Turbidity is an expression of the scattering and absorption of light through water. The presence of clay, silt, fine organic and inorganic matter, soluble colored organic compounds, and plankton and other microscopic organisms increases turbidity. Increasing turbidity can be an indication of increased runoff from land. It is an important consideration for drinking water as finished water has turbidity limits. State water quality standards address turbidity in waters classified for Trout.

TOTAL SUSPENDED SOLIDS

Total Suspended Solids (TSS) are the suspended organic and inorganic particulate matter in water. Although increasing TSS can also be an indication of increased runoff from land, TSS differs from turbidity in that it is a measure of the mass of material in, rather than light transmittance through, a water sample. High TSS can adversely impact fish and fish food populations and damage invertebrate populations. There are no explicit state standards for TSS.

HEAVY METALS

The analytical procedures used by the Department measure total metal concentration, which is a relatively conservative approach, since the total metal concentration is always greater than the acid-soluble or dissolved fraction. Most heavy metal criteria for freshwater are calculated from formulas using water hardness. The formulas used to calculate criteria values are constructed to apply to the entire United States, including Alaska and Hawaii. As with all the USEPA criteria, there is also a large margin of safety built into the calculations. The applicability of the hardness based criteria derived from the USEPA formulas to South Carolina waters has been a subject of much discussion. Hardness values vary greatly nationwide (from zero into the hundreds), with South Carolina representing the lower end of the range (statewide average value is approximately 20 mg/l).

Representatives of the USEPA Region IV standards group have stated that no toxicity data for hardness values less than 50 mg/l were used in the development of the formulas. They have expressed reservations about the validity of the formulas when applied to hardness values below 50 mg/l. Based on this opinion, South Carolina's state standards for metals are based on a hardness of 50 mg/l for waters where hardness is 50 mg/l or less, resulting in several criteria values below the Department's current analytical detection limits. Therefore, any detectable concentration of cadmium, copper, or lead is an excursion beyond recommended criteria.

The SCDHEC monitoring data have historically indicated that zinc and copper levels in South Carolina waters are elevated relative to USEPA criteria, apparently a statewide phenomenon in both fresh and salt waters, and possibly resulting from natural conditions or nonpoint sources. These levels do not appear to adversely affect state fisheries, which suggests that the levels are the result of long-term local conditions to which the fauna have adapted, as opposed to point source pollution events. It is difficult to assess the significance of heavy metal excursions due to the questionable applicability of the formulas at low hardness values and the occurrence of calculated criteria below present detection limits. Atmospheric inputs are recognized as important sources of metals to aquatic systems. Metals are released to the atmosphere from the burning of fossil fuels (coal, oil, gasoline), wastes (medical, industrial, municipal), and organic materials. The metals are then deposited on land and in waterways from the atmosphere via rainfall.

Assessment Methodology

USE SUPPORT DETERMINATION

At the majority of SCDHEC's monitoring stations, water samples for analysis are collected as surface grab samples once per month, quarter, or year, depending on the parameter. Grab samples collected at a depth of 0.3 meters are considered a surface measurement. At most stations sampled by boat, dissolved oxygen and temperature are sampled as a water column profile, with measurements being made at a depth of 0.3 meters below the water surface and at one-meter intervals to the bottom. At stations sampled from bridges, these parameters are measured only at a depth of 0.3 meters. For the purpose of assessment, only surface samples are used in standards comparisons and trend assessments. All water and sediment samples are collected and analyzed according to standard procedures (SCDHEC 1981, 1994). Macroinvertebrate community structure is analyzed routinely at selected stations as a means of detecting adverse biological impacts on the aquatic fauna due to water quality conditions which may not be readily detectable in the water column chemistry.

Results from water quality samples can be compared to state standards and USEPA criteria, with some restrictions due to time of collection and sampling frequency. The monthly sampling frequency employed in the ambient monitoring network may be insufficient for strict interpretation of the standards. The USEPA does not define the sampling method or frequency other than indicating that it should be "representative". The grab sample method is considered to be representative for the purpose of indicating excursions relative to standards, within certain considerations. A single grab sample is more representative of a one-hour average than a four-day average, more representative of a one-day average than a one-month average, and so on (see also Screening & Additional Considerations for Water Column Metals below); thus, when inferences are drawn from grab samples relative to standards, sampling frequency and the intent of the standards must be weighed. When the sampling method or frequency does not agree with the intent of the particular standard, conclusions about water quality should be considered as only an indication of conditions, not as a proven circumstance.

The time period used to assess standards compliance is the last complete five years of data, in the Broad Basin it is 1991 through 1995. This time period was chosen in light of subsequent basin assessments that will evaluate data collected within the five years prior to the last assessment.

AQUATIC LIFE USE SUPPORT

One important goal of the Clean Water Act and state standards is to maintain the quality of surface waters in order to provide for the survival and propagation of a balanced indigenous aquatic community of fauna and flora. The degree to which aquatic life is protected (aquatic life use support) is assessed by comparing important water quality characteristics and the concentrations of potentially toxic pollutants with numeric standards.

Support of aquatic life uses is based on the percentage of standards excursions and, where data are available, the composition and functional integrity of the biological community.
A dissolved oxygen (DO) criterion of 4 mg/l is used for Class SB, 6 mg/l for TN and TPGT, and 5 mg/l for all other Classes. An excursion is an occurrence of a DO concentration less than the stated criterion. For pH, there are several acceptable ranges applied depending on the Class of water: 6-8 SU for TPGT; 6-8.5 SU for FW; 5-8.5 SU for FW*; and 6.5-8.5 for SFH, SA, and SB. For DO and pH, if 10 percent or less of the samples contravene the appropriate standard, then the standards are said to be fully supported. A percentage of standards excursions between 11-25 is considered partial support of the standard, and a percentage greater than 25 is considered to represent nonsupport of the standard, unless excursions are due to natural conditions.

Care must be taken in interpretation of dissolved oxygen data as they relate to aquatic life support.

A station for which there are 12 samples could have 3 excursions and be considered to partially meet the standard. This could translate into 3 continuous months where the criteria were not met. Depending on the extent of the excursions, this could be a minor stress for the community or a significant stress that would preclude attainment of the goal of maintaining a balanced indigenous population of native flora and fauna. A single month with extremely low dissolved oxygen concentrations could represent a significant stress, while the criteria would indicate the aquatic life use was fully supported.

If the acute aquatic life standard is exceeded for any individual toxicant (heavy metals, priority pollutants, chlorine, ammonia) in more than 10 percent of the samples, the standard is not supported. If the acute aquatic life standard is exceeded more than once, but in less than or equal to 10 percent of the samples, the standard is partially supported. If the conclusion for any single parameter is that the standard is not supported, then it is concluded that aquatic life uses are not supported. If the conclusion for any single parameter is that the standard is partially supported, then it is concluded that aquatic life uses are partially supported. Biological data are the ultimate deciding factor for aquatic life uses, regardless of chemical conditions. The goal of the standards is the protection of a balanced indigenous aquatic community.

Since most toxicants are collected with less frequency than the physical parameters, some judgement must be used in applying this guidance (see also Screening & Additional Considerations for Water Column Metals below). If the sample size is small, as in the case of something sampled only annually, a single sample above the acute standard constitutes more than 10 percent of the samples. In this instance, it is possible for a single sample to result in a conclusion that aquatic life uses are not supported, despite what other data suggest. In such a circumstance it is noted that aquatic life uses may not be fully supported and the site is prioritized for the collection of biological data, or additional monitoring and investigation, to verify the true situation.

MACROINVERTEBRATE DATA INTERPRETATION

Macroinvertebrate community assessments are used, where available, to supplement or verify Aquatic Life Use Support determinations based on water chemistry data and to evaluate potential impacts from the presence of sediment contaminants. Aquatic and semi-aquatic macroinvertebrates are identified to the lowest practical taxonomic level depending on the condition and maturity of specimens collected. The EPT Index and the North Carolina Biotic Index are the main indices used in analyzing macroinvertebrate data (NCDEHNR 1995). To a lesser extent taxa richness and sometimes total abundance may be used to help interpret data.

The EPT Index is a tabulation of taxa richness within the generally pollution-sensitive groups. EPT values are used in a relative way (usually compared with least impacted regional sites) for station comparisons (Plafkin *et al.* 1989). A database is currently being developed to establish significant EPT index levels to be used in conjunction with the biotic index to address aquatic life use support.
The biotic index for a sample is the average pollution tolerance of all organisms collected, based on assigned taxonomic tolerance values (NCDEHNR 1995).

One method of qualitative data analysis is taxa richness. This is the number of distinct taxa collected and is the simplest measure of diversity. High taxa richness is generally associated with high water quality. Increasing levels of pollution progressively eliminate the more sensitive taxa, resulting in lower taxa richness.

Total abundance is the enumeration of all macroinvertebrates collected at a sampling location. This is generally not regarded as a qualitative metric; however, when gross differences in abundance occur between stations this metric may be considered as a potential indicator.

RECREATIONAL USE SUPPORT

The degree to which the swimmable goal of the Clean Water Act is attained (recreational use support) is based on the frequency of fecal coliform bacteria excursions and the occurrence of swimming area closures. For fecal coliform bacteria, an excursion is an occurrence of a bacteria concentration greater than 400/100 ml for all Classes. Comparisons to the bacteria geometric mean standard are not considered appropriate based on sampling frequency and the intent of the standard. If 10 percent or less of the samples are greater than 400/100 ml then recreational uses are said to be fully supported. A percentage of standards excursions between 11-25% is considered partial support of recreational uses, and greater than 25% is considered to represent nonsupport of recreational uses.

FISH CONSUMPTION USE SUPPORT

Fish consumption use support is determined by the occurrence of advisories or bans on consumption for a waterbody. For the support of fish consumption uses, a fish consumption advisory indicates partial use support, a consumption ban indicates nonsupport of uses.

The Department uses a risk-based approach to evaluate mercury concentrations in fish tissue and to issue consumption advisories in affected waterbodies. This approach contrasts the average daily exposure dose to the reference dose (RfD) (ATSDR 1992). Using these relationships, fish tissue data are interpreted by determining the consumption rates that would not be likely to pose a health threat to adult males and nonpregnant adult females. Because an acceptable RfD for developmental neurotoxicity has not been developed, pregnant women, infants, and children were advised to avoid consumption of fish from any waterbody where an advisory was issued.

HUMAN HEALTH STANDARDS

State standards for human health are also evaluated in the preparation of the Watershed Water Quality Management Strategy assessments (SCDHEC 1993). For contaminants with human health standards (ie. heavy metals, pesticides), a potential human health threat is indicated if the median concentration exceeds the standard.

Additional Screening and Prioritization Tools

LONG-TERM TREND ASSESSMENT

As part of the watershed assessments, surface data from each station are analyzed for statistically significant long-term trends using a modification of Kendall's tau, which is a nonparametric test removing seasonal effects (Bauer *et al.* 1984, Hirsch *et al.* 1982, Smith *et al.* 1982, Smith *et al.* 1987). Flows are not available for most stations, and the parametric concentrations are not flow-corrected. Seasonal Kendall's tau analysis is used to test for the presence of a statistically significant trend of a parameter, either increasing or decreasing, usually over a twelve to fifteen year period. It indicates whether the concentration of a given parameter is exhibiting consistent change in one direction over the specified time period. A two sided test at p=0.1 is used to determine statistically significant trends, and the direction of trend. An estimate of the magnitude of any statistically significant trend is calculated as in Smith *et al.* (1982).

A rigorous evaluation for trends in time-series data usually includes a test for autocorrelation. The data are not tested for autocorrelation prior to the trend analysis. It is felt that autocorrelation would not seriously compromise a general characterization of water quality trends based on such a long series of deseasonalized monthly samples.

One of the advantages of the seasonal Kendall test is that values reported as being below detection limits (DL) are valid data points in this nonparametric procedure, since they are all considered to be tied at the DL value. When the DL changed during the period of interest, all values are considered to be tied at the highest DL occurring during that period (Hirsch *et al.* 1982). Since it is possible to measure concentrations equal to the value of the DL, values less than DL are reduced by subtraction of a constant so that they remain tied with each other, but are less than the values equal to the DL. Since fecal coliform bacteria detection limits vary with sample dilution, there is no set DL; therefore, for values reported as less than some number, the value of the number is used.

SEDIMENT SCREENING

There are no sediment standards; therefore, in order to identify sediments with elevated metals concentrations, percentiles are constructed using five years of statewide sediment data (SCDHEC 1995a). Only values greater than the detection limit were used for chromium, copper, nickel, lead, and zinc. Because so few concentrations of cadmium and mercury are measured above the detection limit, all samples were pooled for these metals. A sediment metal concentration is considered to be high if it is in the top 10% of the pooled results, and very high if it is in the top 5%. Any analytical result above detection limits is flagged for pesticides, PCBs, and other priority pollutants. Sites with noted high metals concentrations or the occurrence of other contaminants above detection limits are prioritized for the collection of biological data, or additional monitoring and investigation, to verify the true situation.

SCREENING & ADDITIONAL CONSIDERATIONS FOR WATER COLUMN METALS

The USEPA criteria for heavy metals to protect aquatic life are specified as a four-day average and a one-hour average (USEPA 1986), and have been adopted as state standards (SCDHEC 1993). Because of the quarterly sampling frequency for heavy metals, the USEPA advises against comparisons to chronic toxicity standards (four-day average concentration); therefore, only the acute standard (one-hour average) for the protection of aquatic life is used in the water quality assessment (Table 1).

Table 1. Metal Standards in Water (µg/l)				
Metal	Present Detection Level	Freshwater 1Hr. Acute Ave.	Saltwater 1Hr. Acute Ave.	Human Health
*Cadmium	10.0	1.79	43.0	5.000
Chromium (VI)	10.0	16.00	1100.0	50.000
*Copper	10.0	9.22	2.9	
*Lead	50.0	33.78	140.0	50.000
Mercury	0.2	2.40	2.1	0.153
*Nickel	20.0	789.00	75.0	4584.000
*Zinc	10.0	65.00	95.0	
* Freshwater standards based on a hardness of 50 mg/l as $CaCO_3$.				

Zinc and copper are elevated statewide and concentrations are frequently measured in excess of the calculated acute aquatic life standards. To identify areas where zinc, copper, and other metals are elevated in the water column above normal background concentrations, concentrations greater than the detection limit from all SCDHEC monitoring sites statewide for a five year period are pooled and the 90th and 95th percentiles are computed (SCDHEC 1995a). This is done separately for each metal for both fresh and saltwaters. The individual measurements from each monitoring station are then compared to these percentiles. As in sediments, a metal concentration is referred to as "high" if it is in the top 10% of the pooled results, and "very high" if it is in the top 5%. All water column values referred to as "high" or "very high" are also in excess of the acute aquatic life standard listed in Table 1. For chromium, because so few concentrations are above the detection limit, all samples collected are used to generate the percentiles. Sites with noted high metals concentrations are prioritized for the collection of biological data, or additional monitoring and investigation, to verify the true situation.

Point Source Contributions

Wasteload Allocation Process

A wasteload allocation (WLA) is the portion of a stream's assimilative capacity for a particular pollutant which is allocated to an existing or proposed point source discharge. Existing WLAs are updated during the basin review process and included in permits during the normal permit expiration and reissuance process. New WLAs are developed for proposed projects seeking a discharge permit or for existing discharges proposing to increase their effluent loading at the time of application. Wasteload allocations for oxygen demanding parameters are developed by the Water Quality Modeling Section, and WLAs for toxic pollutants and metals are developed by the appropriate permitting division.

The ability of a stream to assimilate a particular pollutant is directly related to its physical and chemical characteristics. Various techniques are used to estimate this capacity. Simple mass balance/dilution calculations may be used for a particular conservative (nondecaying) pollutant while complex models may be used to determine the fate of nonconservative pollutants that degrade in the environment. Waste characteristics, available dilution and the number of discharges in an area may, along with existing water quality, dictate the use of a simple or complex method of analysis. Projects which generally do not require complex modeling include: groundwater remediation, noncontact cooling water, mine dewatering, air washers, and filter backwash.

Streams are designated either effluent limited or water quality limited based on the level of treatment required of the dischargers to that particular portion of the stream. In cases where the USEPA published effluent guidelines, the minimum treatment levels required by law are sufficient to maintain instream water quality standards, and the stream is said to be effluent limited. Streams lacking the assimilative capacity for a discharge at minimum treatment levels are said to be water quality limited. In cases where better than technology limits are required, water quality, not minimum requirements, controls the permit limits. The Department's Water Quality Modeling Section recommends limits for numerous parameters including ammonia nitrogen (NH3-N), dissolved oxygen (DO), total residual chlorine (TRC), and five-day biochemical oxygen demand (BOD5). Limits for other parameters, including metals, toxics, and nutrients are developed by the Water Facilities Permitting Division or the Industrial, Agricultural, and Stormwater Permitting Division in conjunction with support groups within the Department.

Permitting Strategy

The Water Facilities Permitting Division and the Industrial, Agricultural, and Stormwater Permitting Division are responsible for drafting and issuing NPDES permits. All NPDES permits in the Broad Basin are to be drafted and issued, or revoked and reissued by September 30, 1997 and will all be reissued together in 2002. Broad Basin permits that remain unissued after September 30, 1997 will be issued during the first quarter of Fiscal Year 98. These permits will also be reissued in 2002 to coincide with the basin permitting year. Major NPDES reissued permits will be individually public noticed in a newspaper of general circulation and minor NPDES reissued permits will be individually public noticed by posting in accordance with Regulation 61-9. New NPDES permits and modifications of existing NPDES permits will be issued as the need arises. New permits and modifications of existing permits will be public noticed by newspaper advertisement and site posting. The permitting Divisions will coordinate drafting of permits for reissue and public notices in the Broad Basin by watershed management units in 2002.

The permitting Divisions use general permits with statewide coverage for certain categories of minor NPDES permits. Discharges covered under general permits include utility water, potable surface water treatment plants, potable groundwater treatment plants with iron removal, petroleum contaminated groundwater, and mine dewatering activities. Additional activities proposed for general permits include bulk oil terminals, aquacultural facilities, and ready-mix concrete/concrete products. Land application systems for land disposal and lagoons are also permitted, and the municipal, community (private), and industrial land application systems will be included in this document as well as NPDES point source dischargers.

A completed draft permit is sent to the permittee, the SCDHEC District office, and if it is a major permit, to the USEPA for review. When the permit draft is finalized, a public notice is issued. Comments from the public are considered and, if requested, a public hearing may be arranged. Both oral and written comments are collected at the hearing, and after considering all information, the Department staff makes the decision whether to issue the permit as drafted, issue a modified permit, or to deny the permit. Everyone who participated in the process receives a copy of the final staff decision. It is anticipated that minor permits will be grouped by watershed and publicly noticed together; major permits will individually stand public review. Staff decisions may be appealed according to the procedures in Regulation 61-72.

Nonpoint Source Contributions

Nonpoint source pollutants are generally introduced to a waterbody during a storm event and enter the system from diverse sources. Nonpoint source contributions originate from a variety of sources that include agriculture, silviculture, construction, urban stormwater runoff, hydrologic modification, landfills, mining, and residual wastes.

Section 319 of the 1987 Amendments to the Clean Water Act required states to assess the nonpoint source water pollution associated with surface and groundwater within their borders and then develop and implement a management strategy to control and abate the pollution. The first Assessment of Nonpoint Source Pollution in South Carolina (SCDHEC 1989) accomplished this purpose. The NPS Management Program developed strategies and targeted waterbodies for priority implementation of management projects. The priority list has been updated several times since then. The current list appears in the State Nonpoint Source Pollution Management Program (SCDHEC 1995b). Comprehensive projects are currently being implemented in a number of these watersheds. Components of the projects vary depending on the particular NPS impacts in the watershed, but all include BMP demonstrations, education, and monitoring.

The conventional §319 NPS Management Program has typically involved SCDHEC program areas or large institutional cooperators such as The Clemson Extension Service and the Department of Natural Resources undertaking large scale projects. In an effort to diversify the participation in the program, the Department allocated a portion of §319 funds to institute a new grants program known as Minigrants. In keeping with the Department's vision statement "Local Solutions to Local Problems", this program sought to gain the involvement of smaller organizations like local governments, nonprofit organizations, and schools in NPS projects that are locally focused and generally smaller in scale.

The purpose of South Carolina's Nonpoint Source Pollution Management Program is to insure the protection and restoration of the state's waters from nonpoint source water pollution impacts. The Plan document describes programs (both regulatory and voluntary) for NPS abatement, targets watersheds for NPS project implementation, and describes the state's strategy under each of the eight categories of NPS sources identified in South Carolina. In each of the categorical sections, management measures are described. Management measures are defined as "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution". The management measures address the following major categories: agriculture, forestry, urban areas, marinas/recreational boating, hydromodification, mining, land application of wastes, and wetlands. The Nonpoint Source Management Program initiates NPS projects during the implementation phase of a targeted basin.

Landfill Activities

All landfill activities within the State are permitted and regulated by the Department's Bureau of Land and Waste Management. All active and closed industrial and municipal solid waste landfills are identified in the appropriate watershed evaluations.

Mining Activities

Mining activities within the State are permitted by the Mining and Reclamation Division of the Department's Bureau of Land and Waste Management. Resource extraction activities and locations are identified in the appropriate watershed evaluations.

Recreational Camps

The two types of camping facilities permitted by the Department through Regulation 61-39 are Resident Camps and Family Camps. Resident camps are organized camps where one or more buildings are provided for sleeping quarters. These camps are typically operated for educational, recreational, religious, or health purposes. Family camps are organized camps where camp sites are provided for use by the general public or certain groups. The camp sewage is discharged into a public collection, treatment and disposal system if available, or an onsite wastewater treatment and disposal system (septic tank) is used. Camp locations are identified in the appropriate watershed evaluations.

Groundwater Concerns

Groundwater is an important resource for drinking water use, together with agricultural, industrial and commercial usages. Based on USEPA drinking water standards, the overall quality of South Carolina's groundwater is excellent. Contaminated groundwater is expensive and difficult to restore; therefore, groundwater protection for present and future usage is the management emphasis. Localized sources of groundwater contamination can include: septic tanks, landfills (municipal and industrial), surface impoundments, underground storage tanks, above ground storage tanks, hazardous waste sites (abandoned and regulated), salt water intrusion, land application or treatment, agricultural activities, road salting, spills and leaks. For the purposes of this assessment, only groundwater contamination affecting surface waters will be identified. A more detailed accounting of groundwater contamination will be addressed in the Broad Basin update in 2001. The groundwater contamination inventory (SCDHEC 1997a) was used to identify groundwater-related problem areas in the basin. Sites in the inventory are referenced by name and county, and are updated annually.

Water Supply

Water treatment facilities are permitted by the Department for municipal and industrial potable water production. As per the 1983 Water Use Reporting and Coordination Act (Act 282), all water uses over 100,000 gallons per day must report their usage. This includes industrial, agricultural, mining, golf courses, public supply, commercial, recreational, hydro power, thermo power, and nuclear power activities. Intake location and the volume removed from a stream are identified in the watershed evaluations for both municipal (potable) and industrial uses.

Growth Potential and Planning

Land use and management can define the impacts to water quality in relation to point and nonpoint sources. Assessing the potential for an area to expand and grow allows for water quality planning to occur and, if appropriate, increased monitoring for potential impairment of water quality. Indicators used to predict growth potential include water and sewer service, road and highway accessibility, and population trends. These indicators and others were used as tools to determine areas within the Broad Basin having the greatest potential for impacts to water quality as a result of development.

Many counties in the Broad Basin lack county wide zoning ordinances; therefore, there is little local regulatory power to influence the direction or magnitude of regional growth. The majority of municipalities have zoning ordinances in place; however, much of the growth takes place just outside the municipal boundaries, where infrastructure is inadequate. Section 208 of the Clean Water Act serves to encourage and facilitate the development and implementation of areawide waste treatment management plans. The §208 Areawide Water Quality Management Plans were completed in great detail during the 1970's and have recently been updated (SCDHEC 1997b, Appalachian Council of Governments 1997, Central Midlands Council of Governments 1997). Information from the updated reports are used in the individual watershed evaluations.

Watershed boundaries extend along topographic ridges and drain surrounding surface waters. Roads are commonly built along ridge tops, with the best drainage conditions. Cities often develop in proximity to ridges as a result of their plateau terrain. It is not uncommon, then, to find cities or road corridors located along watershed boundaries, and thus influencing or impacting several watersheds.

Implementation Process for Impaired Waters

A Total Maximum Daily Load (TMDL) is the calculated maximum allowable pollutant loading to a waterbody at which water quality standards are maintained. A TMDL is made up of two main components, a load allocation and a wasteload allocation. A load allocation is the portion of the receiving water's loading capacity attributed to existing or future nonpoint sources or to natural background sources. The waste load allocation is the portion of a receiving water's loading capacity allocated to an existing or future point source. A TMDL may also include an unallocated portion of the capacity reserved as a margin of safety or for future development.

A TMDL is a means for recommending controls needed to meet water quality standards in a particular water or watershed. Historically, the typical TMDL has been developed as a wasteload allocation, considering a particular waterbody segment, for a particular point source, to support setting effluent limitations. In order to address the combined cumulative impacts of all sources, broad watershed-based TMDLs will now be developed.

The TMDL process is linked to all other State water quality activities, and water quality impairments are identified through monitoring and assessment. Watershed-based investigations result in source identification and TMDL development. TMDLs form links between water quality standards and point and nonpoint source controls. Where TMDLs are established, they constitute the basis for NPDES permits, and for strategies to reduce nonpoint source pollution. The effectiveness and adequacy of applied controls are evaluated through continued monitoring and assessment.

Broad Basin Description

The ***Broad Basin*** incorporates 32 watersheds within 2 Watershed Management Units (WMU) and some 2.5 million acres within the State of South Carolina (a portion of the basin resides in North Carolina). There are a total of 4,719 stream miles in the Broad Basin. Within the Department's Broad Basin are the Enoree River Basin, the Tyger River Basin, the Pacolet River Basin, and the Broad River Basin.

The ***Enoree River Basin*** encompasses 761.6 square miles extending over the Piedmont region. The Enoree River Basin is described in WMU-0501 and encompasses 5 watersheds, some 487,405 acres of which 9.71% is urban land, 12.25% is agricultural land, 10.64% is scrub/shrub land, 0.73% is barren land, 66.39% is forested land, 0.04% is forested wetland, and 0.24% is water (SCLRCC 1990). The urban land percentage is comprised chiefly of the Greenville Metropolitan area. The Enoree River originates near the City of Travelers Rest and accepts drainage from Beaverdam Creek, Warrior Creek, and Duncan Creek before draining into the Broad River. There are 895.5 stream miles in the Enoree River Basin.

The ***Tyger River Basin*** encompasses 841.6 square miles extending over the Piedmont region. The Tyger River Basin is described in WMU-0501 and encompasses 6 watersheds, some 538,617 acres of which 9.94% is urban land, 13.65% is agricultural land, 8.23% is scrub/shrub land, 0.53% is barren land, 66.98% is forested land, and 0.67% is water (SCLRCC 1990). The urban land percentage is comprised chiefly of the City of Greer and portions of the Cities of Spartanburg and Union. There are a total of 977.1 stream miles in the Tyger River Basin. The Tyger River is formed by the confluence of the South Tyger River, the Middle Tyger River, and the North Tyger River near the City of Woodruff and accepts drainage from Fairforest Creek before flowing into the Broad River.

The ***Pacolet River Basin*** encompasses 489.4 square miles extending over the Piedmont region. The Pacolet River Basin is described in WMU-0502 and encompasses 7 watersheds, some 313,221 acres of which 4.52% is urban land, 18.78% is agricultural land, 5.70% is scrub/shrub land, 0.88% is barren land, 69.06% is forested land, and 1.06% is water (SCLRCC 1990). The urban land percentage is comprised chiefly of a portion of the City of Spartanburg. There are a total of 580.1 stream miles in the Pacolet River Basin. The South Pacolet River flows through Lake William C. Bowen and joins the North Pacolet River, which originates in North Carolina, to form Lake Blalock and the Pacolet river. The Pacolet River accepts drainage from Lawsons Fork Creek before flowing into the Broad River.

The ***Broad River Basin*** is described in Watershed Management Unit 0502 and encompasses 14 watersheds and 1,844.8 square miles excluding the Enoree River, the Tyger River, and the Pacolet River Basins which all drain into the Broad River. The Broad River originates in North Carolina and flows across the Piedmont region of South Carolina. Of the 1,180,693 acres, 8.23% is urban land, 11.93% is agricultural land, 5.28% is scrub/shrub land, 0.40% is barren land, 72.24% is forested land, 0.02% is forested wetland, and 1.90% is water (SCLRCC 1990). The urban land percentage is comprised chiefly of the Cities of Gaffney and Chester, and portions of the Cities of York, Union, and Columbia. There are a total of 2,266.3 stream miles in the Broad River Basin. The portion of the Broad River within South Carolina accepts drainage from Buffalo Creek, Cherokee Creek, Kings Creek, Thicketty Creek, Bullock Creek, the Pacolet

River, Turkey Creek, Browns Creek, the Sandy River, the Tyger River, the Enoree River, the Little River, and Cedar Creek.

Physiographic Regions

The State of South Carolina has been divided into six Major Land Resource Areas (MLRAs) by the USDA Soil Conservation Service (USDA 1982): the Blue Ridge, Piedmont, Sand Hills, Upper Coastal Plain, Lower Coastal Plain, and the Coastal Zone. The MLRAs are physiographic regions that have soils, climate, water resources, and land uses in common. The Broad Basin is entirely within the Piedmont region, which is defined as an area of gently rolling to hilly slopes with narrow stream valleys dominated by forests, farms, and orchards; elevations range from 375 to 1,000 feet.

Land Use/Land Cover

General land use/land cover data for South Carolina was derived from SPOT multispectral satellite images using image mapping software to inventory the State's land classifications (SCLRCC 1990). The classifications describing the Broad Basin are as follows.

Urban land is characterized by man-made structures and artificial surfaces related to industrial, commercial and residential uses, as well as vegetated portions of urban areas.

Agricultural/Grass land is characterized by cropland, pasture and orchards, and may include some grass cover in Urban, Scrub/Shrub and Forest areas.

Scrub/Shrub land is adapted from the western Rangeland classification to represent the "fallow" condition of the land (currently unused, yet vegetated), and is most commonly found in the dry Sandhills region including areas of farmland, sparse pines, regenerating forest lands and recently harvested timber lands.

Forest land is characterized by deciduous and evergreen trees not including forests in wetland settings.

Forested Wetland (swampland) is the saturated bottomland, mostly hardwood forests that are primarily composed of wooded swamps occupying river floodplains and isolated low-lying wet areas, primarily located in the Coastal Plain.

Barren land is characterized by an unvegetated condition of the land, both natural (rock, beaches and unvegetated flats) and man-induced (rock quarries, mines and areas cleared for construction in urban areas or clearcut forest areas).

Water (non-land) is characterized by freshwaters only in this basin.

Soil Types

The dominant soil associations, or those soil series comprising, together, over 40% of the land area, were recorded for each watershed in percent descending order. The individual soil series for the Broad Basin are described as follows (USDA 1963-1990).

Alpin soils are well drained and excessively drained, sandy soils with a loamy or sandy subsoil.

Badin soils are moderately deep, well drained, moderately permeable, clayey soils that formed in material weathered from Carolina Slate or other fine grained rock, on ridgetops and side slopes.

Cataula soils are deep, gently sloping to strongly sloping, well drained soils with a loamy surface layer and a clayey subsoil.

Cecil soils are deep, well drained, gently sloping to sloping soils that have red subsoil.

Davidson soils are deep, gently sloping to strongly sloping, well drained to somewhat poorly drained soils with a loamy surface layer and a clayey subsoil.

Enon soils are well drained to somewhat poorly drained, shallow to deep soils, mainly brownish, firm to extremely firm clay loam to clay in the subsoil, on narrow and medium ridges.

Georgeville soils are gently sloping to sloping, well drained and moderately well drained soils.

Goldston soils are dominantly sloping to steep, well drained to excessively drained soils.

Helena soils are gently sloping to sloping, moderately well drained to well drained soils.

Herndon soils are gently sloping to sloping, well drained and moderately well drained soils.

Hiwassee soils are well drained, moderately sloping soils with clayey subsoil, moderately deep.

Madison soils are well drained, moderately sloping soils, with clayey subsoil, moderately deep.

Pacolet soils are well drained, moderately steep soils with clayey subsoil, moderately deep.

Tatum soils are dominantly sloping to steep, well drained to excessively drained soils, with a loamy subsoil, moderately deep or shallow to weathered rock.

Wilkes soils are dominantly strongly sloping to steep, well drained soils.

Winnsboro soils are well drained, gently sloping to steep, moderately deep to deep clayey soils.

Slope and Erodibility

The slope values used in this strategy are approximate slopes derived by NRCS field personnel conducting soil surveys (USDA 1963-1990). The definition of soil erodibility differs from that of soil erosion. Soil erosion may be more influenced by slope, rainstorm characteristics, cover, and land management than by soil properties. Soil erodibility refers to the properties of the soil itself, which cause it to erode more or less easily than others when all other factors are constant. The soil erodibility factor, K, is the rate of soil loss per erosion index unit as measured on a unit plot (USDA 1978), and represents an average value for a given soil reflecting the combined effects of all the soil properties that significantly influence the ease of soil erosion by rainfall and runoff if not protected. The K values in this assessment were derived from the Nonpoint Source Pollution Assessment (SCLRCC 1988), where values closer to 1.0 represent higher soil erodibility and a greater need for best management practices to minimize erosion and contain those sediments which do erode. The range of K-factor values in the Broad Basin is from 0.15 to 0.39, among the 32 hydrologic units or watersheds.

Watershed Evaluations and Implementation Strategies Within WMU-0501

Watershed Management Unit (WMU) 0501 consists primarily of the ***Enoree River Basin*** and the ***Tyger River Basin***. WMU-0501 encompasses the Piedmont region of the State. There are a total of 11 watersheds in WMU-0501, some one million acres of which 9.83% is urban land, 12.98% is agricultural land, 9.38% is scrub/shrub land, 0.63% is barren land, 66.70% is forested land, 0.02% is forested wetland, and 0.46% is water (SCLRCC 1990). There are a total of 1,872.6 stream miles in WMU-0501.

The Enoree River originates near the City of Travelers Rest and accepts drainage from Beaverdam Creek, Warrior Creek, and Duncan Creek before draining into the Broad River. The Tyger River is formed by the confluence of the South Tyger River, the Middle Tyger River, and the North Tyger River near the City of Woodruff and accepts drainage from Fairforest Creek before flowing into the Broad River.

Climate

Normal yearly rainfall in the WMU-0501 area is 48.83 inches, according to the S.C. historic climatological record (SCWRC 1990). Data compiled from National Weather Service stations in Greenville-Spartanburg, Spartanburg, Woodruff, Union, Laurens, Whitmire, and Newberry were used to determine the general climate information for this portion of the State. The highest level of rainfall occurs in the spring with 13.55 inches; 12.41, 10.37, and 12.50 inches of rain falling in the summer, fall, and winter, respectively. The average annual daily temperature is 60.6°F. Spring temperatures average 60.5°F and summer, fall, and winter temperatures are 77.4°F, 61.4°F, and 43.1°F, respectively.

03050108-010

(Enoree River)

General Description

Watershed 03050108-010 is located in Greenville, Spartanburg, and Laurens Counties and consists primarily of the ***Enoree River*** and its tributaries from its origin to Beaverdam Creek. The watershed occupies 169,597 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Madison series. The erodibility of the soil (K) averages 0.27; the slope of the terrain averages 10%, with a range of 2-25%. Land use/land cover in the watershed includes: 21.64% urban land, 20.52% agricultural land, 5.76% scrub/shrub land, 1.18% barren land, 50.81% forested land, and 0.08% water.

The Enoree River originates near the City of Travelers Rest and accepts drainage from the North Enoree River, Long Branch, Beaverdam Creek, Buckhorn Creek (Buckhorn Lake), Mountain Creek (Mountain Lake), Cane Creek, and Princess Creek. Brushy Creek flows through the City of Greenville to enter the river next followed by Rocky Creek (Oak Grove Lake, Shannon Lake, Little Rocky Creek), Dillard Creek, Abner Creek (Vine Creek, Padgett Creek), another Little Rocky Creek, and Peters Creek. Gilder Creek (Earls Lake) originates near the City of Mauldin and is joined by Bridge Fork Creek, Little Gilder Creek, Graze Branch, Horsepen Creek, and Long Branch before flowing into the river downstream of Peters Creek. Hunter Branch enters the river next followed by Buzzard Spring Branch and Lick Creek. Durbin Creek originates near the City of Simpsonville and accepts drainage from Howard Branch, Wilson Branch, Little Durbin Creek, and South Durbin Creek (Reedy Creek) before draining into the Enoree River. Dildane Creek flows into the river downstream of Durbin Creek and is followed by Brock Page Creek and Boggy Creek. Due to the absence of point source dischargers and the presence of endangered species and other special characteristics, portions of Buckhorn Creek may qualify as a potential ORW (outstanding resource water) candidate. There are several ponds and lakes (12-52 acres) in this watershed used for recreational purposes, and a total of 366.2 stream miles, all classified FW. Paris Mountain State Park is located to the north of the City of Greenville; portions of Buckhorn Creek and Mountain Creek are located within the park. There is a Heritage Trust Preserve along the Enoree River just upstream of its confluence with the North Enoree River.

Water Quality

Enoree River - There are seven monitoring sites along this portion of the Enoree River. Aquatic life uses are not supported at the furthest upstream site **(BE-001)** due to chronic occurrences of zinc in excess of the aquatic life acute standard. Every sample collected during the assessment period fell into either the very high or high concentration range, including 17 very high concentrations and 3 high concentrations. In addition, there is a significantly increasing trend in turbidity. The 1995 sediment sample revealed the pesticides P,P'DDT, P,P'DDD, and P,P'DDE (metabolites of DDT). Although the use of DDT was banned in 1973, it is very persistent in the environment. Significantly decreasing trends in five-day biochemical oxygen demand

and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions.

Aquatic life uses are fully supported at the next site downstream (BE-015), but may be threatened by a significantly increasing trend in pH. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. At the next site downstream **(BE-017)**, aquatic life uses are partially supported due to occurrences of copper in excess of the aquatic life acute standard. Recreational uses are not supported at either BE-015 or BE-017 due to fecal coliform bacteria excursions.

Further downstream **(BE-018)**, aquatic life uses are partially supported based on macroinvertebrate community data. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. Aquatic life uses are also partially supported at the next site downstream **(BE-019)** based on macroinvertebrate community data.

At the next site downstream **(B-037)**, aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions. Aquatic life uses are also fully supported at the furthest downstream site (B-040), but recreational uses are partially supported due to fecal coliform bacteria excursions. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Beaverdam Creek (BE-039) **-** Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Mountain Creek (B-186) **-** Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in turbidity. A significantly decreasing trend in total phosphorus concentration suggests improving conditions for this parameter. Recreational uses are not supported due to fecal coliform bacteria excursions. In addition, there is a significantly increasing trend in fecal coliform bacteria concentration. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Princess Creek (B-192) **-** Aquatic life uses are not supported due to pH excursions and occurrences of zinc in excess of the aquatic life acute standard, including a very high concentration measured in 1995. In addition, there are increasing trends in pH and total nitrogen concentrations. A significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Pesticides (dieldrin and phosdrin) were detected in the 1994 sediment sample. Recreational uses are partially supported due to fecal coliform bacteria excursions, compounded by a significantly increasing trend in fecal coliform bacteria concentration.

Brushy Creek **-** There are two monitoring sites along Brushy Creek. Aquatic life uses are fully supported at both the upstream site **(BE-035)** and the downstream site **(BE-009)**, and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration at the downstream site suggest improving conditions for these parameters. Recreational uses are not supported at either site due to fecal coliform bacteria excursions.

Rocky Creek (BE-007) **-** Aquatic life uses are fully supported, and a significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentration, and turbidity suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. In addition, there is a significantly increasing trend in fecal coliform bacteria concentration.

Gilder Creek **-** There are three monitoring sites along Gilder Creek **(BE-040, B-241, BE-020)**. Aquatic life uses are fully supported at all sites, but may be threatened at the midstream and downstream sites due to a significantly increasing trend in pH. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters at all sites. In addition, a significantly increasing trend in dissolved oxygen concentration at B-241 and BE-020 and decreasing turbidity at BE-040 and B-241 suggest improving conditions. Recreational uses are not supported at any site due to fecal coliform bacteria excursions, and there is a significantly increasing trend in fecal coliform bacteria concentration at all sites.

Lick Creek (B-038) **-** Aquatic life uses are fully supported, and a significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Durbin Creek **-** There are three monitoring sites along Durbin Creek. Aquatic life uses are fully supported at the upstream site **(B-035)** and the midstream site **(B-097)**, but recreational uses are not supported at these sites due to fecal coliform bacteria excursions. In addition, there is a significantly increasing trend in fecal coliform bacteria concentration at the midstream site. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions at both the upstream and midstream sites for these parameters. Aquatic life uses are fully supported at the downstream site **(B-022)** based on macroinvertebrate community data. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Buckhorn Lake **-** In an effort to provide access for swimming and fishing, aquatic herbicides were applied in 1994 by the South Carolina Department of Natural Resources.

Recreational Swimming Areas

RECEIVING STREAM	*SWIMMING LOCATION*
BEAVERDAM CREEK TRIBUTARY	PARIS MOUNTAIN

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
ENOREE RIVER CITY OF WOODRUFF PIPE #: 001 FLOW: 1.8	SC0045802 MAJOR MUNICIPAL EFFLUENT
ENOREE RIVER POLYTECH INC. PIPE #: 001 FLOW: M/R	SCG250062 MINOR INDUSTRIAL EFFLUENT
ENOREE RIVER NATIONAL STARCH & CHEMICAL CO. PIPE #: 002 FLOW: 0.12 WQL FOR BOD5,DO,TRC,NH3N	SC0038229 MAJOR INDUSTRIAL WATER QUALITY
ENOREE RIVER JPS AUTOMOTIVE PRODUCTS/TAYLORS PIPE #: 001 FLOW: 0.0707 WQL FOR BOD5	SCG641015; SCG250149 MINOR INDUSTRIAL WATER QUALITY
ENOREE RIVER INMAN MILLS/RAMEY PLANT PIPE #: 001 FLOW: 0.05 WQL FOR BOD5,DO,TRC,NH3N	SC0002496 MINOR INDUSTRIAL WATER QUALITY
ENOREE RIVER WCRSA/TAYLORS AREA PLANT PIPE #: 001 FLOW: 7.5 WQL FOR BOD5,DO,TRC,NH3N	SC0024309 MAJOR MUNICIPAL WATER QUALITY
ENOREE RIVER WCRSA/PELHAM PLANT PIPE #: 001 FLOW: 7.5 WQL FOR BOD5,DO,TRC,NH3N	SC0033804 MAJOR MUNICIPAL WATER QUALITY
ENOREE RIVER WCRSA/GILDER CREEK PIPE #: 001 FLOW: 4.0 WQL FOR BOD5,DO,TRC,NH3N	SC0040525 MAJOR MUNICIPAL WATER QUALITY
ENOREE RIVER GREENWOOD HOLDING CORP./GREER PIPE #: 001 FLOW: 0.03 WQL FOR BOD5,DO	SC0042056 MINOR INDUSTRIAL WATER QUALITY
ENOREE RIVER ENOREE LANDFILL	PROPOSED MINOR INDUSTRIAL

PIPE #: 001 FLOW: 0.0033	EFFLUENT
PRINCESS CREEK CAROLINA PRODUCTS WWTP PIPE #: 001 FLOW: M/R	SCG250047 MINOR INDUSTRIAL EFFLUENT
BEAVERDAM CREEK WCRSA/COACHMAN ESTATES PIPE #: 001 FLOW: 0.025 WQL FOR BOD5,DO,TRC,NH3N	SC0024040 MINOR MUNICIPAL WATER QUALITY
MOUNTAIN CREEK ALTAMONT FOREST PIPE #: 001 FLOW: 0.0124 WQL FOR TRC,NH3N	SC0034398 MINOR COMMUNITY WATER QUALITY
MOUNTAIN CREEK MORTON INTERNATIONAL, INC. PIPE #: 001 FLOW: M/R	SCG250097 MINOR INDUSTRIAL EFFLUENT
PRINCESS CREEK EXIDE/GENERAL BATTERY CORP. PIPE #: 001 FLOW: M/R	SC0042633 MINOR INDUSTRIAL EFFLUENT
BRUSHY CREEK LIBERTY LIFE INSURANCE PIPE #: 001 FLOW: 0.03	SCG250166 MINOR INDUSTRIAL EFFLUENT
ROCKY CREEK NYCOIL COMPANY/DM DIV. PIPE #: 001 FLOW: M/R	SCG250061 MINOR INDUSTRIAL EFFLUENT
ROCKY CREEK METROMONT MATERIALS/ROPER MTN PIPE #: 001 FLOW: M/R	SC0044636 MINOR INDUSTRIAL EFFLUENT
ROCKY CREEK TRIBUTARIES GE/GREENVILLE GAS TURBINE PLT PIPE #: 001 FLOW: 0.45 PIPE #: 010 FLOW: MR PIPE #: 011 FLOW: MR	SC0003484 MINOR INDUSTRIAL EFFLUENT EFFLUENT EFFLUENT
VINE CREEK BECKLEY STONE CO./PELHAM QUARRY PIPE #: 001 FLOW: M/R	SCG730042 MINOR INDUSTRIAL EFFLUENT
BROCK PAGE CREEK PIEDMONT DIELECTRICS PIPE #: 001 FLOW: M/R	SCG250056 MINOR INDUSTRIAL EFFLUENT
PADGETT CREEK SSSD/HIGHWAY 101 BUSINESS PARK PIPE #: 001 FLOW: 0.03-0.04 WQL FOR BOD5,DO,TRC; NH3N IN SUMMER & WINTER	SC0047350 MINOR MUNICIPAL WATER QUALITY
DILLARD CREEK CHEVRON USA, INC. PIPE #: 001 FLOW: M/R	SCG830001 MINOR INDUSTRIAL EFFLUENT

GILDER CREEK RENOSOL CORPORATION PIPE #: 001 FLOW: 0.0002	SC0037966 MINOR INDUSTRIAL EFFLUENT
GILDER CREEK BI-LO INC./MAULDIN WAREHOUSE PIPE #: 001 FLOW: M/R	SCG250063 MINOR INDUSTRIAL EFFLUENT
BRIDGE FORK CREEK METROMONT MATERIALS/MAULDIN PIPE #: 001 FLOW: 0.002	SC0038016 MINOR INDUSTRIAL EFFLUENT
DURBIN CREEK WCRSA/DURBIN CREEK PLT PIPE #: 001 FLOW: 3.3 PIPE #: 001 FLOW: VARIABLE (PROPOSED) WQL FOR BOD5,DO,TRC,NH3N	SC0040002 MAJOR MUNICIPAL WATER QUALITY WATER QUALITY
DURBIN CREEK PARA-CHEM SOUTHERN, INC. PIPE #: 001 FLOW: M/R	SCG250117 MINOR INDUSTRIAL EFFLUENT
LITTLE ROCKY CREEK BROCKMAN CATFISH FARM PIPE #: 001 FLOW: 0.1 WQL FOR BOD5,DO	SC0042030 MINOR INDUSTRIAL WATER QUALITY
ENOREE RIVER TRIBUTARY BUCK-A-ROO RANCH INC. PIPE #: 001 FLOW: 0.0101 WQL FOR TRC,NH3N	SC0026662 MINOR COMMUNITY WATER QUALITY

LAND APPLICATION **FACILITY NAME**	**PERMIT#** **TYPE**
SPRAYFIELD 3R, INC. GREER SITE 2-BROCKMAN RD	ND0077399 INDUSTRIAL

Camp Facilities

FACILITY NAME/TYPE ***RECEIVING STREAM***	***PERMIT #*** ***STATUS***
CAMP BUCKHORN/RESIDENT BUCKHORN CREEK	23-305-0127 ACTIVE

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
CRYOVAC DUMP INDUSTRIAL	CERCLA SCD980844021 BEING CLOSED
ENOREE LANDFILL MUNICIPAL	231001-1102 ACTIVE

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
ASHMOORE BROTHERS, INC. 418 SAND PIT	0883-30 SAND

Water Supply

WATER USER (TYPE) *STREAM*	*RATED PUMP. CAPACITY (GPM)* *AMT. TRT./DIV. (MGD)*
JPS AUTOMOTIVE PRODUCTS/TAYLORS PLT 2 (I) ENOREE RIVER	1389.O 2.O

Groundwater Concerns

The groundwater in the vicinity of the property owned by Colonial Pipeline (Site #14828) is contaminated with petroleum products (home fuel oil) due to spills and leaks. The surface water affected by the contamination is Durbin Creek and the area is being monitored. The groundwater in the vicinity of the property owned by Buddy's Inc. (Site #04167) is also contaminated with petroleum products. In this case the contamination is due to underground storage tanks and is considered a risk-based corrective action priority classification 1 (SCDHEC 1997). The contaminated plume is discharging to Brushy Creek.

The groundwater in the vicinity of the property owned by Para-chem Southern, Inc. is contaminated with volatile organic compounds (VOC) resulting from several sources including landfills, pits, ponds, lagoons, and unpermitted disposal. This is an EPA NPL site and is currently in the assessment and remediation phase. The surface water affected by the VOCs is an unnamed tributary of Durbin Creek. Another area with contaminated groundwater is in the vicinity of the property owned by GE Gas Turbine, and it is contaminated with VOCs, petroleum products, and phenol resulting from several sources including spills and leaks, pits, ponds, lagoons, septic tank/tile fields and unknown sources. The facility is currently in the assessment, monitoring, and remediation phases. The groundwater extraction system in the WWTP area has been effective in bringing the stream into compliance. The surface water affected by the contamination is Little Rocky Creek.

Growth Potential

There is a high potential for residential, commercial, and industrial growth in this watershed, which contains the eastern portion of the greater Greenville area. The expansion of the Greenville-Spartanburg Airport and highway improvements around the airport and connecting Greenville to the City of Greer and on to the City of Spartanburg will stimulate continued industrial growth between SC 101, SC 417, the Enoree River, and SC 14. Future industrial development will be prevalent along I-385. The City of Woodruff should also experience industrial, commercial, and residential growth.

Implementation Strategy

This section of the Enoree River is impaired by elevated levels of copper from unknown sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible. Biological samples were collected at sites further downstream and will be evaluated to determine the cause of their impairment. The Enoree River, Beaverdam Creek, and Mountain Creek are impaired from elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050108-020

(Enoree River)

General Description

Watershed 03050108-020 is located in Spartanburg, Laurens, and Union Counties and consists primarily of the ***Enoree River*** and its tributaries from Beaverdam Creek to Duncan Creek. The watershed occupies 71,546 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Wilkes series. The erodibility of the soil (K) averages 0.25; the slope of the terrain averages 18%, with a range of 2-45%. Land use/land cover in the watershed includes: 0.85% urban land, 6.20% agricultural land, 5.13% scrub/shrub land, 0.44% barren land, 87.34% forested land, and 0.04% water.

This segment of the Enoree River accepts drainage from the upstream reach (03050108-010) together with the Beaverdam Creek Watershed, Twomile Creek (Hannah Creek), Buckhead Creek, the Warrior Creek Watershed, Enoree Creek, and Cedar Shoals Creek. Elishas Creek enters the river next followed by Frenchman Creek, Johns Creek (Wildcat Branch), Sispring Branch, and Hills Creek. There are a few recreational lakes (10-35 acres) in this watershed and a total of 126.5 stream miles, all classified FW. The lower portion of the watershed resides within the Sumter National Forest.

Water Quality

Enoree River - There are three monitoring sites along this section of the Enoree River. Aquatic life uses are fully supported at the upstream site **(BE-024)**, and a significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Recreational uses are partially supported due to fecal coliform bacteria excursions. Aquatic life uses are also fully supported at the midstream **(B-041)** and downstream **(B-053)** sites, but may be threatened by a significantly decreasing trend in pH, a significantly increasing trend in turbidity, and a high concentration of zinc measured in 1991. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported at either B-041 or B-053 due to fecal coliform bacteria excursions. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
ENOREE RIVER	SC0041602
TOWN OF WHITMIRE WTP	MINOR DOMESTIC
PIPE #: 001 FLOW: M/R	EFFLUENT
ENOREE CREEK	SCG730013

CAROLINA VERMICULITE PIPE #: 001 FLOW: M/R	MINOR INDUSTRIAL EFFLUENT
ENOREE RIVER RIVERDALE MILLS W&S DISTRICT PIPE #: 001 FLOW: 0.09 WQL FOR BOD5,DO,TRC,NH3N	SC0035734 MINOR MUNICIPAL WATER QUALITY
ENOREE RIVER WR GRACE/SUMMER MINE PIPE #: 001 FLOW: M/R	SCG730001 MINOR INDUSTRIAL EFFLUENT
TWOMILE CREEK PIEDMONT DIELECTRICS CORP., INC. PIPE #: 001 FLOW: M/R	SCG250056 MINOR INDUSTRIAL EFFLUENT
BUCKHEAD CREEK WR GRACE/ROPER MINE PIPE #: 001 FLOW: M/R	SCG730089 MINOR INDUSTRIAL EFFLUENT
BUCKHEAD CREEK TRIBUTARY WR GRACE/KEARNEY MILL PIPE #: 001 FLOW: M/R	SC0045811 MINOR INDUSTRIAL EFFLUENT

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
TOWN OF WHITMIRE MUNICIPAL	SCD980558084 CLOSED
NATIONAL STARCH INDUSTRIAL	422433-1601 CLOSED

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
PATTERSON VERMICULITE CO. NUMBER 8 MINE	1034-30 VERMICULITE
WR GRACE & CO. SCHUMACHER MINE	0907-42 VERMICULITE
WR GRACE & CO. BELK MINE	0693-42 VERMICULITE
WR GRACE & CO. WATSON MINE	1023-42 VERMICULITE
WR GRACE & CO. GIDEON MINE	0833-42 VERMICULITE
WR GRACE & CO. SUMMER MINE	0714-30 VERMICULITE

WR GRACE & CO. ROPER MINE	1119-30 VERMICULITE ORE
WR GRACE & CO. DESHIELDS #1 & #2 MINE	1019-42 VERMICULITE ORE
WR GRACE & CO. BOYD-WHITMORE MINE	1118-30 VERMICULITE ORE
RAY BROWN ENTERPRISES BROWN SAND MINE #2	0861-42 SAND
CAROLINA VERMICULITE SUMNER #1 MINE	0754-42 VERMICULITE
CAROLINA VERMICULITE LAURENCE MINE	1048-44 VERMICULITE ORE

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF CLINTON (M) ENOREE RIVER	3.5 1.7
TOWN OF WHITMIRE (M) ENOREE RIVER	2.2 1.0

Growth Potential

There is a low potential for growth in the upper portion of this watershed associated with industrial development along US 221. The watershed is bisected by I-26 and some growth may be expected around the interstate interchanges. A commercial corridor has developed along US 176 and SC 72 serving the Whitmire community. Public water is available, but little growth is expected.

Implementation Strategy

The Enoree River is impaired by elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050108-030

(Beaverdam Creek/Warrior Creek)

General Description

Watershed 03050108-030 is located in Laurens County and consists primarily of ***Beaverdam Creek and Warrior Creek*** and their tributaries. The watershed occupies 34,834 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Madison-Davidson-Pacolet series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 14%, with a range of 2-40%. Land use/land cover in the watershed includes: 0.78% urban land, 21.91% agricultural land, 13.72% scrub/shrub land, 1.78% barren land, 61.04% forested land, and 0.77% water.

Beaverdam Creek flows into the Enoree River near the Town of Enoree and further downstream Warrior Creek enters the river. Beaverdam Creek accepts drainage from Wallace Branch and Warrior Creek accepts drainage from Double Branch and Strouds Branch. There are several ponds and lakes (11-183 acres) in this watershed used for recreation, industry, mining, flood control, water supply, and aquaculture. There are a total of 85.3 stream miles, all classified FW.

Water Quality

Beaverdam Creek (B-246) - Aquatic life uses are fully supported based on physical, chemical, and macroinvertebrate community data. Recreational uses are not supported due to fecal coliform bacteria excursions.

Warrior Creek - There are two monitoring sites along Warrior Creek. Aquatic life uses are fully supported at the upstream site **(B-150)**, but may be threatened by the occurrence of chromium in excess of the acute aquatic life standard. Recreational uses are not supported due to fecal coliform bacteria excursions. At the downstream site **(B-742)**, aquatic life uses are fully supported based on macroinvertebrate community data.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
BEAVERDAM CREEK VULCAN MATERIALS CO./GRAY COURT PIPE #: 001 FLOW: M/R	SCG730055 MINOR INDUSTRIAL EFFLUENT
WARRIOR CREEK WR GRACE/KEARNEY MILL PIPE #: 002 FLOW: 0.025 PROPOSED; WQL FOR BOD5,DO,TRC,NH3N	SC0045811 MINOR INDUSTRIAL WATER QUALITY

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
CAROLINA VERMICULITE CHARLES WALDREP	0970-30 VERMICULITE
VULCAN MATERIALS CO. GRAY COURT QUARRY	0061-30 GRANITE
WR GRACE & CO. F. WALDREP MINE	1022-30 VERMICULITE ORE
WR GRACE & CO. WRIGHT NO. 1 & 2	0278-30 VERMICULITE
WR GRACE & CO. DAVIS-DEWITT MINE	1018-30 VERMICULITE ORE

Growth Potential

There is a low to moderate potential for growth in this watershed. I-385 crosses the watershed and some industrial growth may be expected around interstate interchanges.

03050108-040

(Duncan Creek)

General Description

Watershed 03050108-040 is located in Laurens and Newberry Counties and consists primarily of ***Duncan Creek*** and its tributaries. The watershed occupies 92,409 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Wilkes-Madison-Pacolet series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 16%, with a range of 2-45%. Land use/land cover in the watershed includes: 4.57% urban land, 7.62% agricultural land, 5.90% scrub/shrub land, 0.63% barren land, 81.02% forested land, and 0.26% water.

Duncan Creek originates near the Town of Ora and accepts drainage from Duncan Creek Reservoir 6B (73 acres), Long Branch, Saxton Branch, Beards Fork Creek, Millers Fork (Sand Creek), and Allisons Branch. Beards Fork Creek and Millers Fork enter Duncan Creek near the City of Clinton. Further downstream near the Town of Whitmire, South Fork Duncan Creek (Ned Wesson Branch) enters Duncan Creek followed by Mulberry Branch and Sandy Branch. There are several ponds and lakes (11-73 acres) in this watershed used for recreational, municipal, and flood control purposes and a total of 142.5 stream miles, all classified FW. The lower portion of the watershed resides within the Sumter National Forest.

Water Quality

Duncan Creek (B-072) - Aquatic life uses are fully supported based on macroinvertebrate community data, but may be threatened by a significantly decreasing trend in dissolved oxygen concentration and by occurrences of zinc in excess of the aquatic life acute standard, including a very high concentration measured in 1995. Significantly decreasing trends in total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Duncan Creek Reservoir 6B (B-735) - Aquatic life uses are fully supported. Although a pH excursion occurred, high pH levels are not uncommon in lakes with significant aquatic plant communities and are considered natural, not standards violations. Duncan Creek Reservoir 6B is a 73-acre impoundment at the headwaters of an unnamed tributary to Duncan Creek at the top of the watershed in Laurens County. The maximum depth is approximately 15 feet (4.5 m) and the average depth is 5.4 feet (1.7 m). The reservoir's watershed comprises approximately 0.8 square miles (2 km2). It is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended.

Beards Fork Creek (B-231) - Aquatic life uses are partially supported due to dissolved oxygen excursions. In addition, there is a significantly decreasing trend in pH. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions, compounded by a significantly increasing trend in fecal coliform bacteria concentration.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
DUNCAN CREEK TOWN OF WHITMIRE PIPE #: 001 FLOW: 0.6 PIPE #: 001 FLOW: 1.0 (PROPOSED) WQL FOR TRC	SC0022390 MINOR MUNICIPAL WATER QUALITY WATER QUALITY
BEARDS FORK CREEK JOHNSON'S CHEVRON PIPE #: 001 FLOW: M/R WQL FOR BOD5	SC0041629 MINOR INDUSTRIAL WATER QUALITY
BEARDS FORK CREEK CLINTON MILLS/BAILEY PIPE #: 001 FLOW: 0.101 PIPE #: 002 FLOW: M/R	SCG250146 MINOR INDUSTRIAL EFFLUENT EFFLUENT
MILLERS FORK CITY OF CLINTON/GARY ST. WTP PIPE #: 001 FLOW: 0.101	SCG645004 MINOR MUNICIPAL EFFLUENT

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
CLINTON MILLS MUNICIPAL	DWP-019 CLOSED
CITY OF CLINTON MUNICIPAL	DWP-026; DWP-914 CLOSED MSW; PROPOSED C&D

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
WR GRACE & CO. GOODWIN MINE	0692-30 VERMICULITE
WR GRACE & CO. COOPER #1 & #2	1064-30 VERMICULITE ORE

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF CLINTON (M) DUNCAN CREEK	3.5 1.7
TOWN OF WHITMIRE (M) DUNCAN CREEK	1.0 1.0

Growth Potential

There is a high potential for industrial growth in this watershed, which contains the City of Clinton and the intersection of I-26 and I-385. Future industrial development will be prevalent along I-385 to the area south of Clinton. US 221 crosses the watershed connecting the Cities of Laurens and Spartanburg, and US 276 connects the Cities of Clinton and Greenville.

Implementation Strategy

Duncan Creek is impaired from elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050108-050

(Enoree River)

General Description

Watershed 03050108-050 is located in Newberry and Laurens Counties and consists primarily of the ***Enoree River*** and its tributaries from Duncan Creek to its confluence with the Broad River. The watershed occupies 119,020 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Pacolet-Wilkes series. The erodibility of the soil (K) averages 0.25; the slope of the terrain averages 13%, with a range of 2-40%. Land use/land cover in the watershed includes: 1.03% urban land, 5.87% agricultural land, 2.42% scrub/shrub land, 0.18% barren land, 90.44% forested land, and 0.07% water.

This segment of the Enoree River accepts drainage from the upstream reaches (03050108-010, 03050108-030) together with Sulphur Spring Branch, Collins Branch, and Indian Creek. Indian Creek originates near the Town of Joanna and accepts drainage from Fort Branch, Loftons Branch, Locust Branch, Long Branch (Buncombe Branch), Headleys Creek (Peges Creek), Pattersons Creek, Asias Branch, Gilders Creek (Johns Mountain Branch, Joshuas Branch), and Hunting Creek. South Fork Kings Creek (Little Kings Creek, Means Branch) enters the river near the City of Newberry followed by Fosters Branch, Quarters Branch, and Subers Creek. There are 175.0 stream miles in this watershed, all classified FW. The entire watershed resides within the Sumter National Forest and the Enoree River Waterfowl Area is located near the confluence with the Broad River.

Water Quality

Enoree River (B-054) - Aquatic life uses are fully supported, but may be threatened by a significantly decreasing trend in dissolved oxygen concentration and a significantly increasing trend in total suspended solids. Sediment samples revealed di-n-butylphthalate in 1995. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Indian Creek (B-071) - Aquatic life uses are fully supported based on macroinvertebrate community data.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
HEADLEYS CREEK	SC0024732
JOANNA KOA	MINOR COMMUNITY
PIPE #: 001 FLOW: 0.010	WATER QUALITY
WQL FOR BOD5,DO,TRC,NH3N	

Growth Potential

There is a low potential for growth in this watershed, with the exception of the City of Woodruff. Woodruff is expected to experience industrial, commercial, and residential growth. The remainder of the watershed is effectively excluded from development by residing in the Sumter National Forest.

03050107-010

(South Tyger River)

General Description

Watershed 03050107-010 is located in Greenville and Spartanburg Counties and consists primarily of the ***South Tyger River*** and its tributaries. The watershed occupies 114,241 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Cataula series. The erodibility of the soil (K) averages 0.29; the slope of the terrain averages 8%, with a range of 2-25%. Land use/land cover in the watershed includes: 9.14% urban land, 22.16% agricultural land, 4.32% scrub/shrub land, 1.21% barren land, 62.09% forested land, and 1.09% water.

Mush Creek (Johnson Creek, Dysort Lake, Meadow Fork), Barton Creek (McKinney Creek also known as Burban Fork Creek, Noe Creek), and Pax Creek join to form the South Tyger River near Pax Mountain. Just downstream of the confluence the South Tyger River is impounded to form Lake Robinson. Downstream of Lake Robinson, the South Tyger River is joined by Beaverdam Creek and forms Lake Cunningham (Clear Creek). Downstream from Lake Cunningham near the City of Greer, the river accepts drainage from Frohawk Creek, Wards Creek, and Maple Creek. The river then flows through Berrys Pond (60 acres) and accepts drainage from 58 acre-Silver Lake (Williams Creek), Brushy Creek (Powder Branch), Bens Creek, Chickenfoot Creek, and Ferguson Creek (Quarter Creek, Big Ferguson Creek, Little Ferguson Creek). There are several ponds and lakes (10-250 acres) in this watershed used for recreation, industry, water supply, and irrigation. There are a total of 248.5 stream miles, all classified FW.

Water Quality

South Tyger River - There are six monitoring sites along the South Tyger River. Aquatic life uses are fully supported at the furthest upstream site **(B-741)** based on macroinvertebrate community data. Aquatic life uses are also fully supported further downstream **(B-149)**, and significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentration, and turbidity suggest improving conditions for these parameters. Recreational uses are fully supported at this site, but may be threatened by a significantly increasing trend in fecal coliform bacteria concentration. Continuing downstream **(B-263)**, aquatic life uses are again fully supported, but may be threatened by a significantly increasing trend in turbidity. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions, but a significantly decreasing trend in fecal coliform bacteria concentrations suggests improving conditions.

Aquatic life uses are partially supported at the next site downstream **(B-005A)** based on macroinvertebrate community data. Further downstream **(B-005)**, aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions. Aquatic life and recreational uses are fully supported at the furthest downstream site **(B-332)**, but aquatic life uses may be threatened by a high concentration of zinc measured in 1995. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Mush Creek (B-317) - Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in turbidity and a high concentration of zinc measured in a 1994 sediment sample. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions.

Lake John Robinson (CL-100) - Lake Robinson is an 802-acre impoundment on the South Tyger River in Greenville County, with a maximum depth of approximately 40 feet (12.3 m) and an average depth of approximately 18 feet (5.4 m). Lake Robinson's watershed comprises 47 square miles (123 km2). The lake is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of Lake Robinson's desirable trophic condition is recommended.

Lake Cunningham (B-341) - Lake Cunningham is a 250-acre impoundment on the South Tyger River in Greenville County, with a maximum depth of approximately 19 feet (5.8 m) and an average depth of 8.9 feet (2.7 m). Lake Cunningham's watershed comprises approximately 48 square miles (124 km2), and includes Lake John Robinson. Historical eutrophication studies indicate that Lake Cunningham's trophic condition is improving. It is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended. Aquatic life and recreational uses are fully supported.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
SOUTH TYGER RIVER SSSD/S.TYGER REGIONAL WWTP PIPE #:001 FLOW: 1.0-2.0 WQL FOR TRC	PROPOSED MAJOR MUNICIPAL WATER QUALITY
SOUTH TYGER RIVER WR GRACE/CRYOVAC/DUNCAN PLT PIPE #: 001 FLOW: 0.05025 WQL FOR DO,NH3N	SC0002313 MINOR INDUSTRIAL WATER QUALITY
SOUTH TYGER RIVER CITY OF GREER/S.TYGER RIVER WWTP PIPE #: 001 FLOW: 1.75 WQL FOR DO,TRC,NH3N	SC0020770 MAJOR MUNICIPAL WATER QUALITY
SOUTH TYGER RIVER TOWN OF DUNCAN WWTP PIPE #: 001 FLOW: 0.275 WQL FOR DO,TRC,NH3N	SC0021008 MINOR MUNICIPAL WATER QUALITY
SOUTH TYGER RIVER LAKEVIEW STEAK HOUSE PIPE #: 001 FLOW: 0.0158	SC0030465 MINOR COMMUNITY EFFLUENT
SOUTH TYGER RIVER MEMC ELECTRONIC MATERIALS PIPE #: 001 FLOW: 0.9 PIPE #: 001 FLOW: 1.2 (PROPOSED) WQL FOR TRC	SC0036145 MAJOR INDUSTRIAL WATER QUALITY WATER QUALITY
SOUTH TYGER RIVER CITY OF GREER CPW WTP PIPE #: 001 FLOW: M/R WQL FOR TRC	SCG645020 MINOR DOMESTIC WATER QUALITY
SOUTH TYGER RIVER SSSD/RIVER FALLS PLANTATION PIPE #: 001 FLOW: 0.07 (PROPOSED) PIPE #: 001 FLOW: 0.14 (PROPOSED) NOT CONSTRUCTED	SC0043524 MINOR MUNICIPAL EFFLUENT EFFLUENT
SOUTH TYGER RIVER CITY OF GREER/MAPLE CREEK PLT PIPE #: 001 FLOW: 4.5 WQL FOR DO,TRC,NH3N	SC0046345 MAJOR MUNICIPAL WATER QUALITY
BEAVERDAM CREEK DAVIDSON MINERAL/SANDY FLATS PIPE #: 001 FLOW: M/R	SCG730079 MINOR INDUSTRIAL EFFLUENT

BURBAN FORK CREEK LOOKUP LODGE/PM UTILITIES INC. PIPE #: 001 FLOW: 0.03 WQL FOR TRC,NH3N	SC0026379 MINOR COMMUNITY WATER QUALITY
MEADOW FORK NORTH GREENVILLE COLLEGE PIPE #: 001 FLOW: 0.04 WQL FOR TRC,NH3N	SC0026565 MINOR COMMUNITY WATER QUALITY
MEADOW FORK LAUREL VALLEY INC. PIPE #: 001 FLOW: 0.2 WQL FOR TRC,NH3N; NOT CONSTRUCTED	SC0045331 MINOR MUNICIPAL WATER QUALITY
WILLIAMS CREEK CARMET COMPANY PIPE #: 001 FLOW: 0.009 WQL FOR DO,TRC,NH3N	SC0038083 MINOR INDUSTRIAL WATER QUALITY
WILLIAMS CREEK MILLIKEN/ARMITAGE PLT PIPE #: 001 FLOW: 0.36 WQL FOR TRC,NH3N	SC0023451 MINOR INDUSTRIAL WATER QUALITY
WILLIAMS CREEK TRIBUTARY US ALUMOWELD CO., INC. PIPE #: 001 FLOW: 0.003 WQL FOR NH3N,TRC	SC0043982 MINOR INDUSTRIAL WATER QUALITY

LAND APPLICATION **FACILITY NAME**	**PERMIT#** **TYPE**
SPRAYFIELD RD ANDERSON APPLIED TECH. CTR.	ND0067351 MUNICIPAL
SPRAYFIELD 3R, INC./GREER SITE 1-WOFFORD RD	ND0077399 INDUSTRIAL

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
CITY OF GREER-SOUTH TYGER WWTP SLUDGE MONOFIL	421003-1501 ACTIVE

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
DAVIDSON MINERAL PROPERTIES, INC. SANDY FLAT QUARRY	0502-23 GRANITE
KING ASPHALT, INC. THEO	0809-42 SAND

CAROLINA VERMICULITE NUKKER-THOMPSON MINE	0893-42 VERMICULITE

Camp Facilities

FACILITY NAME/TYPE *RECEIVING STREAM*	*PERMIT #* *STATUS*
LOOKUP LODGE/RESIDENT BURBAN FORK CREEK	23-305-0116 ACTIVE

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF GREER CPW (M) LAKE CUNNINGHAM	18.0 8.0

Groundwater Concerns

The groundwater in the vicinity of the property owned by Elmore Waste Disposal is contaminated with volatile organic compounds (VOC) resulting from unpermitted disposal. The facility is currently in the remediation phase. The surface water affected by the VOCs is Wards Creek.

Growth Potential

There is a high potential for growth in this watershed, which contains the City of Greer. The Greenville-Spartanburg Airport expansion, the development of the BMW automotive plant, and highway improvements in the area surrounding the BMW plant will stimulate continued growth. Growth is also expected around the I-85 and US 29 corridors, which connect the Cities of Greenville, Greer, and Spartanburg. The Town of Duncan is expected to serve as a bedroom community for the Greer-Spartanburg area.

Implementation Strategy

The South Tyger River has an impaired macroinvertebrate community from point sources. A facility is currently under enforcement action for acute toxicity. The river is also impacted by elevated levels of fecal coliform bacteria due to point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050107-020

(North Tyger River)

General Description

Watershed 03050107-020 is located in Spartanburg County and consists primarily of the upper *North Tyger River* and its tributaries. The watershed occupies 22,376 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Cataula series. The erodibility of the soil (K) averages 0.27; the slope of the terrain averages 12%, with a range of 2-40%. Land use/land cover in the watershed includes: 10.74% urban land, 32.45% agricultural land, 0.57% scrub/shrub land, 0.37% barren land, 54.14% forested land, and 1.73% water.

Jordan Creek, which was impounded to create Lake Cooley, drains into the North Tyger River along with several unnamed tributaries. There are several ponds and lakes (10-330 acres) in this watershed used for recreational purposes and 44.9 stream miles, all classified FW.

Water Quality

North Tyger River (B-219) - Aquatic life uses are partially supported due to occurrences of zinc, including a high concentration that was in excess of the aquatic life acute standard. In addition, there are significantly decreasing trends in dissolved oxygen concentration and pH, and a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions, compounded by a significantly increasing trend in fecal coliform bacteria concentration.

Lake Cooley (B-348) - Lake Cooley is a 330-acre impoundment on Jordan Creek in Spartanburg County, with a maximum depth of approximately 39 feet (12.0 m) and a mean depth of 4.0 feet (1.2 m). Lake Cooley's watershed comprises approximately 10 square miles (27 km2). The lake is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of Lake Cooley's desirable trophic condition is recommended. Aquatic life and recreational uses are fully supported.

Unnamed Tributary to the North Tyger River (B-315) - Aquatic life uses are fully supported, but may be threatened by a significantly decreasing trend in pH. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)***	***NPDES#*** ***TYPE*** ***LIMITATION***
NORTH TYGER RIVER SSSD/BUCKEYE FOREST	SC0000957 MINOR MUNICIPAL

PIPE #: 001 FLOW: 0.06 | EFFLUENT

NORTH TYGER RIVER
STEVECOKNIT/MICKEL PLT
PIPE #: 001 FLOW: M/R

SCG250147
MINOR INDUSTRIAL
EFFLUENT

NORTH TYGER RIVER
LEIGH FIBERS, INC.
PIPE #: 001 FLOW: M/R

SCG250170
MINOR INDUSTRIAL
EFFLUENT

LAKE COOLEY
VULCAN MATERIALS CO.
PIPE #: 001 FLOW: M/R

SCG730056
MINOR INDUSTRIAL
EFFLUENT

NORTH TYGER TRIBUTARY
JACKSON MILLS/WELLFORD PLT
PIPE #: 001 FLOW: 0.05
WQL FOR DO,TRC,NH3N

SC0001716
MINOR MUNICIPAL
WATER QUALITY

Landfill Activities

SOLID WASTE LANDFILL NAME *FACILITY TYPE*	*PERMIT #* *STATUS*
WELLFORD LANDFILL MUNICIPAL	421001-1101 ACTIVE
WELLFORD LANDFILL C&D LANDFILL	421001-1201 ACTIVE
OLD WELLFORD LANDFILL MUNICIPAL	DWP-012 CLOSED
MESSER MIRROR INDUSTRIAL	IWP-196 ACTIVE
PALMETTO LANDFILL MUNICIPAL	422401-1101 ACTIVE

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
VULCAN MATERIAL CO. LYMAN QUARRY	0587-42 GRANITE
GROUND IMPROVEMENT TECHNIQUES, INC. WELLFORD CLAY MINE	1125-42 CLAY

Growth Potential

There is a high potential for growth in this watershed, which connects the Cities of Greer and Spartanburg via the I-85 corridor and major roads with I-85 interchanges. There are also industrial developmental pressures along US 29. The City of Spartanburg is building regional treatment facilities, which should provide for future growth. The City of Wellford is expected to serve as a bedroom community for the Greer-Spartanburg area.

Implementation Strategy

The North Tyger River is impaired by elevated levels of zinc from unknown sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible. The North Tyger River is also impaired from elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050107-030

(North Tyger River)

General Description

Watershed 03050107-030 is located in Spartanburg County and consists primarily of the lower ***North Tyger River*** and its tributaries. The watershed occupies 33,797 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Davidson-Pacolet-Enon-Cecil series. The erodibility of the soil (K) averages 0.29; the slope of the terrain averages 8%, with a range of 2-15%. Land use/land cover in the watershed includes: 18.00% urban land, 16.55% agricultural land, 2.52% scrub/shrub land, 0.08% barren land, 62.77% forested land, and 0.08% water.

Frey Creek (Grays Creek) drains into the North Tyger RIver followed by Jimmies Creek, Cub Branch, Ranson Creek, Tim Creek (Montgomery Pond), and Stillhouse Branch. Further downstream the river flows through Ott Shoals and accepts drainage from Wards Creek (Tanyard Branch), Tin Roof Branch, Johnson Branch (Big Branch), and Thomas Branch. There are several ponds and lakes (10-137 acres) in this watershed used for recreational purposes and 75.2 stream miles, all classified FW.

Water Quality

North Tyger River - There are three monitoring sites along this portion of the North Tyger River. Aquatic life uses are fully supported at the upstream site **(B-017)** based on macroinvertebrate community data. Further downstream **(B-162)**, aquatic life uses are also fully supported, but may be threatened by a significantly decreasing trend in pH and a significantly increasing trend in turbidity. A significantly increasing trend in dissolved oxygen concentration and a significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for these parameters. Aquatic life uses are again fully supported at the downstream site **(B-018A)**, but recreational uses are not supported at either downstream location due to fecal coliform bacteria excursions. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM FACILITY NAME PERMITTED FLOW @ PIPE (MGD)	NPDES# TYPE LIMITATION
NORTH TYGER RIVER ABCO INDUSTRIES LTD. PIPE #: 001 FLOW: 0.036	SC0002321 MAJOR INDUSTRIAL EFFLUENT
NORTH TYGER RIVER LAIDLAW ENV. SERVICES PIPE #: 001 FLOW: 0.234	SC0040517 MAJOR INDUSTRIAL EFFLUENT
NORTH TYGER RIVER SSSD/NORTH TYGER RIVER	SC0043532 MAJOR MUNICIPAL

PIPE #: 001 FLOW: 2.0 WQL FOR TRC,NH3N	WATER QUALITY
NORTH TYGER RIVER SSSD/NORTH TYGER RIVER PIPE #: 001 FLOW: 5.5 (PROPOSED) WQL FOR BOD5,DO,TRC,NH3N	SC0043532 MAJOR MUNICIPAL WATER QUALITY
NORTH TYGER RIVER SSSD/REEVES BROS. WWTP PIPE #: 001 FLOW: 0.085 PIPE #: 001 FLOW: 0.1013 (PROPOSED)	SC0047139 MINOR MUNICIPAL EFFLUENT EFFLUENT
CUB BRANCH HARMON'S TRAILER PARK PIPE #: 001 FLOW: 0.03 WQL FOR DO,TRC,NH3N	SC0033308 MINOR MUNICIPAL WATER QUALITY
CUB BRANCH SSSD/FOREST PARK ESTATES PIPE #: 001 FLOW: 0.05 WQL FOR TRC,NH3N	SC0034321 MINOR MUNICIPAL WATER QUALITY
CUB BRANCH SSSD/SHORESBROOK SD PIPE #: 001 FLOW: 0.2 WQL FOR TRC,NH3N	SC0035891 MINOR MUNICIPAL WATER QUALITY
TIM CREEK SSSD/ROEBUCK MIDDLE SCHOOL PIPE #: 001 FLOW: 0.02 WQL FOR DO,TRC,NH3N	SC0037532 MINOR MUNICIPAL WATER QUALITY
TIM CREEK SSSD/TIM CREEK WWTP PIPE #: 001 FLOW: 0.05 WQL FOR TRC,NH3N	SC0041491 MINOR MUNICIPAL WATER QUALITY
JIMMIES CREEK SYBRON CHEMICALS WWTP PIPE #: 001 FLOW: 0.36 WQL FOR DO	SC0003492 MINOR INDUSTRIAL WATER QUALITY
RANSON CREEK MADERA SD PIPE #: 001 FLOW: 0.076 WQL FOR DO,TRC,NH3N	SC0021687 MINOR COMMUNITY WATER QUALITY
RANSON CREEK TRIBUTARY LINVILLE HILLS SD PIPE #: 001 FLOW: 0.12 WQL FOR DO,TRC,NH3N	SC0034169 MINOR MUNICIPAL WATER QUALITY
FREY CREEK MIDWAY PARK INC. PIPE #: 001 FLOW: 0.015 WQL FOR TRC	SC0030571 MINOR COMMUNITY WATER QUALITY

Landfill Activities

SOLID WASTE LANDFILL NAME *FACILITY TYPE*	*PERMIT #* *STATUS*
PALMETTO LANDFILL MUNICIPAL	422401-1101 ACTIVE
BATCHILDER BLASIUS SMELTING SLAG LANDFILL	---- CLOSED
SPRINGS INDUSTRIES/SPARTANBURG COUNTY INDUSTRIAL/MUNICIPAL	---- CLOSED
TINDAL CONCRETE SPECIAL WASTE LANDFILL INDUSTRIAL	423340-1601 ACTIVE

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
WR GRACE & CO. JOHNSON MINE	0834-42 VERMICULITE

Growth Potential

There is a moderate potential for growth in this watershed. I-26 bisects the watershed and growth is expected around the major highway interchanges, along with industrial developmental pressures along US 29 and US 221. The City of Spartanburg is building regional treatment facilities, which should provide for future growth.

Implementation Strategy

The North Tyger River is impaired by elevated levels of zinc from unknown sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible. The North Tyger River is also impaired from elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050107-040

(Middle Tyger River)

General Description

Watershed 03050107-040 is located in Greenville and Spartanburg Counties and consists primarily of the ***Middle Tyger River*** and its tributaries. The watershed occupies 64,948 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil series. The erodibility of the soil (K) averages 0.28; the slope of the terrain averages 8%, with a range of 2-15%. Land use/land cover in the watershed includes: 9.02% urban land, 23.85% agricultural land, 0.77% scrub/shrub land, 1.08% barren land, 64.32% forested land, and 0.95% water.

The Middle Tyger River accepts drainage from Campbell Creek, Beaverdam Creek (Barnes Creek), and Spencer Creek before flowing into Lyman Lake (Meadow Creek). Downstream of Lyman Lake, another Beaverdam Creek (Foyster Creek, Thompson Branch, Berrys Millpond, Silver Lake) flows into the river followed by Twin Lakes much further downstream. There are several ponds and lakes (16-500 acres) in this watershed used for recreational, industrial, municipal, and irrigational purposes. There are a total of 120.3 stream miles, all classified FW.

Water Quality

Middle Tyger River **-** There are three monitoring sites along the Middle Tyger River. Aquatic life uses are fully supported at the upstream site **(B-148)** based on macroinvertebrate community, but may be threatened by a significantly increasing trend in turbidity, occurrences of zinc (including a very high concentration) in excess of the aquatic life acute standard, and a very high concentration of cadmium measured in sediment. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Aquatic life uses are fully supported at the midstream site **(B-012)**, but may be threatened by a significantly decreasing trend in pH. A significantly decreasing trend in five-day biochemical oxygen demand concentration suggests improving conditions for this parameter. Aquatic life uses are again fully supported at the downstream site **(B-014)** based on physical, chemical, and macroinvertebrate community data. Recreational uses are not supported at any site due to fecal coliform bacteria excursions and there is a significantly increasing trend in fecal coliform bacteria concentration. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
MIDDLE TYGER RIVER	SC0002453
SPARTAN MILLS/STARTEX MILL	MAJOR INDUSTRIAL

PIPE #: 001 FLOW: 0.9 WQL FOR BOD5,DO,TRC	WATER QUALITY
MIDDLE TYGER RIVER TOWN OF LYMAN WWTP PIPE #: 001 FLOW: 6.0 WQL FOR BOD5,DO,TRC,NH3N	SC0021300 MAJOR MUNICIPAL WATER QUALITY
MIDDLE TYGER RIVER SJWD/WTP PIPE #: 001 FLOW: M/R	SCG643003 MINOR MUNICIPAL EFFLUENT
MIDDLE TYGER RIVER SSSD/BROOKSIDE VILLAGE PIPE #: 001 FLOW: 0.08	SC0023698 MINOR MUNICIPAL EFFLUENT
MIDDLE TYGER RIVER SSSD/TWIN LAKES SD PIPE #: 001 FLOW: 0.12	SC0035696 MINOR MUNICIPAL EFFLUENT

LAND APPLICATION **FACILITY NAME**	**PERMIT#** **TYPE**
SPRAYFIELD BLUE RIDGE HIGH SCHOOL	ND0064629 MUNICIPAL

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
SPRINGS INDUSTRIES INDUSTRIAL	—— CLOSED

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
CLARK CONSTRUCTION CO. CLARK-TYGER SAND MINE	0886-23 SAND
PANEX-EC RESTER MINE	0880-23 SAND & GRAVEL

Water Supply

WATER USER (TYPE) ***STREAM***	***PUMPING CAPACITY (MGD)*** ***REG. PUMPING CAPACITY (MGD)***
SJWD (M) MIDDLE TYGER RIVER	32.8 14.0

Growth Potential

There is a high potential for growth in this watershed, which connects the Cities of Greer and Spartanburg via the I-85 corridor and major roads with I-85 interchanges. There are also industrial developmental pressures along US 29. The Towns of Lyman and Startex are expected to serve as a bedroom community for the Greer-Spartanburg area.

Implementation Strategy

The Middle Tyger River is impaired by elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050107-050

(Tyger River)

General Description

Watershed 03050107-050 is located in Spartanburg and Union Counties and consists primarily of the ***Tyger River*** and its tributaries from its confluence with the South and North Tyger Rivers to its confluence with the Broad River. The watershed occupies 152,393 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Wilkes-Madison series. The erodibility of the soil (K) averages 0.24; the slope of the terrain averages 20%, with a range of 6-45%. Land use/land cover in the watershed includes: 0.70% urban land, 6.74% agricultural land, 5.28% scrub/shrub land, 0.34% barren land, 86.90% forested land, and 0.05% water.

The Tyger River is formed by the confluence of the South Tyger River Watershed and the North Tyger River Watershed. The Tyger River then accepts drainage from Nichol Branch (Kelly Branch), Vise Branch, Harrelson Branch (Wofford Branch, Aiken Branch), Jimmies Creek, Cane Creek (Martha Shands Branch, Williams Branch, Trail Branch), Motley Branch, Hackers Creek, and Dutchman Creek. Dutchman Creek accepts drainage from Harrison Branch, Newman Branch, Smith Creek (Jennings Branch), Powder Spring Branch, Shands Branch (Pennywinkle Branch), Paint Bearden Branch, Bearden Branch, another Wofford Branch, Wiley Fork Creek (Carson Branch), and Dry Branch. Cowdens Creek enters the river next followed by Mill Creek, another Wofford Branch, Holcombe Branch, Isaacs Creek, and Sparks Creek. Further downstream, the Tyger River accepts drainage from the Fairforest Creek Watershed, the Tinker Creek Watershed, Hawkins Creek, Johnsons Creek, Padgetts Creek, Evans Branch, Rennicks Branch, Duffs Branch, Peters Creek, and Cane Creek (Brocks Creek). Due to the absence of point source dischargers and the presence of endangered species and other special characteristics, portions of the Tyger River within the Sumter National Forest may qualify as potential ORW candidates. There are a few ponds and lakes (10-25 acres) in this watershed used for recreational purposes and 234.5 stream miles, all classified FW. The lower half of the watershed resides within the Sumter National Forest. Rose Hill State Park is located near the confluence of the Tyger River and Fairforest Creek.

Water Quality

Tyger River - There are two monitoring sites along the Tyger River. Aquatic life uses are fully supported at the upstream site **(B-008)**, but may be threatened by significantly decreasing trends in dissolved oxygen concentration and pH, and a significantly increasing trend in turbidity. Sediment samples revealed a very high concentration of chromium in 1992 and a high concentration in 1993. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. In addition, there is a significantly increasing trend in fecal coliform bacteria concentration.

At the downstream site **(B-051)**, aquatic life uses are not supported due to occurrences of zinc in excess of the aquatic life acute standard, including a high concentration in 1993. In addition, there are significantly increasing trends in pH and turbidity. Significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Jimmies Creek (B-019) - Aquatic life uses are fully supported. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Dutchman Creek (B-733) - Aquatic life uses are fully supported based on macroinvertebrate community data.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
TYGER RIVER SC DEPT. CORR./CROSS ANCHOR CORR. INST. PIPE #: 001 FLOW: 0.35	SC0036773 MINOR COMMUNITY EFFLUENT
TYGER RIVER SYNTHETIC IND./SPARTANBURG PLT PIPE #: 001 FLOW: M/R	SCG250074 MINOR INDUSTRIAL EFFLUENT

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
WR GRACE & CO. FOSTER MINE	0460-42 VERMICULITE
WR GRACE & CO. PROVIDENCE MINE	0706-42 VERMICULITE
WR GRACE & CO. C. CASEY MINE	1017-42 VERMICULITE ORE
WR GRACE & CO. MYERS MINE	1021-42 VERMICULITE ORE
KING ASPHALT, INC. JOSEPH W. THEO MINE	1124-42 SAND
PATTERSON VERMICULITE CO. FANNIE YOUNG MINE	0585-42 VERMICULITE

Growth Potential

There is an overall low potential for growth in this watershed. An exception would be the City of Woodruff, which is expected to experience residential, commercial, and industrial growth. The lower portion of the watershed is effectively excluded from development by the Sumter National Forest. The western section of the Town of Carlisle is in this watershed, and two projects have been proposed which could influence its growth. One is to impound the Tyger River to create a public access lake to promote development, and the other is to develop a regional solid waste landfill. Union County is currently developing a feasibility study for a multi-county landfill.

Implementation Strategy

The Tyger River is impaired by elevated levels of zinc from unknown sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible. The Tyger River is also impaired from elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050107-060

(Fairforest Creek/Tinker Creek)

General Description

Watershed 03050107-060 is located in Spartanburg and Union Counties and consists primarily of ***Fairforest Creek and Tinker Creek*** and their tributaries. Both Fairforest Creek and Tinker Creek flow into the Broad River. The watershed occupies 155,396 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Madison-Wilkes series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 13% with a range of 2-40%. Land use/land cover in the watershed includes: 14.57% urban land, 11.42% agricultural land, 3.14% scrub/shrub land, 0.34% barren land, 70.22% forested land, and 0.31% water.

Fairforest Creek originates near the City of Spartanburg and accepts drainage from Goat Pond Creek, Holston Creek, Beaverdam Creek (Reedy Creek), Foster Creek (Underwood Branch), Reedy Branch, Buffalo Creek (Zimmerman Pond), Fleming Branch, Goose Branch, Stillhouse Branch (Smith Branch), and Lancaster Branch (James Branch, Pauline Creek, Dugan Creek). Kelsey Creek flows through Lake Craig (Lake Johnson, Thompson Creek) before entering Fairforest Creek. Black Branch (Whitestone Spring Branch) flows into Fairforest Creek next followed by McElwain Creek (Story Branch, Mineral Spring Branch, Sulphur Spring Branch), Kennedy Creek (Iscons Creek, Cunningham Creek), McClure Creek, Sugar Creek (another Beaverdam Creek, Whitlock Lakes, White Pine Lake), Swink Creek (Bishop Branch), and Rocky Creek. Swink Creek is also known as Mitchell Creek and Bishop Branch is also known as Mill Creek. Further downstream, Fairforest Creek accepts drainage from Mitchell Creek, another Sugar Creek (West Springs Branch), another Buffalo Creek, Dining Creek, Shoal Creek (Toschs Creek), Sand Creek, and Morris Branch.

Tinker Creek flows into the Broad River downstream of Fairforest Creek. Tinker Creek accepts drainage from Henry Creek (Reno Lake), Brushy Creek, and Swift Run. There are several ponds and lakes (11-105 acres) in this watershed used for recreational purposes, and 253.7 stream miles, all classified FW. The lower portion of the watershed resides within the Sumter National Forest, and Croft State Park is located next to Fairforest Creek, just south of the City of Spartanburg.

Water Quality

Fairforest Creek - There are five monitoring sites along Fairforest Creek. Aquatic life uses are fully supported at the upstream sites **(B-020, B-164)**, but may be threatened by a significantly increasing trend in turbidity at both sites and a significantly decreasing trend in pH at B-020. A significantly decreasing trend in total phosphorus concentration at both upstream sites suggests improving conditions for this parameter. Recreational uses are not supported at either site due to fecal coliform bacteria excursions. This is compounded at B-164 by a significantly increasing trend in fecal coliform bacteria concentration.

Further downstream **(B-021)**, aquatic life uses are partially supported based on macroinvertebrate community data. In addition, there is a significantly increasing trend in turbidity, and occurrences of chromium and zinc in excess of the aquatic life acute standard, including two high concentrations of zinc.

Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions, compounded by a significantly increasing trend in fecal coliform bacteria concentration.

Aquatic life uses are also partially supported at the next site downstream **(BF-007)** due to dissolved oxygen excursions. In addition, there is a significantly decreasing trend in dissolved oxygen concentration. This is a secondary monitoring station and sampling is purposely biased towards periods with potentially low dissolved oxygen concentrations. Significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentration, and turbidity suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions; however, a significantly decreasing trend in fecal coliform bacteria concentration suggests improving conditions for this parameter. At the furthest downstream site **(BF-008)**, aquatic life uses are fully supported based on physical, chemical, and macroinvertebrate community data. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions.

This creek was Class B until April, 1992. Because of chronically high concentrations of fecal coliform bacteria in the upper portions of this creek, samples were collected from additional sites on upper Fairforest Creek in August of 1995. No obvious point source was identified as concentrations were extremely high at all sampling sites, with the exception of the most upstream site. Even at the upstream site Class FW standards were exceeded. The most likely sources of the elevated fecal coliform bacteria concentrations are stormwater runoff and sewage collection system failures.

Unnamed Tributary to Fairforest Creek (B-321) - Aquatic life uses are not supported due to occurrences of chromium, copper, lead, and zinc in excess of the aquatic life acute standard, including a very high concentration of zinc in 1994, a high concentration of copper in 1994, and a high concentration of zinc in 1995. In addition, there is a significantly decreasing trend in pH and a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions, compounded by a significantly increasing trend in fecal coliform bacteria concentration.

Kelsey Creek (B-235) - Aquatic life uses are fully supported, but may be threatened by significantly decreasing trends in dissolved oxygen concentration and pH, and a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Lake Johnson (CL-035) - Aquatic life uses are fully supported. Although pH excursions occurred, higher pH levels are not uncommon in lakes with significant aquatic plant communities and are considered natural, not standards violations. Lake Edwin Johnson, in Croft State Park in Spartanburg County, is a 40-acre impoundment on Thompson Creek. Lake Johnson's maximum depth is approximately 28 feet (8.5 m); average depth is approximately 14 feet (4.4 m). The lake's watershed comprises approximately 9.3 square miles (24 km2) and includes Lake Craig. Lake Johnson currently maintains an intermediate trophic condition among small lakes in South Carolina; the lake is managed for fishing and supports high algal biomass.

Lake Craig (CL-033) - Aquatic life uses are fully supported. Lake Tom Moore Craig, in Croft State Park in Spartanburg County, is a 105-acre impoundment on Kelsey Creek. The average depth of Lake Craig is approximately 17 feet (5.2 m); the maximum depth is approximately 20 feet (6.1 m). The lake's watershed comprises approximately 8.1 square miles (21 km2). Historical eutrophication studies indicate that Lake Craig's trophic condition is improving; the impoundment has been reconstructed after being destroyed in 1990 floods. The lake is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of Lake Craig's desirable trophic condition is recommended.

Swink Creek or Mitchell Creek (B-199) - Aquatic life uses are fully supported. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Toschs Creek - There are two monitoring sites along Toschs Creek. Aquatic life uses are fully supported at the upstream site **(B-067A)**, and significantly decreasing trends in five-day biochemical oxygen demand and turbidity suggest improving conditions for these parameters. Aquatic life uses are also fully supported at the downstream site **(B-067B)**, but may be threatened by a significantly increasing trend in pH. Significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentrations, and turbidity suggest improving conditions for these parameters. Recreational uses are not supported at either site due to fecal coliform bacteria excursions, and is compounded at the downstream site by a significantly increasing trend in fecal coliform bacteria concentration. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Tinker Creek - There are three monitoring sites along Tinker Creek. Aquatic life uses are fully supported at the upstream site **(B-286)**. Aquatic life uses are also fully supported at the midstream site **(B-287)**, but may be threatened by a significantly increasing trend in pH. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration at both the upstream and midstream sites suggest improving conditions for these parameters. Aquatic life uses are again fully supported at the downstream site **(B-336)** based on macroinvertebrate community data, but may be threatened by occurrences of copper and zinc in excess of the aquatic life acute standard. Recreational uses are not supported at any site due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
FAIRFOREST CREEK SSSD/FAIRFOREST PLANT PIPE #: 001 FLOW: 14.1 WQL FOR TRC,NH3N	SC0020435 MAJOR MUNICIPAL WATER QUALITY
FAIRFOREST CREEK FAIRWOODS SD/UNITED UTILITIES PIPE #: 001 FLOW: 0.065	SC0035041 MINOR COMMUNITY EFFLUENT
FAIRFOREST CREEK SSSD/CAROLINA COUNTRY CLUB PIPE #: 001 FLOW: 0.25 WQL FOR DO,TRC	SC0039560 MINOR MUNICIPAL WATER QUALITY
FAIRFOREST CREEK CITY OF UNION/TOSCHS CREEK WWTP PIPE #: 001 FLOW: 6.0 PROPOSED; WQL FOR BOD5,DO,TRC,NH3N	SC0047244 MAJOR MUNICIPAL WATER QUALITY
FAIRFOREST CREEK MAYFAIR MILLS/MAYFAIR & BAILEY PIPE #: 001 FLOW: M/R	SCG250015 MINOR INDUSTRIAL EFFLUENT
FAIRFOREST CREEK DITCH ADO CORP. WWTP PIPE #: 001 FLOW: M/R	SCG250071 MINOR INDUSTRIAL EFFLUENT
FAIRFOREST CREEK TRIBUTARY POWDERCRAFT CORP. PIPE #: 001 FLOW: M/R	SCG250159 MINOR INDUSTRIAL EFFLUENT
FAIRFOREST CREEK TRIBUTARY SPARTAN MILLS/SPARTAN DIV. PIPE #: 001 FLOW: M/R	SC0002445 MINOR INDUSTRIAL EFFLUENT
FAIRFOREST CREEK TRIBUTARY STONEHAVEN MHP PIPE #: 001 FLOW: .0225 WQL FOR DO,TRC,NH3N	SC0032409 MINOR COMMUNITY WATER QUALITY
REEDY CREEK SSSD/MARILYNDALE SD PIPE #: 001 FLOW: 0.0415 WQL FOR TRC	SC0030121 MINOR MUNICIPAL WATER QUALITY
GOAT POND CREEK AMOCO FABRICS & FIBERS PIPE #: 001 FLOW: M/R	SC0003107 MINOR INDUSTRIAL EFFLUENT
GOAT POND CREEK	SCG250074

SYNTHETIC IND./SPARTANBURG PLT PIPE #: 001 FLOW: M/R	MINOR INDUSTRIAL EFFLUENT
HOLSTON CREEK EVANS MHP PIPE #: 001 FLOW: 0.0038 WQL FOR TRC,NH3N	SC0029521 MINOR COMMUNITY WATER QUALITY
HOLSTON CREEK MINI MART/SPARTANBURG PIPE #: 001 FLOW: M/R	SCG830017 MINOR INDUSTRIAL EFFLUENT
BEAVERDAM CREEK DAVIDSON MINERAL/SANDY FLATS PIPE #: 001 FLOW: M/R	SCG730079 MINOR INDUSTRIAL EFFLUENT
BEAVERDAM CREEK TRIBUTARY S&S MANUFACTURING PIPE #: 001 FLOW: 0.01 WQL FOR TRC,NH3N	SC0022616 MINOR INDUSTRIAL WATER QUALITY
KELSEY CREEK CITCO PETROLEUM PIPE #: 001 FLOW: M/R	SCG340008 MINOR INDUSTRIAL EFFLUENT
KELSEY CREEK TRIBUTARY COLONIAL PIPELINE/SPARTANBURG PIPE #: 001 FLOW: M/R	SC0040665 MINOR INDUSTRIAL EFFLUENT
MILL CREEK TOWN OF JONESVILLE PIPE #: 001 FLOW: 0.15 PIPE #: 001 FLOW: 0.25 (PROPOSED) WQL FOR DO,TRC,NH3N	SC0024988 MINOR MUNICIPAL WATER QUALITY WATER QUALITY
MINERAL SPRING BRANCH SPARTANBURG BOYS HOME PIPE #: 001 FLOW: 0.0035 WQL FOR TRC	SC0024449 MINOR COMMUNITY WATER QUALITY
ROCKY CREEK MILLIKEN & CO./CEDAR HILL PLT PIPE #: 001 FLOW: 0.0163 PIPE #: 001 FLOW: 0.0170 (PHASE I) PIPE #: 001 FLOW: 0.0198 (PHASE II) WQL FOR TRC,NH3N	SC0000809 MINOR INDUSTRIAL WATER QUALITY WATER QUALITY WATER QUALITY
TOSCHS CREEK TRIBUTARY TORRINGTON CO./UNION BEARINGS PIPE #: 001 FLOW: M/R PIPE #: 002 FLOW: M/R WQL FOR BOD5	SC0038636 MINOR INDUSTRIAL WATER QUALITY WATER QUALITY
ISCONS CREEK TRIBUTARY MILLIKEN & CO./WHITESTONE PIPE #: 001 FLOW: M/R	SC0023370 MINOR INDUSTRIAL EFFLUENT
SUGAR CREEK TRIBUTARY UNION AMOCO STATION	SCG830023 MINOR INDUSTRIAL

PIPE #: 001 FLOW: M/R	EFFLUENT
TINKER CREEK CITY OF UNION/BELTLINE PLANT PIPE #: 001 FLOW: 0.35 WQL FOR BOD5,DO,TRC,NH3N	SC0021202 MINOR MUNICIPAL WATER QUALITY

Landfill Activities

SOLID WASTE LANDFILL NAME *FACILITY TYPE*	*PERMIT #* *STATUS*
RED HILL LANDFILL INDUSTRIAL	422444-1601 ACTIVE
CROFT LANDFILL MUNICIPAL	421001-1102 ACTIVE
OLD CITY/COUNTY DUMP MUNICIPAL	---- CLOSED
MAXIE COPELAND LANDFILL LONGTERM C&D LANDFILL	442329-1201 ACTIVE

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
FAIRFOREST CREEK SAND CO. FAIRFOREST CREEK SAND MINE	1059-42 SAND

Water Supply

WATER USER (TYPE) *STREAM*	*RATED PUMP. CAPACITY (GPM)* *AMT. TRT./DIV. (MGD)*
MAYFAIR MILLS-BAILY PLT FAIRFOREST CREEK	1000 1.44
AMOCO FABRICS & FIBERS CO. FAIRFOREST CREEK TRIBUTARY	1000 3.00

Groundwater Concerns

The groundwater in the vicinity of the properties owned by Ina Bearing - Holly Mobile Home Park (Site #13493) and Spartanburg Steel Products (Site #00403) is contaminated with volatile organic compounds (VOCs) due to unknown sources. The surface water affected by the contamination from Ina Bearing is Fairforest Creek and the facility is currently in the remediation phase (air sparging system initiated). The surface water affected by the contamination from Spartanburg Steel Products is Goat Pond Creek which drains into Fairforest Creek. The facility is currently in the assessment and monitoring phases.

The groundwater in the vicinity of the property owned by Blackman Uhler Chemical is contaminated with volatile organic compounds (VOC) resulting from pits, ponds, and lagoons. This is a RCRA facility and is currently in the remediation phase. The surface water affected by the VOCs is an unnamed tributary of

Kelsey Creek. Another area with groundwater contaminated by VOCs is the I-85 Site, also resulting from pits, ponds, and lagoons. The area is currently in the assessment phase and the affected surface water is Fairforest Creek.

Growth Potential

There is a high potential for growth in this watershed, which contains portions of the Cities of Spartanburg and Union. Industrial growth in particular is expected along the I-85 corridor and major roads with I-85 interchanges. There are also industrial developmental pressures along I-26, US 29, and US 221. Urban development is evident in the City of Union and in the unincorporated Buffalo Mill Village in the form of residential, commercial, and industrial uses. Growth is most evident along the US 176 Bypass. US 176 north from Union to Spartanburg has recently been widened to four lanes and has generated the development of an industrial park. The lower portion of the watershed is effectively excluded from development by the Sumter National Forest.

Implementation Strategy

Fairforest Creek has an impaired macroinvertebrate community, low dissolved oxygen concentrations, and elevated fecal coliform bacteria concentrations due to point and nonpoint sources. The macroinvertebrate samples will be evaluated to determine the cause of their impairment. Toschs Creek and Tinker Creek are also impaired from elevated levels of fecal coliform from point and nonpoint sources. Permit revisions have been initiated and oxygen and bacterial improvements are expected in the next basin rotation. An enforcement action is also underway for fecal coliform bacteria.

A Fairforest Creek tributary is impaired by elevated levels of zinc, chromium, lead, and copper related to unknown and point sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible.

Watershed Evaluations and Implementation Strategies Within WMU-0502

Watershed Management Unit (WMU) 0502 consists of the ***Pacolet River Basin*** and the ***Broad River Basin***. WMU-0502 extends across the Piedmont region of the State and contains 21 watersheds, some 1.5 million acres of which 7.41% is urban land, 13.44% is agricultural land, 5.37% is scrub/shrub land, 0.50% is barren land, 71.54% is forested land, 0.02% is forested wetland, and 1.72% is water (SCLRCC 1990). There are a total of 2,846.4 stream miles in WMU-0502.

The Broad River flows across the North Carolina/South Carolina state line and accepts drainage from Buffalo Creek, Cherokee Creek, Kings Creek, Thicketty Creek, Bullock Creek, the Pacolet River, Turkey Creek, Browns Creek, the Sandy River, the Little River, and Cedar Creek in WMU-0502 and the Enoree River and the Tyger River from WMU-0501.

Fish Consumption Advisory

A fish consumption advisory has been issued by SCDHEC for portions of the Broad River advising people to limit the amount of some types of fish consumed from this river due to mercury contamination. Pregnant women, infants, children, and people with neurologic diseases face the greatest risk of mercury related health problems and should not eat any fish from these waters. The consumption of Largemouth Bass from the Broad River south of Neal Shoals in Union County to the confluence with the Saluda River in Columbia should be restricted to no more than 3.25 pounds per month.

The source of mercury contamination in fish tested by the Department is uncertain. Mercury occurs naturally and may account for a portion of the levels found in fish tissue. Another source is deposition from the air, a result of the combustion of fossil fuels. The Department continues to monitor for mercury in ambient air and precipitation. A precipitation sampler is located at the Congaree Swamp National Monument as part of the National Air Deposition Program, Mercury Deposition Network. Weekly composite samples are collected for mercury analysis to provide background concentrations for application across the State. The continuous monitoring of mercury concentrations in air is also conducted at the site.

There is no data available linking mercury in wastewater discharges as a major source of mercury in fish, nor can mercury levels be traced to any industries. South Carolina is one of 40 states that are seeing high mercury levels in fish and have issued advisories. These states are working together and with the U.S. Environmental Protection Agency to try and identify the cause or causes of mercury in fish.

Climate

Normal yearly rainfall in the WMU-0502 area is 48.25 inches, according to the S.C. historic climatological record (SCWRC 1990). Data compiled from National Weather Service stations in Rainbow Lake, Gaston Shoals, Gaffney, Ninety Nine Islands, Spartanburg, Santuck, Chester, Blair, Winnsboro, Parr, Little Mountain, Columbia at USC, and Columbia Metropolitan Airport were used to determine the general climate information for this portion of the State. The highest level of rainfall occurs in the summer with 13.55 inches; 12.41, 10.37, and 12.50 inches of rain falling in the fall, winter, and spring, respectively. The average annual daily temperature is 62.1°F. Summer temperatures average 78.4°F and fall, winter, and spring temperatures are 63.0°F, 45.0°F, and 62.1°F, respectively.

03050105-050

(Broad River)

General Description

Watershed 03050105-050 is located in Cherokee and Spartanburg Counties and consists primarily of tributaries of the ***Broad River***. This watershed occupies 16,454 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Pacolet series. The erodibility of the soil (K) averages 0.28; the slope of the terrain averages 10%, with a range of 2-45%. Land use/land cover in the watershed includes: 8.95% urban land, 37.39% agricultural land, 1.36% scrub/shrub land, 0.32% barren land, 51.79% forested land, and 0.19% water.

Before the Broad River flows across the South Carolina/North Carolina border it accepts drainage from several streams originating in South Carolina that flow into North Carolina including Arrowood Branch, Big Horse Creek (Little Horse Creek, Jolleys Lake), Suck Creek, and Ashworth Creek. There are several small ponds and lakes in this watershed used for recreational purposes and 26.8 stream miles, all classified FW.

Water Quality

There are no water quality monitoring stations in this watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
LITTLE HORSE CREEK	SC0002429
SPARTAN MILLS/MONTGOMERY DIV.	MAJOR INDUSTRIAL
PIPE #: 001 FLOW: M/R	WATER QUALITY
WQL FOR TRC	

Growth Potential

There is a low potential for growth in this watershed.

03050105-090

(Broad River)

General Description

Watershed 03050105-090 is located in Cherokee and York Counties and consists primarily of the ***Broad River*** and its tributaries from the North Carolina border to the Pacolet River. The watershed occupies 82,652 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Wilkes-Goldston-Badin series. The erodibility of the soil (K) averages 0.28; the slope of the terrain averages 12%, with a range of 2-45%. Land use/land cover in the watershed includes: 4.54% urban land, 18.42% agricultural land, 0.84% scrub/shrub land, 1.04% barren land, 73.37% forested land, and 1.79% water.

After the river crosses the state line, it accepts drainage from Ross Creek (Sarratt Creek), Mikes Creek, the Bowens River (Wylies Creek), the Buffalo Creek Watershed, and the Cherokee Creek Watershed. Further downstream, Peoples Creek (Furnace Creek, Toms Branch) drains into the river near the City of Gaffney. Doolittle Creek enters the river next, near the Town of Blacksburg, followed by London Creek (Lake Cherokee, Little London Creek), Bear Creek, McKowns Creek, Dry Branch, the Kings Creek Watershed, and Quinton Branch. Mud Creek enters the river next, downstream of Mud Island, followed by Guyonmbore Creek, Mountain Branch, Abingdon Creek (Wolf Branch, Service Branch, Jenkins Branch), the Thicketty Creek Watershed, Beaverdam Creek (McDaniel Branch), the Bullock Creek Watershed, and Dry Creek (Nelson Creek).

There are several ponds and lakes (10-45 acres) in this watershed used for recreation and water supply and 229.3 stream miles, all classified FW. A fifteen mile segment of the Broad River, extending from Ninety Nine Islands Dam to the river's confluence with the Pacolet River is designated as a South Carolina State Scenic River in recognition of it's outstanding natural resources.

Water Quality

Broad River - There are two monitoring sites along this section of the Broad River. Aquatic life uses are fully supported at the upstream site **(B-042)**, but may be threatened by a significantly increasing trend in pH and a high concentration of zinc measured in 1991. Sediment samples revealed P,P'DDT and P,P'DDE (metabolites of DDT) in 1993, together with high concentrations of chromium and nickel. Although the use of DDT was banned in 1973, it is very persistent in the environment. Significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions; however, a significantly decreasing trend in fecal coliform bacteria concentration suggests improving conditions for this parameter:

At the downstream site **(B-044)**, aquatic life uses are not supported due to occurrences of cadmium, chromium, copper, lead, and zinc in excess of the aquatic life acute standards, including a high concentration of zinc in 1992 and a very high concentration in 1995. In addition, there is a significantly increasing trend in pH. Sediment samples revealed P,P'DDT in 1993. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are partially supported at this site due to fecal coliform bacteria excursions.

Canoe Creek - Aquatic life uses are partially supported at the site immediately upstream of the Town of Blacksburg wastewater treatment plant discharge (B-755), and not supported at the site immediately downstream of the discharge (B-756) or further downstream (B-088) based on macroinvertebrate community data (Shealy Environmental Services, Inc., 1996). Department data at B-088 indicates dissolved oxygen excursions, a significantly decreasing trend in dissolved oxygen concentration and a significantly increasing trend in five-day biochemical oxygen demand. A significantly decreasing trend in total phosphorus concentration suggests improving conditions for this parameter. Recreational uses are not supported due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed. In addition, the main discharge to this stream is being relocated to the Broad River, thus improving bacterial conditions.

Peoples Creek (B-211) - Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentration, and turbidity suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions; however, a significantly decreasing trend in fecal coliform bacteria concentration suggests improving conditions for this parameter. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Furnace Creek (B-100) - Aquatic life uses are fully supported, but may be threatened by a significantly decreasing trend in dissolved oxygen concentration and a significantly increasing trend in pH. Sediment samples revealed a high concentration of zinc in 1991, P,P'DDT and O,P'DDT in 1993 and P,P'DDT again in 1994. Although the use of DDT was banned in 1973, it is very persistent in the environment. Significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentration, and turbidity suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Doolittle Creek (B-323) - Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Lake Cherokee (B-343) - Lake Cherokee is a 45-acre impoundment at the headwaters of London Creek in Cherokee County, with a maximum depth of approximately 32 feet (9.8 meters) and an average depth of 11 feet (3.4 meters). Lake Cherokee's watershed comprises approximately 0.2 square miles (0.4 km2). Historical eutrophication studies indicate that Lake Cherokee's trophic condition is improving. It is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended. Aquatic life and recreational uses are fully supported. In an effort to provide access for boating and fishing, 300 triploid grass carp (20/vegetated acre) were stocked in 1991 and aquatic herbicides were applied in 1989, 1991, and 1995.

Guyonmoore Creek (B-330) - Aquatic life uses are fully supported, and recreational uses are partially supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
BROAD RIVER SC DISTRIBUTORS INC. PIPE #: 001 FLOW: 0.04	SC0002755 MINOR MUNICIPAL EFFLUENT
BROAD RIVER MILLIKEN & CO./MAGNOLIA PLT PIPE #: 001 FLOW: 3.45 PIPE #: 001 FLOW: 4.879 (PROPOSED)	SC0003182 MAJOR INDUSTRIAL EFFLUENT EFFLUENT
BROAD RIVER CHAMPION PRODUCTS PIPE #: 001 FLOW: 2.0	SC0035947 MAJOR INDUSTRIAL EFFLUENT
BROAD RIVER CITY OF GAFFNEY/PEOPLES CREEK PLT PIPE #: 001 FLOW: 3.5 WQL FOR DO	SC0047091 MAJOR MUNICIPAL WATER QUALITY
BROAD RIVER TOWN OF BLACKSBURG/CANOE CREEK PLT PIPE #: 001 FLOW: 0.68 (PROPOSED) WQL FOR DO,TRC,NH3N	SC0047457 MINOR MUNICIPAL WATER QUALITY
CANOE CREEK TOWN OF BLACKSBURG/CANOE CREEK PLT PIPE #: 001 FLOW: 0.34 WQL FOR DO,TRC,NH3N	SC0026042 MINOR MUNICIPAL WATER QUALITY
BEAVERDAM CREEK G & W INC. PIPE #: 001 FLOW: 0.005 WQL FOR BOD5,DO,TRC,NH3N	SC0027561 MINOR INDUSTRIAL WATER QUALITY
PEOPLES CREEK HAMRICK MILLS PIPE #: 001 FLOW: M/R	SCG250167 MINOR INDUSTRIAL EFFLUENT
PEOPLES CREEK CHEROKEE CO. COGEN PARTNERS PIPE #: 001 FLOW: M/R	SCG250110 MINOR INDUSTRIAL EFFLUENT

LAND APPLICATION FACILITY NAME	PERMIT# TYPE
SPRAYFIELD PEELER RUG COMPANY	ND0070980 INDUSTRIAL
SPRAYFIELD SCREEN PRINTERS	ND0003417 INDUSTRIAL

Landfill Activities

SOLID WASTE LANDFILL NAME *FACILITY TYPE*	*PERMIT #* *STATUS*
CITY OF GAFFNEY CWP INDUSTRIAL/C&D	APPLYING FOR PERMIT ACTIVE

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
SQUAW VALLEY SAND CO. BROAD RIVER PLANT	0042-09 SAND
THOMAS SAND CO. BLACKSBURG PLANT	0869-09 SAND
RAY BROWN ENTERPRISES HIDDEN VALLEY MINE	0123-09 SAND
RAY BROWN ENTERPRISES BROWN #3 SAND MINE	1070-09 SAND

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF GAFFNEY BPW (M) BROAD RIVER	18.0 12.0

Growth Potential

There is a moderate potential for growth in this watershed, which contains the Town of Blacksburg and a portion of the City of Gaffney. The City of Gaffney is planning for new subdivision growth by considering new regional treatment facilities near the Cherokee Creek-Broad River area. Major growth is expected along the I-85 corridor, particularly in the area north of Gaffney. The potential for industrial growth exists along SC 329 east of Gaffney due to the existing industrial park and the proposal of another park.

Implementation Strategy

The Broad River is impaired by elevated levels of copper, cadmium, lead, and zinc from unknown or possibly point sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible. Peoples Creek is impaired from elevated levels of fecal coliform resulting from point sources, and bacteria conditions are expected to improve now that permit revisions have been initiated. Canoe Creek has an impaired macroinvertebrate community and elevated fecal coliform levels due to point sources. The facility is being upgraded and relocated, and conditions should improve.

03050105-100

(Buffalo Creek)

General Description

Watershed 03050105-100 is located in Cherokee County and consists primarily of ***Buffalo Creek*** and its tributaries. The watershed occupies 9,917 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Herndon-Helena-Goldston-Georgeville series. The erodibility of the soil (K) averages 0.34; the slope of the terrain averages 10%, with a range of 2-45%. Land use/land cover in the watershed includes: 7.22% urban land, 21.20% agricultural land, 0.51% scrub/shrub land, 0.84% barren land, 70.23% forested land, and 0.01% water.

Bee Branch flows across the North Carolina border and drains into Buffalo Creek, which flows into the Broad River. There are 19.5 stream miles in this watershed, all classified FW.

Water Quality

Buffalo Creek **-** There are three monitoring sites along Buffalo Creek. Aquatic life uses are fully supported at the upstream site **(B-740)** based on macroinvertebrate community data. Aquatic life uses are also fully supported at the midstream site **(B-119)**, but may be threatened by a significantly increasing trend in total phosphorus concentration, a high concentration of zinc measured in 1992, and PCB 1260 in 1991. Aquatic life uses are partially supported at the downstream site **(B-057)** due to occurrences of cadmium, chromium, and copper in excess of the aquatic life acute standards, including a very high concentration of copper measured in 1992. In addition, there is a significantly increasing trend in pH and total phosphorus concentration, and the PAH indeno(1,2,3-cd)pyrene was detected in 1995. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total nitrogen concentrations at both the midstream and downstream sites suggest improving conditions for these parameters. Recreational uses are not supported at any site due to fecal coliform bacteria excursions, and there is a significantly increasing trend in bacteria concentrations at the midstream site.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
BUFFALO CREEK EMRO MARKETING SPEEDWAY #66 PIPE #: 002 FLOW: 0.0075 WQL FOR BOD5,DO,TRC,NH3N	SC0042196 MINOR INDUSTRIAL WATER QUALITY
BUFFALO CREEK TNS MILLS INC./BLACKSBURG PLT PIPE #: 001 FLOW: M/R	SCG250043 MINOR INDUSTRIAL EFFLUENT

BUFFALO CREEK TRIBUTARY
BROAD RIVER TRUCK STOP
PIPE #: 001 FLOW: 0.01
WQL FOR TRC,NH3N

SC0032433
MINOR COMMUNITY
WATER QUALITY

BEE BRANCH TRIBUTARY
JM BROWN VEND/MR. WAFFLE
PIPE #: 001 FLOW: 0.0092
WQL FOR TRC;NH3N

SC0031968
MINOR MUNICIPAL
WATER QUALITY

Water Supply

WATER USER (TYPE) *STREAM*	*RATED PUMP.CAP.(GPM)* *AMT. TRT./DIV. (MGD)*
MILLIKEN & CO.-MAGNOLIA FINISHING (I) BUFFALO CREEK	3400.0 4.896

Growth Potential

There is a moderate potential for growth in this watershed, which contains a portion of the Town of Blacksburg. Major growth is expected along the I-85 corridor, which stretches across the watershed. Commercial growth is also associated with the I-85 corridor near the Town of Blacksburg.

Implementation Strategy

Buffalo Creek is impaired by elevated levels of copper, cadmium, and lead. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible.

03050105-110

(Cherokee Creek)

General Description

Watershed 03050105-110 is located in Cherokee County and consists primarily of ***Cherokee Creek*** and its tributaries. The watershed occupies 14,911 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Goldston-Badin series. The erodibility of the soil (K) averages 0.22; the slope of the terrain averages 10%, with a range of 2-45%. Land use/land cover in the watershed includes: 20.87% urban land, 33.65% agricultural land, 0.56% scrub/shrub land, 0.74% barren land, 42.79% forested land, and 1.38% water.

Cherokee Creek flows through Lake Whelchel (180 acres) near the City of Gaffney and accepts drainage from Allison Creek in the lake and Providence Creek downstream of the lake before flowing into the Broad River. There are several ponds and lakes (10-180 acres) in this watershed used for recreational and municipal purposes. There are 34.5 stream miles, all classified FW.

Water Quality

Cherokee Creek (B-056) - Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand and turbidity suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
CHEROKEE CREEK	SC0020508
CITY OF GAFFNEY/PROVIDENCE CREEK PLT	MAJOR MUNICIPAL
PIPE #: 001 FLOW: 1.80	WATER QUALITY
WQL FOR DO,TRC,NH3N	
PROVIDENCE CREEK	SC0021121
CITY OF GAFFNEY/WTP	MINOR DOMESTIC
PIPE #: 001 FLOW: 1.02	WATER QUALITY
WQL FOR TRC	

Landfill Activities

SOLID WASTE LANDFILL NAME / *FACILITY TYPE*	*PERMIT #* / *STATUS*
CHEROKEE COUNTY LANDFILL MUNICIPAL	111001-1101 ACTIVE

Mining Activities

MINING COMPANY / *MINE NAME*	*PERMIT #* / *MINERAL*
BOREN BRICK HIGGINS RED CLAY PIT	0113-09 CLAY
BOREN BRICK SHALE PIT	0114-09 SHALE

Water Supply

WATER USER (TYPE) / *STREAM*	*PUMPING CAPACITY (MGD)* / *REG. PUMPING CAPACITY (MGD)*
CITY OF GAFFNEY BPW (M) LAKE WHELCHEL	— 18.0

Groundwater Concerns

The groundwater in the vicinity of the property owned by SKF Tools (Site #13699) is contaminated with volatile organic compounds (VOCs). The source of the contamination is spills and leaks. The facility is currently in the remediation phase. The surface water affected by the contamination is Providence Creek.

Growth Potential

There is a moderate potential for growth in this watershed, which contains a portion of the City of Gaffney. The City of Gaffney is planning for new subdivision growth by considering new regional treatment facilities near the Cherokee Creek-Broad River area. Major growth is expected along the I-85 corridor, particularly in the area north of Gaffney. Commercial growth is also associated with the I-85 corridor near the SC 11 interchange north of Gaffney and at the SC 105 interchange with the new outlet center. The potential for industrial growth exists along SC 329 east of Gaffney due to the existing industrial park and the proposal of another park.

Implementation Strategy

Cherokee Creek is impaired from elevated levels of fecal coliform resulting from point sources, and bacteria conditions are expected to improve now that permit revisions have been initiated. An enforcement action is currently underway for fecal coliform bacteria.

03050105-120
(Kings Creek)

General Description

Watershed 03050105-120 is located in Cherokee and York Counties and consists primarily of ***Kings Creek*** and its tributaries. The watershed occupies 33,018 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Goldston-Badin series. The erodibility of the soil (K) averages 0.15; the slope of the terrain averages 13%, with a range of 2-45%. Land use/land cover in the watershed includes: 1.10% urban land, 14.48% agricultural land, 0.30% scrub/shrub land, 0.48% barren land, 83.41% forested land, and 0.23% water.

Kings Creek originates in North Carolina and flows across the state line to accept drainage from Modlin Branch, Dixon Branch, Ponders Branch, Stonehouse Branch, Dellingham Branch, Mill Creek, and Jumping Branch. Further downstream, Garner Branch flows into Kings Creek followed by Manning Branch, Bells Branch, Beech Branch, Wolf Creek, and Nells Branch before draining into the Broad River. There are several recreational ponds and lakes in this watershed and 77.1 stream miles, all classified FW. Kings Mountain National Military Park and Kings Mountain State Park are additional natural resources in the watershed.

Water Quality

Kings Creek (B-333) - Although there were occurrences of copper in excess of the aquatic life acute standard, based on macroinvertebrate community data, aquatic life uses are fully supported. Recreational uses are partially supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
KINGS CREEK DITCH	SC0047783
COMPRESSOR STATION/GROVER	MINOR INDUSTRIAL
PIPE #: 001 FLOW: 0.22	EFFLUENT
MILL CREEK TRIBUTARY	SCG730068
VULCAN MATERIALS CO.	MINOR INDUSTRIAL
PIPE #: 001 FLOW: M/R	EFFLUENT

Mining Activities

MINING COMPANY	***PERMIT #***
MINE NAME	***MINERAL***
BOREN BRICK	0115-09
SERICITE PIT	SERICITE

VULCAN MATERIALS CO. BLACKSBURG QUARRY	0354-09 LIMESTONE
BORAL BRICKS, INC.-ASHE DIV. ROBERTS MINE	0221-09 SHALE
TAYLOR CLAY PRODUCTS CO. GROVER MINE	0199-09 MANGANESE SCHIST
INDUSTRIAL MINERALS, INC. KINGS CREEK MINE	0162-09 SERICITE

Growth Potential

There is a low potential for growth in this watershed due to the absence of public utilities.

03050105-130

(Thicketty Creek)

General Description

Watershed 03050105-130 is located in Cherokee County and consists primarily of ***Thicketty Creek*** and its tributaries. The watershed occupies 98,730 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Pacolet-Wilkes-Herndon-Madison series. The erodibility of the soil (K) averages 0.30; the slope of the terrain averages 16%, with a range of 2-45%. Land use/land cover in the watershed includes: 5.04% urban land, 19.53% agricultural land, 0.59% scrub/shrub land, 0.92% barren land, 73.51% forested land, and 0.41% water.

Thicketty Creek joins with Macedonia Creek to form Lake Thicketty at the top of the watershed. Thicketty Creek then accepts drainage from Thicketty Mountain Creek (Linder Creek), Clary Creek, Allgood Branch, and Irene Creek (Cole Creek) near the City of Gaffney. Little Thicketty Creek (Rocky Ford Creek, Cowpens Creek) enters Thicketty Creek next followed by Limestone Creek (Mill Creek, Skelton Creek) and Big Blue Branch (Blue Branch). North Goucher Creek and South Goucher Creek join in Hammett Lake to form Goucher Creek (Gum Root Creek), which flows into Thicketty Creek, downstream of Big Blue Creek. Jones Creek (Martin Lake) enters Thicketty Creek next followed by Timber Ridge Branch, Minkum Creek (Polecat Creek), Crocker Branch, Lusts Mill Creek, and Gilkey Creek. Gilkey Creek accepts drainage from Gaffney Country Club Lake, Blanton Creek, Peeler Branch, Spencer Branch (also known as Cartum Branch), Dry Fork Creek, Martin Branch, and Rocky Branch. Thicketty Creek drains into the Broad River. There are several ponds and lakes (10-100 acres) in this watershed used for recreation, irrigation, and flood control. There are a total of 213.9 stream miles, all classified FW.

Water Quality

Thicketty Creek - There are three monitoring sites along Thicketty Creek. Aquatic life uses are fully supported at the upstream site **(B-095)**, the midstream site **(B-133)** based on macroinvertebrate community data, and the downstream site **(B-062)**. A significantly decreasing trend in five-day biochemical oxygen demand at the midstream and downstream sites suggest improving conditions for this parameter. Recreational uses are not supported at any site due to fecal coliform bacteria excursions, which is compounded at the downstream site by a significantly increasing trend in fecal coliform bacteria concentrations. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Lake Thicketty (B-342) - Lake Thicketty is a 100-acre impoundment on Thicketty and Macedonia Creeks in Cherokee County, with a maximum depth of approximately 20 feet (6.1 m), and an average depth of 10 feet (3.1 m). Lake Thicketty's watershed comprises 6.9 square miles (18 km2). Historical eutrophication studies indicate that Lake Thicketty's trophic condition is improving. It is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended. Aquatic life and recreational uses are fully supported.

Irene Creek (B-059) - Aquatic life uses are fully supported, and a significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentrations, and turbidity suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Limestone Creek (B-128) - Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Gilkey Creek (B-334) - Aquatic life uses are fully supported based on physical, chemical, and macroinvertebrate community data. Recreational uses are not supported due to fecal coliform bacteria excursions.

Recreational Swimming Areas

RECEIVING STREAM	*SWIMMING LOCATION*
LAKE RUFUS	CAMP LEA

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
THICKETTY CREEK CITY OF GAFFNEY/CLARY WWTP PIPE #: 001 FLOW: 3.6 WQL FOR BOD5,DO,TRC,NH3N	SC0031551 MAJOR MUNICIPAL WATER QUALITY
LITTLE THICKETTY CREEK JIM'S TRAILER PARK PIPE #: 001 FLOW: 0.01 WQL FOR TRC,NH3N	SC0030503 MINOR COMMUNITY WATER QUALITY
ALLGOOD BRANCH PINECONE CAMPGROUND PIPE #: 001 FLOW: 0.018 WQL FOR TRC,NH3N	SC0034002 MINOR COMMUNITY WATER QUALITY
IRENE CREEK NESTLE FROZEN FOODS CORP. PIPE #: 001 FLOW: 0.066 WQL FOR TRC	SC0037664 MINOR INDUSTRIAL WATER QUALITY
IRENE CREEK TIMKEN CO./GAFFNEY BEARING PIPE #: 001 FLOW: 0.013	SC0000949 MINOR INDUSTRIAL EFFLUENT
MILL CREEK HAMRICK MILLS/MUSGROVE MILLS	SCG250168 MINOR INDUSTRIAL

PIPE #: 001 FLOW: M/R	EFFLUENT
SPENCERS BRANCH TRIBUTARY BRIARCREEK SD I/UNITED UTILITIES PIPE #: 001 FLOW: 0.0228 WQL FOR TRC,NH3N	SC0023736 MINOR COMMUNITY WATER QUALITY
SPENCERS BRANCH BRIARCREEK SD II/UNITED UTILITIES PIPE #: 001 FLOW: 0.020 WQL FOR TRC,NH3N	SC0026409 MINOR COMMUNITY WATER QUALITY
JONES CREEK MEDLEY FARMS NPL SITE PIPE #: 001 FLOW: 0.041	SC0046469 MINOR INDUSTRIAL EFFLUENT

Growth Potential

There is a moderate potential for growth in this watershed associated with I-85 and the City of Gaffney. Major growth is expected along the I-85 corridor, which stretches across the watershed, particularly in the area north of Gaffney. US 29 and a rail line also stretches across the watershed from Spartanburg to Gaffney.

Implementation Strategy

Thicketty Creek is impaired by elevated levels of fecal coliform bacteria resulting from point and nonpoint sources. Permit revisions have been initiated and conditions are expected to improve.

03050105-140

(Bullock Creek)

General Description

Watershed 03050105-140 extends through York County and consists primarily of ***Bullock Creek*** and its tributaries. The watershed occupies 76,376 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Wilkes-Cecil-Goldston-Badin series. The erodibility of the soil (K) averages 0.22; the slope of the terrain averages 13%, with a range of 2-45%. Land use/land cover in the watershed includes: 0.22% urban land, 15.88% agricultural land, 0.36% scrub/shrub land, 0.68% barren land, 82.74% forested land, and 0.12% water.

Bullock Creek originates near the South Carolina/North Carolina border and accepts drainage from Gin Branch, Rocky Branch, Buckhorn Creek (Silver Creek), and Clark Fork. Clark Fork also originates near the state line and flows through Lake Crawford to join Jennings Branch and forms Lake York before accepting drainage from Biggers Branch and Saltlick Branch. Downstream of Clark Fork, Bullock Creek accepts drainage from Thompson Branch, Berry Branch, Purgatory Branch, Mitchell Branch, Plexico Branch, Loves Creek, and Bells Creek (Prater Branch, Dowdle Branch). There are a few ponds and lakes (10-50 acres) in this watershed used for recreation and irrigation and 138.8 stream miles, all classified FW. Kings Mountain State Park extends over the upper portion of the watershed along with Kings Mountain National Military Park.

Water Quality

***Bullock Creek* -** There are two monitoring sites along Bullock Creek. Aquatic life uses are fully supported at the upstream site **(B-739)** based on macroinvertebrate community data. Aquatic life uses are also fully supported at the downstream site **(B-159)**, and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported at this site due to fecal coliform bacteria excursions.

***Lake York (B-737)* -** Aquatic life uses are fully supported. Lake York, located in Kings Mountain State Park in York County, is a 50-acre impoundment on Clark Fork. Lake York's maximum depth is approximately 13 feet (4.0 m); average depth is 9 feet (2.7 m). The lake's watershed comprises approximately 0.8 square miles (2 km2) in North and South Carolina. Lake York is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended. In an effort to provide access for swimming and boating, 600 triploid grass carp (20/vegetated acre) were stocked in 1993 and aquatic herbicides were applied in 1995.

***Long Branch (B-326)* -** Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentrations, and turbidity suggest improving conditions for these parameters. Recreational uses are partially supported at this site due to fecal coliform bacteria excursions.

Clark Fork - There are two monitoring sites along Clark Fork. Aquatic life uses are fully supported at the site upstream of Crawford Lake (**B-325**), but may be threatened by a significantly decreasing trend in pH. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are partially supported at this site due to fecal coliform bacteria excursions. Aquatic life uses are also fully supported at the site downstream of Crawford Lake (**B-157**) based on macroinvertebrate community data. In an effort to provide access for swimming and boating in Crawford Lake, 200 triploid grass carp (20/vegetated acre) were stocked in 1992 and aquatic herbicides were applied in 1990-1996.

Recreational Swimming Areas

RECEIVING STREAM	*SWIMMING LOCATION*
LAKE CRAWFORD	KINGS MTN STATE PARK

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
LONG BRANCH US PARK SERVICE/KINGS MTN NATL MIL PARK PIPE #: 001 FLOW: 0.023 WQL FOR DO,TRC,NH3N	SC0025275 MINOR INDUSTRIAL WATER QUALITY

Growth Potential

There is a low potential for growth in this watershed, which contains the Towns of Hickory Grove and Sharon, and public water service is limited to these towns. Although the area is largely rural, residential activity is increasing as a result of the close proximity to the Town of Clover, the City of York, and the Greater Charlotte Metropolitan Area.

03050105-150

(North Pacolet River)

General Description

Watershed 03050105-150 is located in Spartanburg County and consists primarily of the ***North Pacolet River*** and its tributaries. The watershed occupies 30,145 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Hiwassee series. The erodibility of the soil (K) averages 0.28; the slope of the terrain averages 10%, with a range of 2-25%. Land use/land cover in the watershed includes: 8.57% urban land, 22.87% agricultural land, 0.97% scrub/shrub land, 0.13% barren land, 66.92% forested land, and 0.54% water.

The North Pacolet River originates in North Carolina and accepts drainage from Vaughn Creek (Lake Lanier) and Wolfe Creek, which originate in South Carolina. After flowing across the state line, the river accepts drainage from Page Creek. Hooper Creek, Collinsville Creek, and Bear Creek enter the river next; all originating in North Carolina. Obed Creek drains into the river at the base of the watershed. There are a few recreational ponds and lakes (10-90 acres) in this watershed and a total of 71.6 stream miles, all classified FW with the exception of Vaughn Creek which is classified ORW. Due to the absence of point source dischargers and the presence of endangered species and other special characteristics, portions of a Vaughn Creek tributary may qualify as a potential ORW candidate.

Water Quality

North Pacolet River **-** There are three monitoring sites along the North Pacolet River. Aquatic life uses are fully supported at the upstream site **(B-719)** based on macroinvertebrate community data.
Aquatic life uses are also fully supported at the midstream site **(B-026)**, but may be threatened by a significantly decreasing trend in pH and a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total nitrogen concentration suggest improving conditions for these parameters. At the downstream site **(B-126)**, aquatic life uses are again fully supported, but may be threatened by an occurrence of lead in excess of the aquatic life acute standard. Recreational uses are not supported at any site due to fecal coliform bacteria excursions.

Vaughn Creek (B-099-7) **-** Aquatic life uses are fully supported based on macroinvertebrate community data.

Lake Lanier **-** There are two monitoring sites along Lake Lanier. Aquatic life uses are fully supported at the uplake site **(B-099A)**, but may be threatened by significantly decreasing trends in dissolved oxygen concentration and pH, and a significantly increasing trend in turbidity. Recreational uses are partially supported at this site due to fecal coliform bacteria excursions. Aquatic life uses are also fully supported at the downlake site **(B-099B)**, but may be threatened by a significantly decreasing trend in pH and a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are fully supported.

Page Creek (B-301) - Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM FACILITY NAME PERMITTED FLOW @ PIPE (MGD) COMMENT	NPDES# TYPE LIMITATION
NORTH PACOLET RIVER ONEITA INDUSTRIES/FINGERVILLE PIPE #: 001 FLOW: 0.50	SC0035157 MINOR INDUSTRIAL EFFLUENT
NORTH PACOLET RIVER SSSD/FINGERVILLE PIPE #: 001 FLOW: 0.020	SC0047759 MINOR MUNICIPAL EFFLUENT
NORTH PACOLET RIVER MILLIKEN/NEW PROSPECT MILL PIPE #: 001 FLOW: 0.47 WQL FOR DO,TRC,NH3N	SC0023540 MINOR INDUSTRIAL WATER QUALITY
OBED CREEK HB SWOFFORD VOCATIONAL CENTER PIPE #: 001 FLOW: 0.0045 WQL FOR NH3N	SC0028037 MINOR MUNICIPAL WATER QUALITY
PAGE CREEK CITY OF LANDRUM/PAGE CREEK PLT PIPE #: 001 FLOW: 0.3 WQL FOR BOD5,TRC,NH3N	SC0026875 MINOR MUNICIPAL WATER QUALITY
WOLFE CREEK CITY OF LANDRUM/PLANT #1 PIPE #: 001 FLOW: 0.1 WQL FOR TRC,NH3N	SC0021636 MINOR MUNICIPAL WATER QUALITY

Mining Activities

MINING COMPANY MINE NAME	PERMIT # MINERAL
LITTLE ACRES SAND CO. NORTH PACOLET RIVER MINE	1037-42 SAND

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF LANDRUM (M) VAUGHN CREEK TRIBUTARY	0.0 0.0
CITY OF LANDRUM (M) LAKE LANIER - VAUGHN CREEK	2.0 1.0

Growth Potential

There is a low potential for growth in this watershed, which contains the Town of Fingerville.

03050105-160

(South Pacolet River)

General Description

Watershed 03050105-160 is located in Spartanburg County and consists primarily of the ***South Pacolet River*** and its tributaries. The watershed occupies 59,585 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil series. The erodibility of the soil (K) averages 0.28; the slope of the terrain averages 9%, with a range of 2-25%. Land use/land cover in the watershed includes: 8.00% urban land, 25.85% agricultural land, 0.71% scrub/shrub land, 0.44% barren land, 61.90% forested land, and 3.11% water.

The South Pacolet River originates near Glassy Mountain and accepts drainage from Green Creek, Belue Creek, Jamison Mill Creek, Spivey Creek (Clear Branch), and Motlow Creek (Easley Creek, Holston Creek) before forming Lake Bowen (Alexander Creek, Turkey Creek). The South Pacolet River flows out of Lake Bowen to then form the South Pacolet River Reservoir #1 (Mud Creek) which is also known as Spartanburg Reservoir #1 (301 acres). There are 146.4 stream miles in this watershed, all classified FW. Due to the absence of point source dischargers and the presence of endangered species and other special characteristics, portions of a Green Creek tributary, Belue Creek, and Jamison Mill Creek may qualify as potential ORW candidates.

Water Quality

South Pacolet River - There are two monitoring sites along the South Pacolet River. Aquatic life uses are fully supported at the upstream site **(B-720)** based on macroinvertebrate community data. Aquatic life uses are also fully supported at the downstream site **(B-302)**, but may be threatened by an occurrence of lead in excess of the aquatic life acute standard. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Spivey Creek (B-103) - Aquatic life uses are fully supported, and a significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Recreational uses are partially supported at this site due to fecal coliform bacteria excursions.

Lake Bowen - Lake William C. Bowen is a 1600-acre impoundment on the South Pacolet River in Spartanburg County, with a maximum depth of approximately 41 feet (12.5 m) and an average depth of 15 feet (4.7 m). Lake Bowen's watershed comprises 82 square miles (212.6 km2). In 1991, NRCS, in cooperation with SCDHEC, began an educational project to reduce watershed pollutant loads. Historical eutrophication assessments indicate that Lake Bowen's trophic condition is improving. It is currently one of the least eutrophic large lakes in South Carolina, characterized by low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended.

There are two monitoring sites along Lake Bowen. Aquatic life uses are fully supported at the uplake site (**B-340**). Sediment samples revealed P,P'DDT and O,P'DDT, and P,P'DDD, O,P'DDD, P,P'DDE (metabolites of DDT) in 1991. Although the use of DDT was banned in 1973, it is very persistent in the environment. Aquatic life uses are also fully supported at the downlake site (**B-339**), but may be threatened by a very high concentration of cadmium detected in the 1992 sediment sample. Recreational uses are fully supported at both sites.

Spartanburg Reservoir #1 (B-113) - Aquatic life uses are fully supported, but may be threatened by a significantly decreasing trend in dissolved oxygen concentration and a significantly increasing trend in turbidity. A significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Recreational uses are fully supported, but may be threatened by a significantly increasing trend in fecal coliform bacteria concentrations.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
MOTLOW CREEK LINKS O TRYON PIPE #: 001 FLOW: 0.024 WQL FOR DO,TRC,NH3N	SC0042684 MINOR COMMUNITY WATER QUALITY
SOUTH PACOLET RIVER SPARTANBURG WATER SYSTEM WWTP/SIMMS PLT PIPE #: 001 FLOW: 0.004 PIPE #: 001 FLOW: 0.012 (PROPOSED)	SC0030279 MINOR MUNICIPAL EFFLUENT EFFLUENT
SOUTH PACOLET RIVER SPARTANBURG WATER SYSTEM/SIMMS PLT PIPE #: 001 FLOW: 1.17 WQL FOR TRC	SCG643002 MINOR DOMESTIC WATER QUALITY
SPIVEY CREEK CITY OF LANDRUM/WTP PIPE #: 001 FLOW: 0.032 WQL FOR TRC	SCG645029 MINOR DOMESTIC WATER QUALITY
LAND APPLICATION **FACILITY NAME**	**PERMIT#** **TYPE**
SPRAYFIELD CAMPOBELLO-GRAMBLING SCHOOL	ND0067342 MUNICIPAL

Landfill Activities

SOLID WASTE LANDFILL NAME / *FACILITY TYPE*	*PERMIT #* / *STATUS*
BILLY JACKSON C&D LANDFILL	—
C&D LANDFILL	CLOSED

Mining Activities

MINING COMPANY / *MINE NAME*	*PERMIT #* / *MINERAL*
LITTLE ACRES SAND CO.	0805-42
SOUTH PACOLET RIVER MINE	SAND

Water Supply

WATER USER (TYPE) / *STREAM*	*PUMPING CAPACITY (MGD)* / *REG. PUMPING CAPACITY (MGD)*
SPARTANBURG WATER SYSTEM (M)	—
SOUTH PACOLET RIVER RES.#1	64.0

Growth Potential

There is a low to moderate potential for growth in this watershed, which contains the City of Landrum and the Town of Campobello.

03050105-170

(Pacolet River)

General Description

Watershed 03050105-170 is located in Spartanburg and Cherokee Counties and consists primarily of the ***Pacolet River*** and its tributaries from its origin at the confluence of the North and South Pacolet Rivers to Lawsons Fork Creek. The watershed occupies 84,046 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Pacolet series. The erodibility of the soil (K) averages 0.28; the slope of the terrain averages 11%, with a range of 2-45%. Land use/land cover in the watershed includes: 11.15% urban land, 33.26% agricultural land, 0.92% scrub/shrub land, 0.29% barren land, 53.08% forested land, and 1.31% water.

The Pacolet River is formed by the confluence of the North Pacolet River Watershed and the South Pacolet River Watershed. Downstream from the confluence, the Pacolet River accepts drainage from Thompson Creek and forms Lake Blalock (760 acres). Streams draining into Lake Blalock include Buck Creek, Little Buck Creek (Ezell Branch, Cudds Creek, Greenes Lake), and Casey Creek (Carlisle Branch). Downstream from the lake, the Pacolet River accepts drainage from Cherokee Creek (Little Cherokee Creek), Island Creek (Zekial Creek, Double Branch), Pole Bridge Branch, Peters Creek, Cinder Branch, Turkey Hen Branch, Quinn Branch, and Mill Branch. There are several ponds and lakes (10-760 acres) in this watershed used for recreational, municipal, and water supply purposes. There are a total of 156.7 stream miles, all classified FW. Cowpens National Battlefield Site is located between Island Creek and Zekial Creek.

Water Quality

Pacolet River - There are three monitoring sites along the Pacolet River. Aquatic life uses are fully supported at the upstream site **(B-028)**, but may be threatened by significantly increasing trends in total phosphorus concentration and turbidity. A significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Aquatic life uses are also fully supported at the midstream site **(B-163A)**, but may be threatened by decreasing trends in dissolved oxygen concentration and pH. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. At the downstream site **(B-331)**, aquatic life uses are again fully supported. Recreational uses are not supported at the upstream and downstream sites and are partially supported at the midstream site due to fecal coliform bacteria excursions.

Little Buck Creek (B-259) - Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in turbidity. A significantly decreasing trend in total phosphorus concentrations suggests improving conditions for this parameter. Recreational uses are not supported due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Lake Taylor Blalock (B-347) - Lake Blalock in Spartanburg County is a 760-acre impoundment on the Pacolet River, with a maximum depth of approximately 49.5 feet (15 m) and an average depth of 5.6 feet (1.7 m). Lake Blalock's watershed comprises 273 square miles (707 km2), which includes Spartanburg Reservoir #1 and Lake Bowen, and extends into North Carolina. Eutrophication assessments indicate that Lake Blalock is one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of this lake's desirable trophic condition is recommended. Aquatic life and recreational uses are fully supported.

Potter Branch (B-191) - Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in turbidity. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
PACOLET RIVER	SC0042668
SSSD/CLIFTON WWTP	MINOR MUNICIPAL
PIPE #: 001 FLOW: 0.29	EFFLUENT
PACOLET RIVER	SC0002798
HOECHST CELANESE CORP.	MAJOR INDUSTRIAL
PIPE #: 002 FLOW: 0.800	EFFLUENT
PIPE #: 004 FLOW: 0.061	EFFLUENT
PIPE #: 010 FLOW: 0.216	WATER QUALITY
WQL FOR DO,TRC	
PACOLET RIVER	SC0045624
SSSD/TOWN OF COWPENS-WASH. RD	MAJOR MUNICIPAL
PIPE #: 001 FLOW: 1.5	WATER QUALITY
WQL FOR TRC	
PACOLET RIVER	SCG641006
CITY OF SPARTANBURG/LAKE BLALOCK/CHESNEE WTP	MINOR DOMESTIC
PIPE #: 001 FLOW: 1.12	EFFLUENT
NOT CONSTRUCTED	
PACOLET RIVER TRIBUTARY	SCG250055
OMEGA CHEMICALS, INC.	MINOR INDUSTRIAL
PIPE #: 001 FLOW: 1.12	EFFLUENT
CHEROKEE CREEK	SC0046353
SAXONIA-FRANKE OF AMERICA, INC.	MINOR INDUSTRIAL
PIPE #: 001 FLOW: 0.003	EFFLUENT
LITTLE BUCK CREEK	SC0025763
CITY OF CHESNEE/MAIN PLANT WWTP	MINOR MUNICIPAL

PIPE #: 001 FLOW: 0.500 WQL FOR NH3N	WATER QUALITY
PETERS CREEK RR DONNELLEY & SONS CO. PIPE #: 001 FLOW: 0.1202 WQL FOR TRC; NH3N IN SUMMER & WINTER	SC0036102 MINOR INDUSTRIAL WATER QUALITY
PETERS CREEK SPECIALTY INDUSTRIAL PRODUCTS PIPE #: 001 FLOW: 0.0097 WQL FOR TRC	SC0037826 MINOR INDUSTRIAL WATER QUALITY
PETERS CREEK SSSD IDLEWOOD SD PIPE #: 001 FLOW: 0.08 WQL FOR TRC,NH3N	SC0030554 MINOR MUNICIPAL WATER QUALITY
PETERS CREEK TRIBUTARY LIQUID AIR CORP. PIPE #: 001 FLOW: M/R	SCG250046 MINOR INDUSTRIAL EFFLUENT
ISLAND CREEK TALL TALES FISH CAMP PIPE #: 001 FLOW: 0.0136	SC0031577 MINOR COMMUNITY EFFLUENT
CINDER BRANCH SSSD/CINDER BRANCH PLT PIPE #: 001 FLOW: 0.03 WQL FOR DO,TRC; NH3N IN SUMMER & WINTER	SC0035424 MINOR MUNICIPAL WATER QUALITY
CINDER BRANCH SSSD/HILLBROOK FOREST SD PIPE #: 001 FLOW: 0.15	SC0029718 MINOR MUNICIPAL WQL FOR DO,TRC,NH3N

LAND APPLICATION SYSTEM **FACILITY NAME**	**PERMIT #** **TYPE**
SPRAYFIELD SPARTANBURG WATER SYSTEM/SIMMS WTP	ND0074101 DOMESTIC
SPRAYFIELD SPARTANBURG WATER SYSTEM/LAKE BLALOCK WTP	ND0077135 DOMESTIC

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
IRENE BISHOP SHORT TERM C&D LANDFILL	422904-1301 ACTIVE
DAVID STOLTZ SHORT TERM C&D LANDFILL	422422-1301 ACTIVE
JAMES LANCASTER LAND CLEARING DEBRIS LANDFILL	422460-1701 ACTIVE

HASKELL SEXTON SHORT TERM C&D LANDFILL	422484-7301 ACTIVE
HOECHST CELANESE CORP. INDUSTRIAL C&D LANDFILL	423312-1201 ACTIVE

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
CHAPMAN GRADING & CONCRETE CO., INC. CHAPMAN SAND PLANT #6	1081-42 SAND

Groundwater Concerns

The groundwater in the vicinity of the property owned by Freedom Chemical is contaminated with volatile organic compounds (VOC) resulting from spills and leaks. The facility is currently in the assessment phase. The surface water affected by the VOCs is an unnamed tributary of the Pacolet River.

Growth Potential

There is a low to moderate potential for growth in this watershed associated primarily with the City of Chesnee and the Town of Cowpens, both having sewer infrastructure. Industrial growth in particular is expected along the I-85 corridor and major roads with I-85 interchanges.

Implementation Strategy

Little Buck Creek is impaired from elevated levels of fecal coliform bacteria due to point and nonpoint sources. Permit revisions have been initiated and conditions are expected to improve.

03050105-180

(Lawsons Fork Creek)

General Description

Watershed 03050105-180 is located in Spartanburg County and consists primarily of ***Lawsons Fork Creek*** and its tributaries. The watershed occupies 59,348 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil series. The erodibility of the soil (K) averages 0.28; the slope of the terrain averages 8%, with a range of 2-15%. Land use/land cover in the watershed includes: 43.80% urban land, 20.47% agricultural land, 0.35% scrub/shrub land, 0.26% barren land, 35.02% forested land, and 0.10% water.

Lawsons Fork Creek originates near and flows past the City of Spartanburg before draining into the Pacolet River. Lawsons Fork Creek accepts drainage from Greene Creek (Meadow Creek), Camp Creek, Fawn Branch, Big Shoally Creek (Little Shoally Creek, Flatwood Lake, Fairview Lake), Betty Green Creek (Waldrops Lake), Chinquapin Creek, and Fourmile Branch. There are several ponds and lakes (10-20 acres) in this watershed used for recreation, irrigation, and power supply. There are a total of 103.6 stream miles, all classified FW.

Water Quality

Lawsons Fork Creek - There are five monitoring sites along Lawsons Fork Creek. Aquatic life uses are partially supported at the upstream site **(B-221)** based on macroinvertebrate community data, and fully supported at the next site downstream **(B-277)**. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration at these upstream sites suggest improving conditions for these parameters. Further downstream **(B-278)**, aquatic life uses are also fully supported, but may be threatened by a significantly increasing trend in turbidity. A significantly increasing trend in dissolved oxygen concentration and a significantly decreasing trend in five-day biochemical oxygen demand suggest improving conditions for these parameters.

Aquatic life uses are again fully supported at the next site downstream **(BL-005)**, but may be threatened by a significantly decreasing trend in pH. At the furthest downstream site **(BL-001)**, aquatic life uses are partially supported based on macroinvertebrate community data. In addition, there is a significantly decreasing trend in pH and a significantly increasing trend in turbidity. Sediment samples revealed a very high concentration of zinc in 1992, and high concentrations of PAHs anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, benzo(ghi)perylene, and benzo(a)anthracene in 1994. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration at the downstream sites suggest improving conditions for these parameters. Recreational uses are not supported at any site due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
LAWSONS FORK CREEK MILLIKEN & CO./DEWEY PLT PIPE #: 001 FLOW: 0.374 WQL FOR DO,TRC,NH3N	SC0003581 MAJOR INDUSTRIAL WATER QUALITY
LAWSONS FORK CREEK AMOCO OIL/SPARTANBURG TERMINAL PIPE #: 001 FLOW: M/R PIPE #: 002 FLOW: M/R	SC0003549 MINOR INDUSTRIAL EFFLUENT EFFLUENT
LAWSONS FORK CREEK SSSD/LAWSONS FORK PLANT PIPE #: 001 FLOW: 9.0-15.5 WQL FOR DO,TRC,NH3N	SC0020427 MAJOR MUNICIPAL WATER QUALITY
LAWSONS FORK CREEK SPARTAN MILLS/WHITNEY PIPE #: 001 FLOW: M/R	SCG250115 MINOR INDUSTRIAL EFFLUENT
LAWSONS FORK CREEK CITY OF INMAN PIPE #: 001 FLOW: 0.477 PIPE #: 001 FLOW: 1.000 (PROPOSED) WQL FOR DO,TRC,NH3N	SC0021601 MINOR MUNICIPAL WATER QUALITY WATER QUALITY
LAWSONS FORK CREEK CITGO PETROLEUM CORP. PIPE #: 001 FLOW: M/R	SCG340005 MINOR INDUSTRIAL EFFLUENT
LAWSONS FORK CREEK INMAN MILLS WATER DISTRICT PIPE #: 001 FLOW: 0.175 WQL FOR DO,TRC,NH3N	SC0024414 MINOR MUNICIPAL WATER QUALITY
LAWSONS FORK CREEK SOUTHEAST TERMINAL/SPARTANBURG PIPE #: 001 FLOW: M/R	SCG340002 MINOR INDUSTRIAL EFFLUENT
LAWSONS FORK CREEK BORDEN INC. PIPE #: 001 FLOW: M/R	SCG250113 MINOR INDUSTRIAL EFFLUENT
LAWSONS FORK CREEK TRIBUTARY DRAPER CORPORATION PIPE #: 001 FLOW: M/R PIPE #: 002 FLOW: M/R	SCR001582 MINOR INDUSTRIAL EFFLUENT EFFLUENT
GREENE CREEK HUDSON INTERNATIONAL CONDUCTORS PIPE #: 001 FLOW: M/R	SCG250039 MINOR INDUSTRIAL EFFLUENT

CAMP CREEK
STONECREEK SD/UNITED UTILITIES
PIPE #: 001 FLOW: 0.084
WQL FOR DO,TRC,NH3N

SC0031763
MINOR COMMUNITY
WATER QUALITY

MEADOW CREEK
INMAN STONE COMPANY, INC.
PIPE #: 001 FLOW: M/R

SCG730084
MINOR INDUSTRIAL
EFFLUENT

CHINQUAPIN CREEK
SPARTAN MILLS/BEAUMONT PLT
PIPE #: 001 FLOW: M/R

SC0002437
MINOR INDUSTRIAL
EFFLUENT

CHINQUAPIN CREEK
SPARTAN IRON & METAL
PIPE #: 001 FLOW: 0.002

SC0046515
MINOR INDUSTRIAL
EFFLUENT

CHINQUAPIN CREEK
NORTHSIDE ROBO CAR WASH
PIPE #: 001 FLOW: M/R

SCG750002
MINOR INDUSTRIAL
EFFLUENT

FOURMILE BRANCH
CROWN CENTRAL PETROLEUM CORP.
PIPE #: 001 FLOW: M/R

SCG340007
MINOR INDUSTRIAL
EFFLUENT

FOURMILE BRANCH
CONOCO INC./SPARTANBURG TERMINAL
PIPE #: 001 FLOW: M/R
PIPE #: 002 FLOW: M/R
PIPE #: 003 FLOW: M/R

SCG340006
MINOR INDUSTRIAL
EFFLUENT
EFFLUENT
EFFLUENT

LAND APPLICATION SYSTEM
FACILITY NAME

PERMIT #
TYPE

SPRAYFIELD
KOHLER CO.

ND0000892
INDUSTRIAL

Landfill Activities

SOLID WASTE LANDFILL NAME
FACILITY TYPE

PERMIT #
STATUS

MILLIKEN & CO.
INDUSTRIAL

—
CLOSED

PAR GRADING
SHORT TERM C&D LANDFILL

422421-1301
ACTIVE

DRAPER LANDFILL
INDUSTRIAL

IWP-103
ACTIVE

Mining Activities

MINING COMPANY
MINE NAME

PERMIT #
MINERAL

INMAN STONE COMPANY., INC.
INMAN QUARRY

0630-42
GRANITE

Groundwater Concerns

The groundwater in the vicinity of the properties owned by Conoco Inc. (Site #13389), Plantation Pipeline (Site #13652), Exxon Inc. (Site #13432), Fina Oil & Chemical Company (Site #13438), Texaco-Star Enterprises (Site #13726), and Shell Oil Company (Site #13694) are contaminated with petroleum products. Sources of contamination include above ground storage tanks and spills and leaks. The facilities are currently in the assessment and remediation phases, and are participating in a 'community plume agreement'. The surface water affected by the contamination is Fourmile Branch.

The groundwater in the vicinity of the property owned by Milliken & Co. is contaminated with volatile organic compounds (VOC) resulting from pits, ponds, and lagoons. This is a RCRA facility and remedial action has been initiated. The surface water affected by the VOCs is Lawsons Fork Creek.

Growth Potential

There is a high potential for growth in this watershed, which contains a portion of the City of Spartanburg. Industrial growth in particular is expected along the I-85 corridor and major roads with I-85 interchanges. There are also industrial developmental pressures along I-26, US 29, and US 221.

Implementation Strategy

Lawsons Fork Creek has an impaired macroinvertebrate community and elevated levels of fecal coliform bacteria due to both point and nonpoint sources. The biological samples will be evaluated to determine the cause of their impairment. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050105-190

(Pacolet River)

General Description

Watershed 03050105-190 is located in Union, Cherokee, and Spartanburg Counties and consists primarily of the ***Pacolet River*** and its tributaries from Lawsons Fork Creek to the Broad River. The watershed occupies 80,098 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Madison-Cecil-Pacolet series. The erodibility of the soil (K) averages 0.27; the slope of the terrain averages 10%, with a range of 2-25%. Land use/land cover in the watershed includes: 2.12% urban land, 11.77% agricultural land, 3.49% scrub/shrub land, 0.88% barren land, 81.57% forested land, and 0.18% water.

This section of the Pacolet River accepts drainage from its upper reach (03050105-170), together with Richland Creek, Harvey Branch, Browns Branch, Plum Branch, and Mill Branch. Further downstream, Mill Creek (Jumping Run Creek, Eison Branch) enters the river followed by Sandy Run Creek, Peter Hawks Creek, Gault Creek, another Mill Creek, another Gault Creek, Big Creek, Kendrick Branch, and Reedy Branch. The Pacolet River drains into the Broad River. There are a few ponds and lakes (25-40 acres) in this watershed used for recreational, municipal, and industrial purposes. There are a total of 101.8 stream miles in this watershed, all classified FW.

Water Quality

Pacolet River - There are two monitoring sites along this section of the Pacolet River. Aquatic life uses are fully supported at both the upstream **(BP-001)** and the downstream **(B-048)** sites, but may be threatened by a significantly decreasing trend in pH at both sites and a very high concentration of cadmium measured in sediment in 1993 at the downstream site. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentrations at both sites and total nitrogen concentrations at the downstream site suggest improving conditions for these parameters. Recreational uses are not supported at either site due to fecal coliform bacteria excursions, but a significantly decreasing trend in fecal coliform bacteria concentrations suggests improving conditions for this parameter at the downstream site.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
PACOLET RIVER	SC0044717
SSSD/PACOLET MILLS WWTP	MINOR MUNICIPAL
PIPE #: 001 FLOW: 0.3	EFFLUENT
PACOLET RIVER TRIBUTARY	SC0038326
SSSD/PACOLET ELEM. SCHOOL	MINOR MUNICIPAL

PIPE #: 001 FLOW: 0.035	WATER QUALITY
WQL FOR TRC; NH3N IN SUMMER & WINTER	
PACOLET RIVER TRIBUTARY	SC0002411
FMC CORP/SPARTAN MINERALS	MINOR INDUSTRIAL
PIPE #: 001 FLOW: 0.018	WATER QUALITY
PIPE #: 002 FLOW: 0.257	WATER QUALITY
PIPE #: 02a FLOW: 0.120	WATER QUALITY
PIPE #: 003 FLOW: 0.159	WATER QUALITY
WQL FOR METALS	
PACOLET RIVER TRIBUTARY	SC0002941
VULCAN MATERIALS CO.	MINOR INDUSTRIAL
PIPE #: 001 FLOW: M/R	EFFLUENT
MILL CREEK	SC0037371
SPARTAN MILLS/ROSEMONT MILL	MINOR INDUSTRIAL
PIPE #: 001 FLOW: 0.0122	EFFLUENT

Landfill Activities

SOLID WASTE LANDFILL NAME	***PERMIT #***
FACILITY TYPE	***STATUS***
KOHLER LANDFILL	422442-1601
INDUSTRIAL	ACTIVE

Mining Activities

MINING COMPANY	***PERMIT #***
MINE NAME	***MINERAL***
DEATON SAND COMPANY	1016-42
DEATON SAND PIT	SAND
VULCAN MATERIALS CO.	0062-42
PACOLET QUARRY	GRANITE

Growth Potential

There is a low to moderate potential for growth in this watershed, which contains a portion of the Town of Jonesville. Public water and sewer services are available in Jonesville, and residential and commercial uses center around the town and along SC 9.

03050106-010

(Broad River)

General Description

Watershed 03050106-010 is located in Union, Chester, and Fairfield Counties and consists primarily of the ***Broad River*** and its tributaries from the Pacolet River to the Tyger River. The watershed occupies 79,889 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Wilkes-Pacolet-Winnsboro series. The erodibility of the soil (K) averages 0.24; the slope of the terrain averages 21%, with a range of 6-40%. Land use/land cover in the watershed includes: 0.49% urban land, 10.74% agricultural land, 3.70% scrub/shrub land, 0.51% barren land, 82.93% forested land, and 1.63% water.

This section of the Broad River accepts drainage from its upper reach (03050105-094), together with Robertson Branch, Fanning Creek (Sharps Creek), George Branch, Osborn Branch, and the Turkey Creek Watershed. Hughes Creek (Lake John D. Long, Vanderford Branch) enters the river next followed by the Browns Creek Watershed, McCluney Creek, Little Turkey Creek, Clarks Creek, Neals Creek (Hobsons Creek), Mineral Creek, Coxs Creek, and the Sandy River Watershed. There are 156.1 stream miles in this watershed, all classified FW. The lower three-quarters of the watershed, below Turkey Creek, resides within the Sumter National Forest.

Water Quality

A fish consumption advisory has been issued by the Department for mercury and includes portions of the Broad River in this watershed (see Watershed Evaluations and Implementation Strategies Within WMU-0502).

Broad River (B-046) - Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in pH, a very high concentration of zinc measured in 1993, and di-n-butylphthalate detected in 1991. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus and total nitrogen concentrations suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions.

Lake John D. Long (B-344) - Lake John D. Long is a 78-acre impoundment on Hughes Creek in Union County, with a maximum depth of approximately 31 feet (9.4 m) and an average depth of 16 feet (4.9 m). Lake Long's watershed comprises approximately 1.9 square miles (5.0 km). The lake is currently one of the least eutrophic small lakes in South Carolina, characterized by low nutrient concentrations. Preservation of Lake Long's desirable trophic condition is recommended.

Aquatic life and recreational uses are fully supported. Although pH excursions occurred, higher pH levels are not uncommon in lakes with significant aquatic plant communities and are considered natural, not standards violations. In an effort to provide access for boating and fishing, 300 triploid grass carp (30/vegetated acre) were stocked in 1991 and aquatic herbicides were applied in 1991 and 1994-1996.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
BROAD RIVER	SC0001368
CONE MILLS/CARLISLE PLT	MAJOR INDUSTRIAL
PIPE #: 001 FLOW: 2.0	EFFLUENT
PIPE #: 002 FLOW: 0.04	WATER QUALITY
PIPE #: 003 FLOW: 0.12	EFFLUENT
WQL FOR TRC	
BROAD RIVER	SC0002186
SCE&G/NEAL SHOALS HYDRO	MINOR INDUSTRIAL
PIPE #: 001 FLOW:M/R	EFFLUENT
BROAD RIVER	SC0003051
LOCKHART UTIL. CO.	MINOR COMMUNITY
PIPE #: 001 FLOW: 0.169	WATER QUALITY
WQL FOR BOD5,DO,TRC,NH3N	
BROAD RIVER	SC0003051
LOCKHART UTIL. CO.	MINOR COMMUNITY
PIPE #: 001 FLOW: 0.169	EFFLUENT
PROPOSED; DISCHARGE BELOW POWER PLANT	
BROAD RIVER	SC0022756
CLARIANT CORP./LEEDS PLT	MINOR INDUSTRIAL
PIPE #: 001 FLOW: M/R	EFFLUENT

LAND APPLICATION	**PERMIT#**
FACILITY NAME	**TYPE**
SPRAYFIELD	ND0000091
HOECHST CELANESE CORP.	INDUSTRIAL

Mining Activities

MINING COMPANY	***PERMIT #***
MINE NAME	***MINERAL***
MCINTYRE SAND CO., INC.	0825-44
MULLINS MINE	SAND
MCINTYRE SAND CO., INC.	0909-44
CUDD SAND MINE	SAND
SLOAN CONSTRUCTION CO., INC.	0471-44
LOCKHART MINE	SAND
UNION COUNTY	0311-10
CARLISLE PIT	SAND

Camp Facilities

FACILITY NAME/TYPE *RECEIVING STREAM*	*PERMIT #* *STATUS*
LEEDS HUNT CAMP/FAMILY BROAD RIVER TRIBUTARY	12-307-0008 ACTIVE
WOODS FERRY/FAMILY BROAD RIVER	12-307-0005 ACTIVE

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF UNION (M) BROAD RIVER	28.5 8.0
CARLISLE CONE MILLS (M) BROAD RIVER	8.1 5.7
LOCKHART MILLS (M) BROAD RIVER	2.0 1.0

WATER USER (TYPE) *STREAM*	*RATED PUMP. CAP. (GPM)* *AMT. TRT./DIV. (MGD)*
HOECHST CELANESE CORP. (I) BROAD RIVER	200 0.288
HOECHST CELANESE CORP. (I) MINERAL CREEK	694.4 0.576

Growth Potential

There is a low potential for future growth in this watershed. A large portion of the watershed is effectively excluded from development by the Sumter National Forest. Public water service is available in the Towns of Santuck, Lockhart, and Carlisle, and sewer service is available in Lockhart and Carlisle.

03050106-020

(Turkey Creek)

General Description

Watershed 03050106-020 is located in York and Chester Counties and consists primarily of ***Turkey Creek*** and its tributaries. The watershed occupies 96,488 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Wilkes-Cecil-Madison series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 12%, with a range of 2-40%. Land use/land cover in the watershed includes: 1.09% urban land, 11.31% agricultural land, 1.48% scrub/shrub land, 0.54% barren land, 85.47% forested land, and 0.11% water.

Turkey Creek originates near the City of York, flowing out of Caldwell Lake (37 acres) and accepting drainage from Ross Branch (Lake Carolyn), Dry Fork, Little Turkey Creek (McClures Branch, Lindsey Creek), and Bryson Creek. Further downstream, Blue Branch enters Turkey Creek followed by Rainey Branch (Palmer Branch), Susybole Creek (Little Susybole Creek), Mill Creek (Rodens Creek), and McKelvy Creek. There are a few ponds and lakes (10-37 acres) in this watershed used for recreational, municipal, and irrigational purposes. There are a total of 142.3 stream miles in this watershed, all classified FW. The lower tip of the watershed resides within the Sumter National Forest.

Water Quality

Turkey Creek (B-136) - Aquatic life uses are fully supported based on physical, chemical, and macroinvertebrate community data. Recreational uses are fully supported.

Ross Branch (B-086) - Aquatic life uses are fully supported, and a significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Recreational uses are not supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM	***NPDES#***
FACILITY NAME	***TYPE***
PERMITTED FLOW @ PIPE (MGD)	***LIMITATION***
COMMENT	
LITTLE SUSYBOLE CREEK	SCG730085
BECKER MINERALS/LOWRY QUARRY	MINOR INDUSTRIAL
PIPE #: 001 FLOW: M/R	EFFLUENT
SUSYBOLE CREEK TRIBUTARY	SC0043095
MACK ESTATES	MINOR MUNICIPAL
PIPE #: 001 FLOW: 0.02	WATER QUALITY
WQL FOR DO,TRC,NH3N; NOT CONSTRUCTED	

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
REA CONSTRUCTION CO. SAND PIT #123 - TURKEY CREEK MINE	0177-46 SAND
REA CONSTRUCTION CO. SAND PIT #124 - SUSYBOLE CREEK MINE	0180-10 SAND

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF YORK (M) CALDWELL LAKE	4.1 2.2
CITY OF YORK (M) ROSS BRANCH TRIBUTARY - LAKE CAROLYN	4.0 2.2

Growth Potential

There is a low to moderate potential for growth in this watershed, which contains the Town of Lowrys and portions of the City of York, and the Towns of Sharon and McConnells. The City of York is located at the top of the watershed, and extends water and sewer service in and around the city. Residential and commercial development are expected to grow in these areas.

03050106-030

(Browns Creek)

General Description

Watershed 03050106-030 is located in Union County and consists primarily of ***Browns Creek*** and its tributaries. The watershed occupies 34,729 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Madison-Cecil-Wilkes series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 13%, with a range of 2-40%. Land use/land cover in the watershed includes: 5.67% urban land, 18.59% agricultural land, 3.09% scrub/shrub land, 0.32% barren land, 72.20% forested land, and 0.13% water.

Big Browns Creek (Knox Creek, Bethlehem Creek, Meng Creek) originates near the City of Union and merges with Little Browns Creek to form Browns Creek. Gregorys Creek flows into Browns Creek just prior to its confluence with the Broad River. There are 59.6 stream miles in this watershed, all classified FW. The lower portion of the watershed resides within the Sumter National Forest.

Water Quality

Browns Creek (B-155) **-** Aquatic life uses are fully supported based on macroinvertebrate community data, but may be threatened by a very high concentration of zinc measured in 1995 and occurrences of copper in excess of the aquatic life acute standard. Recreational uses are partially supported due to fecal coliform bacteria excursions.

Meng Creek (B-064) **-** Aquatic life uses are fully supported, and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Unnamed tributary to Meng Creek (B-243) **-** Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in pH. Significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus concentration, and turbidity suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Gregorys Creek (B-335) **-** Aquatic life uses are fully supported, but may be threatened by a very high concentration of zinc measured in 1995. Recreational uses are fully supported.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)* *COMMENT*	*NPDES#* *TYPE* *LIMITATION*
BIG BROWNS CREEK CITY OF UNION/MENG CREEK PLANT PIPE #: 001 FLOW: 1.0 WQL FOR DO,TRC,NH3N	SC0047236 MAJOR MUNICIPAL WATER QUALITY
BIG BROWNS CREEK TRIBUTARY SONOCO PRODUCTS/PINCKNEY PLT PIPE #: 001 FLOW: 0.001 WQL FOR BOD5,DO,TRC,NH3N	SC0028789 MINOR INDUSTRIAL WATER QUALITY
MENG CREEK CITY OF UNION/WTP PIPE #: 001 FLOW: 0.062 WQL FOR TRC	SCG645028 MINOR DOMESTIC WATER QUALITY

Landfill Activities

SOLID WASTE LANDFILL NAME *FACILITY TYPE*	*PERMIT #* *STATUS*
UNION COUNTY LANDFILL MUNICIPAL	441001-1101 ACTIVE

Growth Potential

There is a low to moderate potential for growth in this watershed, which contains a portion of the City of Union and the unincorporated Monarch Mill Village. Water service is available in most of the watershed, and the area should continue to experience scattered residential development.

Implementation Strategy

Meng Creek and a tributary to Meng Creek are impaired by elevated levels of fecal coliform bacteria due to both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050106-040
(Sandy River)

General Description

Watershed 03050106-040 is located in Chester County and consists primarily of the ***Sandy River*** and its tributaries. The watershed occupies 102,351 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Wilkes-Madison series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 14%, with a range of 2-40%. Land use/land cover in the watershed includes: 3.41% urban land, 9.12% agricultural land, 3.28% scrub/shrub land, 0.22% barren land, 83.58% forested land, and 0.40% water.

The Sandy River accepts drainage from Chapel Branch and flows through Chester Reservoir (80 acres) near the City of Chester. Downstream from the reservoir, Dry Fork enters the river followed by Caney Fork Creek (Chester State Park Lake, Twomile Branch, Threemile Branch), Carter Branch, Bear Branch (Mountain Lakes), and Seely Creek (Julies Fork, Walkers Mill Branch, Rock Branch, Bond Branch, Long Branch, Gum Spring Branch). Further downstream, the river accepts drainage from Rocky Branch, Brushy Fork Creek (Smith Creek, Starne Branch), the Little Sandy River (Mobley Creek, Coon Creek), and Johns Creek. Chester State Park is located in this watershed and extends over Twomile Branch and Threemile Branch near the City of Chester. There are several ponds and lakes (10-138 acres) in this watershed used for recreational and municipal purposes, and a total of 156.2 stream miles all classified FW. The lower tip of the watershed resides within the Sumter National Forest.

Water Quality

Sandy River (B-075) - Aquatic life uses are fully supported based on physical, chemical, and macroinvertebrate community data. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Chester State Park Lake (CL-023) - Aquatic life uses are fully supported. Chester State Park Lake is a 138-acre impoundment on Twomile Branch and Threemile Branch located within Chester State Park in Chester County. The maximum depth is approximately 17 feet (5.2 m) and the average depth is 8.9 feet (2.7 m). The lake's watershed comprises approximately 9.2 square miles (23.8 km2). Eutrophication assessments indicate that Chester State Park Lake maintains an intermediate trophic condition among small lakes in South Carolina. Valued for fishing, although not intensively managed, the lake can support high algal biomass.

Dry Fork (B-074) - Aquatic life uses may not be supported due to the occurrence of a high concentration of copper and both high and very high concentrations of chromium and nickel in sediments. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
SANDY RIVER HILLTOP MOBILE HOME PARK PIPE #: 001 FLOW: 0.01125 WQL FOR DO,TRC,NH3N	SC0031224 MINOR COMMUNITY WATER QUALITY
SANDY RIVER CITY OF CHESTER/SANDY RIVER WWTP PIPE #: 001 FLOW: 2.133 WQL FOR BOD5,DO,TRC,NH3N	SC0036081 MAJOR MUNICIPAL WATER QUALITY

LAND APPLICATION **FACILITY NAME**	**PERMIT#** **TYPE**
SPRAYFIELD OWENS LAUNDROMAT	ND0001023 INDUSTRIAL
SPRAYFIELD ESSEX INTER INC.	ND0001015 INDUSTRIAL

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
CITY OF CHESTER MUNICIPAL	DWP-069 CLOSED

Camp Facilities

FACILITY NAME/TYPE ***RECEIVING STREAM***	***PERMIT #*** ***STATUS***
CHESTER STATE PARK/FAMILY CHESTER STATE PARK LAKE	12-307-0001 ACTIVE
B&S FAMILY CAMPGROUND/FAMILY SEELY CREEK	12-307-0007 ACTIVE

Growth Potential

There is a low to moderate potential for growth in this watershed, which contains the City of Chester. Water and sewer services are provided in and around Chester and will promote modest residential, commercial, and industrial growth. The majority of the watershed is rural in nature with a high degree of forestry activities.

Implementation Strategy

Dry Fork is impaired by elevated levels of chromium, copper, and nickel from nonpoint sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible.

03050106-050

(Broad River)

General Description

Watershed 03050106-050 is located in Newberry and Fairfield Counties and consists primarily of the ***Broad River*** and its tributaries from the Tyger River to the Parr Shoals dam. The watershed occupies 156,544 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Cecil-Pacolet-Wilkes series. The erodibility of the soil (K) averages 0.24; the slope of the terrain averages 15%, with a range of 2-40%. Land use/land cover in the watershed includes: 0.73% urban land, 11.17% agricultural land, 3.86% scrub/shrub land, 0.34% barren land, 76.86% forested land, and 7.03% water.

This section of the Broad River accepts drainage from its upper reaches (03050105-094, 03050106-010) together with the Tyger River Watershed, the Enoree River Watershed, Beaver Creek (McClures Creek, Chicken Creek, Storm Branch, Reedy Branch, Sandy Fork), Rocky Creek, and Terrible Creek. The Parr Shoals dam impounds the Broad River to form Parr Reservoir, which accepts drainage from Hellers Creek (Second Creek, Buck Branch) and Cannons Creek (Rocky Branch, Kerr Creek, Charles Creek, Mud Creek). Monticello Reservoir (7100 acres) is connected to Parr Reservoir by Frees Creek. There are a few ponds and lakes (10-7100 acres) in this watershed used for recreation, industry, and power supply. There are a total of 294.9 stream miles, all classified FW. The Sumter National Forest and the Broad River Waterfowl Area are natural resources in the watershed.

Water Quality

A fish consumption advisory has been issued by the Department for mercury and includes portions of the Broad River in this watershed (see Watershed Evaluations and Implementation Strategies Within WMU-0502).

Broad River (B-047) - Aquatic life uses are fully supported, but may be threatened by a significantly increasing trend in total phosphorus concentration. A significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Recreational uses are partially supported due to fecal coliform bacteria excursions. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Beaver Creek (B-143) - Aquatic life uses are fully supported based on macroinvertebrate community data.

Cannons Creek (B-751) - Aquatic life uses are fully supported based on macroinvertebrate community data.

Monticello Reservoir - Monticello Reservoir is a 7100-acre divided impoundment flooding most of the Frees Creek watershed in Fairfield County. The upper impoundment is a small recreational lake. The lower impoundment is linked with Parr Reservoir on the Broad River via a pumped storage hydroelectric facility.

Overall, the average depth of Monticello Reservoir is 59 feet (17.9 m) and the maximum depth in the lower impoundment is approximately 126 feet (38.4 m). The lake's watershed comprises approximately 17 square miles (44 km2). Historical eutrophication studies indicate that Monticello Reservoir's trophic condition is improving. It is currently one of the least eutrophic large lakes in South Carolina, characterized by low nutrient concentrations. Preservation of Monticello Reservoir's desirable trophic condition is recommended.

There are two monitoring sites along Monticello Reservoir. Aquatic life uses are fully supported at the upper impoundment site **(B-328)**. Recreational uses are fully supported, but may be threatened by a significantly increasing trend in fecal coliform bacteria concentration. Aquatic life uses are also fully supported at the lower impoundment site **(B-327)**, but may be threatened by a significantly increasing trend in pH and a very high concentration of copper measured in the 1992 sediment sample. Although pH excursions occurred, higher pH levels are not uncommon in lakes with significant aquatic plant communities and are considered natural, not standards violations. Significantly decreasing trends in total phosphorus and total nitrogen concentration, and turbidity at both lake sites suggest improving conditions for these parameters. Recreational uses are fully supported, but may be threatened by a significantly increasing trend in fecal coliform bacteria concentration.

Parr Reservoir - Parr Reservoir is a 4400-acre impoundment on the Broad River in Fairfield and Newberry Counties, linked with Monticello Reservoir via a pumped storage hydroelectric facility. Parr Reservoir's maximum depth is approximately 25 feet (7.6 m) and the average depth is 15 feet (4.6 m). The reservoir's watershed comprises approximately 4750 square miles (12,302 km2) in North and South Carolina. Currently, Parr Reservoir maintains an intermediate trophic condition among large lakes in South Carolina; a short retention time (average approximately four days) results in both high dissolved oxygen concentrations and high turbidity.

There are two monitoring sites along Parr Reservoir. Aquatic life and recreational uses are fully supported at both the uplake site **(B-346)** and the downlake site **(B-345)**. Although a pH excursion occurred at the downlake site, aquatic life uses are considered to be fully supported due to the small number of samples collected.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
BROAD RIVER SCE&G/PARR HYDRO STA. PIPE #: 001 FLOW: M/R	SC0001864 MINOR INDUSTRIAL EFFLUENT
MONTICELLO RESERVOIR SCE&G/SUMMER NUCLEAR STA. PIPE #: 014 FLOW: 0.12 WQL DO,TRC; NH3N IN SUMMER & WINTER	SC0030856 MAJOR INDUSTRIAL WATER QUALITY

PARR RESERVOIR SCE&G/FAIRFIELD PUMPED STORAGE PIPE #: 001 FLOW: M/R	SC0035904 MINOR INDUSTRIAL EFFLUENT
CANNONS CREEK NEWBERRY INN/BEST WESTERN PIPE #: 001 FLOW: 0.0255 WQL FOR TRC,NH3N	SC0026921 MINOR COMMUNITY WATER QUALITY
CHARLES CREEK FOREST HILLS SD/ELBO INC. PIPE #: 001 FLOW: 0.02 WQL FOR DO,TRC,NH3N	SC0024571 MINOR MUNICIPAL WATER QUALITY
KERR CREEK TOWN OF PROSPERITY PIPE #: 001 FLOW: 0.17 WQL FOR DO,TRC,NH3N	PROPOSED MINOR MUNICIPAL WATER QUALITY
ROCKY CREEK TARMAC MID-ATLANTIC, INC. PIPE #: 001 FLOW: M/R	SCG730053 MINOR INDUSTRIAL EFFLUENT

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
NEWBERRY COUNTY LANDFILL MUNICIPAL	DWP-117 CLOSED
NEWBERRY COUNTY COMPOSTING MUNICIPAL	361001-3001 ACTIVE
NEWBERRY COUNTY TRANSFER STATION MUNICIPAL	361001-6007 ACTIVE
SHAKESPEARE CO. LANDFILL INDUSTRIAL	IWP-159 CLOSED

Mining Activities

MINING COMPANY ***MINE NAME***	***PERMIT #*** ***MINERAL***
TARMAC MID-ATLANTIC, INC. BLAIR QUARRY	0130-20 GRANITE
NEWBERRY COUNTY WICKER ESTATE PIT	0299-36 SAND/CLAY

Water Supply

WATER USER (TYPE) ***STREAM***	***PUMPING CAPACITY (MGD)*** ***REG. PUMPING CAPACITY (MGD)***
VC SUMMER NUCLEAR STATION WTP (M) MONTICELLO RESERVOIR	3.1 1.5

Growth Potential

There is a low to moderate potential for growth in this watershed, primarily associated with residential development around the reservoirs, the Town of Jenkinsville, and the City of Newberry. The upper portion of the watershed is effectively excluded from development by the Sumter National Forest, and the overall lack of adequate utilities to serve the remaining area will limit growth.

Implementation Strategy

The Broad River is impaired by elevated levels of fecal coliform bacteria due to point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

03050106-060

(Broad River)

General Description

Watershed 03050106-060 is located in Richland, Newberry, and Fairfield Counties and consists primarily of the ***Broad River*** and its tributaries from the Parr Shoals dam to its confluence with the Saluda River. The watershed occupies 160,922 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Tatum-Alpin-Herndon-Pacolet series. The erodibility of the soil (K) averages 0.29; the slope of the terrain averages 13%, with a range of 2-25%. Land use/land cover in the watershed includes: 15.47% urban land, 5.62% agricultural land, 1.89% scrub/shrub land, 0.46% barren land, 74.96% forested land, and 1.57% water.

This section of the Broad River accepts drainage from its upper reaches (03050105-094, 03050106-010, 03050106-050) together with Mayo Creek, Crims Creek (Rocky Creek, Summers Branch), Wateree Creek (Risters Creek), Boone Creek, Freshley Branch, Mussel Creek, and the Little River Watershed. Hollingshead Creek (Boyd Branch, Wildhorse Branch, Metz Branch, Hope Creek, Bookman Creek) enters the river next followed by the Cedar Creek Watershed, Nipper Creek, Nicholas Creek (Swygert Branch, Moccasin Branch), Slatestone Creek, and Burgess Creek. Crane Creek and Smith Branch enter the river at the base of the watershed near the City of Columbia. Sorghum Branch, Dry Branch (Crescent Lake, Stevensons Lake), Elizabeth Lake (60 acres), and Cumbess Creek drain into Crane Creek followed by North Crane Creek. North Cane Creek accepts drainage from Beasley Creek (Robertson Branch, Lot Branch, Hawkins Branch), Swygert Creek, Dry Fork Creek, and Long Branch. There are several ponds and lakes (10-60 acres) in this watershed used for recreational and irrigational purposes, and a total of 311.6 stream miles, all classified FW. The Harbison State Forest is located next to the Broad River just downstream of Nicholas Creek and a Heritage Trust Preserve is located along Nipper Creek.

Water Quality

A fish consumption advisory has been issued by the Department for mercury and includes portions of the Broad River in this watershed (see Watershed Evaluations and Implementation Strategies Within WMU-0502).

Broad River - There are three monitoring sites along this section of the Broad River. Aquatic life uses may not be supported at the upstream site **(B-236)** due to the occurrence of pesticides (P,P'DDT, P,P'DDE, endrin) and high concentrations of the PAHs benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene in sediment samples. Recreational uses are partially supported due to fecal coliform bacteria excursions. Aquatic life and recreational uses are fully supported at the midstream site **(B-337)**. At the downstream site **(B-080)**, aquatic life uses are not supported due to occurrences of copper and zinc in excess of the aquatic life acute standard. In addition, there is a significantly decreasing trend in dissolved oxygen concentration. Significantly decreasing trends in five-day biochemical oxygen demand, total phosphorus and total nitrogen concentration at both the upstream and downstream sites suggest improving conditions for these parameters.

Recreational uses are partially supported due to fecal coliform bacteria excursions. This river was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Elizabeth Lake (B-110) **-** Aquatic life uses are fully supported. Although pH excursions occurred, they were typical of values seen in blackwater, sandhills systems and were considered natural, not standards violations. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are partially supported due to fecal coliform bacteria excursions. In addition, there is a significantly increasing trend in fecal coliform bacteria concentration.

Crane Creek **-** There are two monitoring sites along Crane Creek. Aquatic life uses are partially supported at the upstream site **(B-081)** based on macroinvertebrate community data. Aquatic life uses are not supported at the downstream site **(B-316)** due to occurrences of copper and zinc in excess of the aquatic life acute standard. In addition, there is a significantly increasing trend in turbidity. A significantly decreasing trend in total phosphorus concentration suggests improving conditions for this parameter. Recreational uses are not supported due to fecal coliform bacteria excursions, and there is a significantly increasing trend in fecal coliform bacteria concentration. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Smith Branch (B-280) **-** Aquatic life uses are not supported based on macroinvertebrate community data. A significantly increasing trend in dissolved oxygen concentration and significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentrations suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM *FACILITY NAME* *PERMITTED FLOW @ PIPE (MGD)*	*NPDES#* *TYPE* *LIMITATION*
BROAD RIVER MARTIN MARIETTA/N. COLUMBIA PIPE #: 001 FLOW: M/R	SCG730066 MINOR INDUSTRIAL EFFLUENT
BROAD RIVER RAINTREE ACRES SD/MIDLANDS UTILITIES PIPE #: 001 FLOW: 0.14	SC0039055 MINOR COMMUNITY EFFLUENT
BROAD RIVER TOWN OF CHAPIN PIPE #: 001 FLOW: 1.2 PIPE #: 001 FLOW: 2.4 (PROPOSED)	SC0040631 MAJOR MUNICIPAL EFFLUENT EFFLUENT

BROAD RIVER RICHLAND COUNTY REGIONAL WWTP PIPE #: 001 FLOW: 2.5	SC0046621 MAJOR MUNICIPAL EFFLUENT
BROAD RIVER AMERADA HESS #40231 PIPE #: 001 FLOW: MR NOT CONSTRUCTED	SC0045187 MINOR INDUSTRIAL EFFLUENT
MAYO CREEK SCE&G/SUMMER NUCLEAR TRAINING CTR PIPE #: 001 FLOW: 0.004 WQL FOR TRC	SC0038407 MINOR INDUSTRIAL WATER QUALITY
CRANE CREEK ATLANTIC SOFT DRINK PIPE #: 001 FLOW: M/R	SCG250021 MINOR INDUSTRIAL EFFLUENT
CRANE CREEK RICHTEX BRICK CORP. PIPE #: 001 FLOW: 0.008 WQL FOR DO,TRC,NH3N	SC0031640 MINOR INDUSTRIAL WATER QUALITY
CRANE CREEK DITCH COLUMBIA I-20 AUTO TRUCK CTR PIPE #: 001 FLOW:M/R	SC0035416 MINOR INDUSTRIAL EFFLUENT
CRANE CREEK TRIBUTARY PRESCOTT TERRACE WWTP PIPE #: 001 FLOW: ---	SC0030899 MINOR MUNICIPAL EFFLUENT
RISTERS CREEK MUNN OIL CO/MUNN-E-S PIPE #: 001 FLOW: M/R NEVER CONSTRUCTED	SCG830006 MINOR INDUSTRIAL EFFLUENT
SMITH BRANCH CROWN SC 17 PIPE #: 001 FLOW: M/R	SC0043681 MINOR INDUSTRIAL EFFLUENT
SMITH BRANCH CHEVRON USA/COLUMBIA PIPE #: 001 FLOW: M/R	SCG830003 MINOR INDUSTRIAL EFFLUENT
NIPPER CREEK TARMAC AMERICA/DREYFUS QUARRY PIPE #: 001 FLOW: M/R	SCG730052 MINOR INDUSTRIAL EFFLUENT

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
GIST BACKHOE & GRINDING SERVICE MUNICIPAL	402445-3001 ACTIVE
WHALES TAIL INERT	---- CLOSED

RICHLAND COUNTY MSW MUNICIPAL	DWP-065 CLOSED
RICHLAND COUNTY C&D LANDFILL	401002-1201 ACTIVE
RICHARDSON CONSTRUCTION CO., INC. C&D LANDFILL	— CLOSED
RICHTEX BRICK CORP. INDUSTRIAL	IWP-147 ACTIVE
CITY OF COLUMBIA-NORTH LANDFILL MUNICIPAL	SCD981-028-699 CLOSED
CAROLINA WRECKING C&D LANDFILL	402451-1301 CLOSED
CAROLINA WRECKING C&D LANDFILL	APPLYING FOR PERMIT ACTIVE
RICHLAND WRECKING CO., INC. C&D LANDFILL (3 SITES)	— CLOSED
NORTH COLUMBIA DEVELOPMENT C&D LANDFILL	— CLOSED
OSS METALS C&D LANDFILL	— CLOSED

Mining Activities

MINING COMPANY *MINE NAME*	*PERMIT #* *MINERAL*
MARTIN MARIETTA MATERIALS NORTH COLUMBIA QUARRY	0099-40 GRANITE
TRIP CONSTRUCTION CO. TRIP CONSTRUCTION MINE	0081-40 SAND
RICHTEX CORP. BROAD RIVER MINE	0187-40 SHALE
TARMAC MID-ATLANTIC, INC. DREYFUS QUARRY	0129-40 GRANITE

Camp Facilities

FACILITY NAME/TYPE *RECEIVING STREAM*	*PERMIT #* *STATUS*
WOODSMOKE CAMPGROUND/FAMILY WILDHORSE BRANCH	40-307-0011 ACTIVE
CAPITAL CITY CAMPGROUND/FAMILY CRANE CREEK TRIBUTARY	40-307-0003 ACTIVE

Water Supply

WATER USER (TYPE) *STREAM*	*PUMPING CAPACITY (MGD)* *REG. PUMPING CAPACITY (MGD)*
CITY OF COLUMBIA (M) BROAD RIVER CANAL	90.0 72.0

Groundwater Concerns

The groundwater in the vicinity of the property owned by Southern Bell is contaminated with petroleum products due to underground storage tanks. The contamination is considered a risk-based corrective action priority classification 1 (SCDHEC 1997). The contaminated plume is discharging to Smith Branch.

Growth Potential

There is a high potential for growth in this watershed, which contains the northwest portion of the City of Columbia and ample water and sewer service. The I-26 and I-77 corridors, which cross the watershed, together with the US 321, US 21, and US 176 corridors will serve to increase residential, commercial, and industrial growth in the Greater Columbia Area. The northwest portion of the city (St. Andrews, Irmo, and Harbison) will continue to develop as a regional commercial hub for the area. Industrial development along the I-77 corridor is expected to remain strong due to the aggressive economic development policy by the City of Columbia and Richland County. The Killian and Blythwood areas in particular are expected to see increased construction activity.

Implementation Strategy

The Broad River is impaired by elevated levels of pesticides, PAHs, zinc, copper, and fecal coliform bacteria from point and nonpoint sources. Biological community data are needed to determine the ecological significance of the metal excursions and should be acquired where feasible. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation. Crane Creek has an impaired macroinvertebrate community and elevated levels of zinc, copper, and fecal coliform bacteria from point and nonpoint sources. Smith Branch also has an impaired macroinvertebrate community and elevated levels of fecal coliform. The biological data will be evaluated to determine the cause of their impairment. Permit revisions have been initiated in Crane Creek and bacterial improvements are expected in the next basin rotation.

03050106-070

(Little River)

General Description

Watershed 03050106-070 is located in Fairfield, Chester, and Richland Counties and consists primarily of the ***Little River*** and its tributaries. The watershed occupies 117,685 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Wilkes-Cecil series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 14%, with a range of 2-40%. Land use/land cover in the watershed includes: 0.39% urban land, 3.92% agricultural land, 4.54% scrub/shrub land, 0.19% barren land, 90.87% forested land, and 0.10% water.

Big Creek and Little Creek join to form the headwaters of the Little River near the Town of Blackstock. Downstream of the confluence, the Little River accepts drainage from Camp Branch, Brushy Fork Creek (Dumpers Creek), the West Fork Little River (Weir Creek, Spring Branch, Williams Creek, Opossum Branch), Lick Branch, and Harden Branch. The Jackson Creek Watershed drain into the river next followed by Crumpton Creek, the Mill Creek Watershed, Morris Creek, Gibson Branch (Manns Branch, Russell Creek), and Home Branch. The Little River drains into the Broad River. There are a few ponds and lakes (10-16 acres) in this watershed used for recreational and industrial purposes. There are a total of 186.4 stream miles in this watershed, all classified FW.

Water Quality

Little River (B-145) - Although a very high concentration of zinc was measured in 1995, based on macroinvertebrate community data, aquatic life uses are fully supported. Significantly decreasing trends in five-day biochemical oxygen demand and total phosphorus concentration suggest improving conditions for these parameters. Recreational uses are not supported due to fecal coliform bacteria excursions, compounded by a significantly increasing trend in fecal coliform bacteria concentration.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM FACILITY NAME PERMITTED FLOW @ PIPE (MGD) COMMENT	NPDES# TYPE LIMITATION
MORRIS CREEK MARTIN MARIETTA/RION QUARRY PIPE #: 001 FLOW: M/R	SCG730060 MINOR INDUSTRIAL EFFLUENT

Camp Facilities

FACILITY NAME/TYPE RECEIVING STREAM	PERMIT # STATUS
GLENN'S 6-10 CAMPGROUND/FAMILY LITTLE RIVER TRIBUTARY	20-307-0012 ACTIVE

Growth Potential

There is a low potential for growth in this watershed due to the absence of public utilities.

03050106-080

(Jackson Creek/Mill Creek)

General Description

Watershed 03050106-080 is located in Fairfield County and consists primarily of ***Jackson Creek and Mill Creek*** and their tributaries. The watershed occupies 37,523 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Madison-Cecil-Wilkes series. The erodibility of the soil (K) averages 0.26; the slope of the terrain averages 12%, with a range of 2-40%. Land use/land cover in the watershed includes: 9.33% urban land, 8.62% agricultural land, 2.57% scrub/shrub land, 0.37% barren land, 78.41% forested land, and 0.70% water.

Jackson Creek is created by the confluence of Winnsboro Branch and Moore Creek near the Town of Winnsboro. Jackson Creek accepts drainage from Jordan Branch, Kennedy Creek, Sand Creek, Stitt Branch, and Gladney Branch before flowing into the Little River. Mill Creek drains into the Little River downstream of Jackson Creek. There are a few ponds and lakes (10-192 acres) in this watershed used for recreational, municipal, and flood control purposes. There are a total of 69.3 stream miles in this watershed, all classified FW.

Water Quality

Jackson Creek (B-102) **-** Aquatic life uses are partially supported based on macroinvertebrate community data. In addition, there is an occurrence of chromium and copper in excess of the aquatic life acute standard. Recreational uses are not supported due to fecal coliform bacteria excursions.

Winnsboro Branch **-** There are two monitoring sites along Winnsboro Branch. Aquatic life uses are fully supported at the upstream site **(B-123)**, but may be threatened by a significantly increasing trend in turbidity. A significantly decreasing trend in five-day biochemical oxygen demand suggests improving conditions for this parameter. Recreational uses are not supported due to fecal coliform bacteria excursions.

Aquatic life uses are also fully supported at the downstream site **(B-077)**, but may be threatened by a significantly decreasing trend in dissolved oxygen concentration and the occurrence of chromium, copper, and zinc in the water column in excess of the aquatic life acute standard, and the detection of PCB-1242 and PCB-1254 in the 1993 sediment sample. A significantly decreasing trend in total phosphorus concentration suggests improving conditions for this parameter. Recreational uses are not supported due to fecal coliform bacteria excursions. This is compounded by a significantly increasing trend in fecal coliform bacteria concentration.

Mill Creek (B-338) **-** Although pH excursions occurred, aquatic life uses are considered to be fully supported due to the small number of samples collected. Recreational uses are not supported due to fecal coliform bacteria excursions.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM ***FACILITY NAME*** ***PERMITTED FLOW @ PIPE (MGD)*** ***COMMENT***	***NPDES#*** ***TYPE*** ***LIMITATION***
JACKSON CREEK TOWN OF WINNSBORO PIPE #: 001 FLOW: 1.6 WQL FOR BOD5,DO,TRC,NH3N	SC0020125 MAJOR MUNICIPAL WATER QUALITY
JACKSON CREEK TRIBUTARY UNIROYAL GOODRICH TIRE MFG. PIPE #: 001 FLOW: M/R	SCG250148 MINOR INDUSTRIAL EFFLUENT
JORDAN BRANCH ROYAL HILL SD/MIDLAND UTILITIES PIPE #: 001 FLOW: 0.04 PROPOSED; WQL FOR BOD5,DO,TRC,NH3N	SC0031046 MINOR COMMUNITY WATER QUALITY

Landfill Activities

SOLID WASTE LANDFILL NAME ***FACILITY TYPE***	***PERMIT #*** ***STATUS***
CHAMBERS FAIRFIELD COUNTY SW TRANSFER STA. MUNICIPAL	---- ACTIVE
FAIRFIELD COUNTY LANDFILL MUNICIPAL	DWP-090 CLOSED

Water Supply

WATER USER (TYPE) ***STREAM***	***PUMPING CAPACITY (MGD)*** ***REG. PUMPING CAPACITY (MGD)***
TOWN OF WINNSBORO (M) SAND CREEK	0.7 0.5
TOWN OF WINNSBORO (M) MILL CREEK - 192 ACRE LAKE	— ---

Growth Potential

There is a low potential for growth in this watershed except for in and around the City of Winnsboro, where water and sewer services exist.

Implementation Strategy

Jackson Creek has an impaired macroinvertebrate community from unknown sources. The biological data will be evaluated to determine the cause of their impairment.

03050106-090
(Cedar Creek)

General Description

Watershed 03050106-090 is located in Fairfield and Richland Counties and consists primarily of ***Cedar Creek*** and its tributaries. The watershed occupies 61,189 acres of the Piedmont region of South Carolina. The predominant soil types consist of an association of the Herndon-Helena-Georgeville series. The erodibility of the soil (K) averages 0.39; the slope of the terrain averages 11%, with a range of 2-25%. Land use/land cover in the watershed includes: 0.66% urban land, 7.17% agricultural land, 1.40% scrub/shrub land, 0.05% barren land, 0.02% forested wetland, 90.35% forested land, and 0.34% water.

Big Cedar Creek originates near the Town of Ridgeway and accepts drainage from Center Creek (Rock Dam Creek), Persimmon Fork, Horse Creek, Williams Branch (Big Branch), and Little Cedar Creek (Crooked Run Creek, Bethel Pond, Smith Branch, Chappel Branch). Big Cedar Creek merges with Harmon Creek (Little Horse Branch, Elkins Creek) to form Cedar Creek which flows into the Broad River. There are a few recreational ponds and lakes (10-20 acres) in this watershed and a total of 150.0 stream miles, all classified FW.

Water Quality

Big Cedar Creek (B-320) - Aquatic life uses are fully supported based on physical, chemical, and macroinvertebrate community data. Recreational uses are partially supported due to fecal coliform bacteria excursions. This creek was Class B until April, 1992 and bacterial conditions may show improvement as the NPDES permits are reissued in the watershed.

Activities Potentially Affecting Water Quality

Point Source Contributions

RECEIVING STREAM FACILITY NAME PERMITTED FLOW @ PIPE (MGD) COMMENT	NPDES# TYPE LIMITATION
CEDAR CREEK TRIBUTARY TOWN OF RIDGEWAY WWTP PIPE #: 001 FLOW: 0.12 WQL FOR BOD5,DO,TRC,NH3N	SC0022900 MINOR MUNICIPAL WATER QUALITY
CENTER CREEK KINGS LABORATORY PIPE #: 001 FLOW: M/R	SC0038474 MINOR INDUSTRIAL EFFLUENT

Growth Potential

There is a low to moderate potential for growth in this watershed. Water and sewer services are available in the Blythewood area.

Implementation Strategy

Big Cedar Creek is impaired from elevated levels of fecal coliform bacteria resulting from both point and nonpoint sources. Permit revisions have been initiated and bacterial improvements are expected in the next basin rotation.

Summary of Water Quality and Implementation Strategies

This summary details both impaired and unimpaired waters. Waters are considered impaired if they are unable to fully meet classified uses for aquatic life, recreation or fish consumption based on the corresponding standards (see Methodology section for interpretation). Noteworthy long-term trends are identified for unimpaired waters. The actions indicated should occur prior to updating this assessment in 2001. (* See text for additional information.)

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
03050108-010 Enoree River* (7 Sites)	Aquatic Life	NS-Zinc (Site 1); PS-Copper (Site 3); PS-Macroinvertebrate Community (Sites 4,5)	Unknown	Monitor the Area for Groundwater; Further Evaluate the Macroinvertebrate Data
	Recreation	PS-Fecal Coliform (Sites 1,6,7); NS-Fecal Coliform (Sites 2,3,4)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Beaverdam Creek	Recreation	NS-Fecal Coliform	Point Source	Facility May Be Eliminated
			Nonpoint Source	Further Evaluation
Mountain Creek*	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Princess Creek*	Aquatic Life	NS-pH, Zinc	Point Source	Evaluate Macroinvertebrate Community
	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation
Brushy Creek (2 Sites)	Recreation	NS-Fecal Coliform (Both Sites)	Nonpoint Source	Further Evaluation
	—	Groundwater - Petroleum Products	Nonpoint Source	Facility in Monitoring Phase
Rocky Creek*	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Little Rocky Creek	—	Groundwater - Petroleum Products, Phenol, Volatile Organic Compounds	Nonpoint Source	Currently in Assessment, Monitoring, & Remediation Phases.
Gilder Creek* (3 Sites)	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Lick Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
Durbin Creek* (3 Sites)	Recreation	NS-Fecal Coliform (Upstream & Midstream Sites)	Point and/or Nonpoint Sources	Further Evaluation
	—	Groundwater - Petroleum Products	Nonpoint Source	A Risk-Based Corrective Action Priority Classification I Underway
Durbin Creek Tributary	—	Groundwater - Volatile Organic Compounds	Nonpoint Source	Facility Currently in Assessment & Remediation Phase
03050108-020 Enoree River* (3 Sites)	Recreation	PS-Fecal Coliform (Upstream Site); NS-Fecal Coliform (Midstream & Downstream Sites)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
03050108-030 Beaverdam Creek	Recreation	NS-Fecal Coliform	Nonpoint Sources	Further Evaluation
Warrior Creek* (2 Sites)	Recreation	NS-Fecal Coliform (Upstream Site)	Nonpoint Source	Further Evaluation
03050108-040 Duncan Creek*	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Beards Fork Creek*	Aquatic Life	PS-Dissolved Oxygen	Nonpoint Source	Further Evaluation.
	Recreation	PS-Fecal Coliform		
03050108-050 Enoree River*	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050107-010 South Tyger River* (6 Sites)	Aquatic Life	PS-Macroinvertebrate Community (Site 4)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation. An Enforcement Action is also Underway. (Proposal to Eliminate and Tie in Point Source)
	Recreation	NS,PS-Fecal Coliform (Sites 3,5)		
Wards Creek	—	Groundwater - Volatile Organic Compounds	Nonpoint Source	Facility Currently in Remediation Phase
Mush Creek*	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
03050107-020 North Tyger River*	Aquatic Life	PS-Zinc	Unknown	Evaluate Macroinvertebrate Community
	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
North Tyger River Tributary	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050107-030 North Tyger River* (3 Sites)	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
03050107-040 Middle Tyger River* (3 Sites)	Recreation	NS-Fecal Coliform (All Sites)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
03050107-050 Tyger River* (2 Sites)	Aquatic Life	NS-Zinc (Upstream Site)	Unknown	Evaluate Macroinvertebrate Community
	Recreation	NS-Fecal Coliform (Both Sites)	Point Sources	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Jimmies Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050107-060 Fairforest Creek* (5 Sites)	Aquatic Life	PS-Metals & Macroinvertebrate Community (Site 3); PS-Dissolved Oxygen (Site 4)	Point and Nonpoint Sources	Permit Actions Initiated & Improvements Expected in Next Basin Rotation.
	Recreation	NS,PS-Fecal Coliform (Sites 1,2,3; Sites 4,5)	Point Source	Permit Actions Initiated & Improvements Expected in Next Basin Rotation. An Enforcement Action is also Underway.
			Nonpoint Source	Further Evaluation
	—	Groundwater - Volatile Organic Compounds	Nonpoint Sources	Facilities Currently in Assessment & Remediation Phases
Fairforest Creek Tributary*	Aquatic Life	NS-Chromium, Copper, Lead, Zinc	Unknown/Point Source	Evaluate Macroinvertebrate Community & Groundwater
	Recreation	NS-Fecal Coliform	Unknown/Nonpoint Source	Further Evaluation

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
Goat Pond Creek	—	Groundwater - Volatile Organic Compounds	Nonpoint Sources	Facility Currently in Assessment & Monitoring Phase
Kelsey Creek*	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Kelsey Creek Tributary	—	Groundwater - Volatile Organic Compounds	Nonpoint Source	RCRA Facility in Remediation Phase
Mitchell Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Toschs Creek* (2 Sites)	Recreation	NS-Fecal Coliform (Both Sites)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation. An Enforcement Action is also Underway.
Tinker Creek* (3 Sites)	Recreation	NS-Fecal Coliform (All Sites)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
03050105-090 Broad River* (2 Sites)	Aquatic Life	NS-Cadmium, Lead, Copper, Zinc (Downstream Site)	Point Source/Unknown (Possibly from N.C.)	Evaluate Macroinvertebrate Community
	Recreation	NS,PS-Fecal Coliform (Both Sites)	Nonpoint Source	Further Evaluation
Canoe Creek* (3 Sites)	Aquatic Life	PS,NS-Macroinvertebrate Community	Point Source	Facility to be Upgraded
	Recreation	NS-Fecal Coliform (Downstream Site)	Point Source	Facility to be Upgraded
Peoples Creek	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Doolittle Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Guyonmoore Creek	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation
Furnace Creek*	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050105-100 Buffalo Creek* (3 Sites)	Aquatic Life	PS-Cadmium, Copper, Chromium (Downstream Site)	Point Source/Unknown (Possibly from N.C.)	Evaluate Macroinvertebrate Community & Groundwater
	Recreation	NS-Fecal Coliform (All Sites)	Nonpoint Source	Further Evaluation

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
03050105-110 Cherokee Creek	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation; An Enforcement Action is also Underway
Providence Creek	—	Groundwater - Volatile Organic Compounds	Nonpoint Source	Facility Currently in Remediation Phase
03050105-120 Kings Creek*	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050105-130 Thicketty Creek* (3 Sites)	Recreation	NS-Fecal Coliform (All Sites)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Irene Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Limestone Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Gilkey Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050105-140 Bullock Creek	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation
Long Branch	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation
Clark Fork* (2 Sites)	Recreation	PS-Fecal Coliform (Upstream Site)	Nonpoint Source	Further Evaluation
03050105-150 North Pacolet River* (3 Sites)	Recreation	NS-Fecal Coliform (2 Downstream Sites)	Nonpoint Source	Further Evaluation
Lake Lanier* (2 Sites)	Recreation	PS-Fecal Coliform (Upstream Site)	Nonpoint Source	Further Evaluation
Page Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050105-160 South Pacolet River (2 Sites)	Recreation	NS-Fecal Coliform (Downstream Site)	Nonpoint Source	Further Evaluation
Spivey Creek	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050105-170 Pacolet River* (3 Sites)	Recreation	NS-Fecal Coliform (All Sites)	Nonpoint Source	Further Evaluation
	—	Groundwater - Volatile Organic Compounds	Nonpoint Source	Facility in Assessment Phase

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
Little Buck Creek*	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Potter Branch*	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050105-180 Lawsons Fork Creek* (5 Sites)	Aquatic Life	PS-Macroinvertebrate Community (Sites 1,5)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source (Urban Runoff from Spartanburg)	Further Evaluation
	Recreation	NS-Fecal Coliform (All Sites)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source (Urban Runoff from Spartanburg)	Further Evaluation
	—	Groundwater - VOCs	Nonpoint Source	Remedial Action has been Initiated for RCRA Facility
Fourmile Branch	—	Groundwater - Petroleum Products	Nonpoint Source	Facilities Currently in Assessment & Remediation Phase, & are Participating in a Community Plume Agreement
03050105-190 Pacolet River* (2 Sites)	Recreation	NS-Fecal Coliform (Both Sites)	Nonpoint Source	Further Evaluation
03050106-010 Broad River*	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050106-020 Ross Branch	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050106-030 Meng Creek	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Meng Creek Tributary*	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
Browns Creek*	Recreation	PS-Fecal Coliform	Nonpoint Source	Further Evaluation

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
03050106-040 Sandy River	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Dry Fork*	Aquatic Life	NS-Copper, Chromium, Nickel	Nonpoint Source (Urban Runoff from Chester)	Evaluate Macroinvertebrate Community & Possibly Groundwater
	Recreation	NS-Fecal Coliform	Nonpoint Source (Urban Runoff from Chester)	Further Evaluation
03050106-050 Broad River*	Recreation	PS-Fecal Coliform Upstream Site (Enoree & Tyger Rivers)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation
03050106-060 Broad River* (3 Sites)	Aquatic Life	NS-Pesticides, PAHs (Upstream Site); Copper, Zinc (Downstream Site)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source (Urban Runoff from Columbia)	Further Evaluation
	Recreation	PS-Fecal Coliform (Upstream & Downstream Site)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source (Urban Runoff from Columbia)	Further Evaluation
Crane Creek* (2 Sites)	Aquatic Life	PS-Macroinvertebrate Community (Upstream Site); NS-Copper, Zinc (Downstream Site)	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source (Urban Runoff from Columbia)	Further Evaluation
	Recreation	NS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source (Urban Runoff from Columbia)	Further Evaluation

PS=Partially Supported; NS=Not Supported

WATERSHED WATERBODY	IMPAIRED USE	CAUSE	POSSIBLE SOURCE	RECOMMENDED ACTION
Smith Branch	Aquatic Life	NS-Macroinvertebrate Community	Nonpoint Source (Urban Runoff from Columbia)	Further Evaluation
	Recreation	NS-Fecal Coliform	Nonpoint Source (Urban Runoff From Columbia)	Further Evaluation
	—	Groundwater - Petroleum Products	Nonpoint Source (Underground Storage Tank Leakage)	Risk-Based Corrective Action Priority Class I is Underway
Elizabeth Lake*	Recreation	PS-Fecal Coliform	Nonpoint Source (Urban Runoff from Columbia)	Further Evaluation
03050106-070 Little River*	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050106-080 Jackson Creek*	Aquatic Life	PS-Macroinvertebrate Community	Unknown	Evaluate Macroinvertebrate data
	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
Winnsboro Branch* (2 Sites)	Recreation	NS-Fecal Coliform (Both Sites)	Nonpoint Source	Further Evaluation
Mill Creek	Recreation	NS-Fecal Coliform	Nonpoint Source	Further Evaluation
03050106-090 Big Cedar Creek	Recreation	PS-Fecal Coliform	Point Source	Permit Actions Initiated & Improvements are Expected in Next Basin Rotation.
			Nonpoint Source	Further Evaluation

UNIMPAIRED WATERS WITH NOTABLE TRENDS

The waters listed in this table are not impaired, but rather display long-term trends that bear following, primarily with continued monitoring.

WATERSHED WATERBODY	CONCERN	POSSIBLE SOURCE	RECOMMENDED ACTION
03050105-160 Lake Bowen	Very High Levels of Cadmium	Unknown	Continue Evaluation
Spartanburg Reservoir #1	Declining Trends in Dissolved Oxygen; Increasing Trend in Turbidity and Fecal Coliform Bacteria	Unknown	Continue Evaluation
03050106-030 Gregorys Creek	Very High Levels of Zinc	Unknown	Continue Evaluation
03050106-050 Monticello Reservoir	Increasing Trends in Fecal Coliform, pH; Very High Levels of Copper	High Geese Population	Continue Evaluation

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APPENDIX A. WMU-0501

Monitoring Station Descriptions

STATION TYPES (P=PRIMARY, S=SECONDARY, W=WATERSHED, BIO=BIOLOGICAL, I=INACTIVE)
CLASS (FW=FRESHWATER, SA=SALTWATER)

03050108-010

BE-001	P	FW	ENOREE RIVER AT UNNUMBERED ROAD W OF US 25, N OF TRAVELERS REST
BE-039	S	FW	BEAVERDAM CREEK AT ROAD 1967
B-186	S	FW	MOUNTAIN CREEK AT S-23-335
B-192	P	FW	PRINCESS CREEK AT SUBER MILL RD, SECOND ROAD S OF US 29 OFF S-23-540
BE-015	S	FW	ENOREE RIVER AT COUNTY ROAD 164
BE-035	S	FW	BRUSHY CREEK AT HOWELL ROAD, APPROXIMATELY 5 MI NE OF GREENVILLE
BE-009	S	FW	BRUSHY CREEK AT S-23-164
BE-007	S	FW	ROCKY CREEK AT BATESVILLE BRIDGE, 1 MI ABOVE CONFLUENCE WITH ENOREE R.
BE-017	P	FW	ENOREE RIVER AT SC 296, 7.5 MI NE OF MAULDIN
BE-040	S	FW	GILDER CREEK AT SC 14, ABOVE GILDERS CREEK PLANT
B-241	S	FW	GILDER CREEK AT S-23-142, 2.75 MI ENE OF MAULDIN
BE-020	S	FW	GILDER CREEK AT S-23-143, 1/4 MI ABOVE CONFLUENCE WITH ENOREE RIVER
BE-018	S/BIO	FW	ENOREE RIVER AT S-30-75
BE-019	BIO	FW	ENOREE RIVER AT SC 418
B-037	S	FW	ENOREE RIVER AT S-42-118, SW OF WOODRUFF
B-038	S	FW	LICK CREEK AT S-42-118, 1 1/4 MI SW WOODRUFF
B-035	S	FW	DURBIN CREEK ON S-23-160, 3 MI E OF SIMPSONVILLE
B-097	P	FW	DURBIN CREEK AT SC 418
BE-022	BIO	FW	DURBIN CREEK AT SC 101
B-040	W	FW	ENOREE RIVER AT S-30-112

03050108-020

BE-024	I	FW	ENOREE RIVER AT US 221
B-041	P	FW	ENOREE RIVER AT SC 49, SE OF WOODRUFF
B-053	W	FW	ENOREE RIVER AT SC 72, 121, & US 176, 1 MI NE WHITMIRE

03050108-030

B-246	W/BIO	FW	BEAVERDAM CREEK AT S-30-97, 7 MI NE OF GRAY COURT
B-150	W	FW	WARRIOR CREEK AT US 221, 8 MI NNE OF LAURENS
B-742	BIO	FW	WARRIOR CREEK AT SC 49

03050108-040

B-735	W	FW	DUNCAN CREEK RESERVOIR 6B
B-231	S	FW	BEARDS FORK CREEK AT US 276 (I-385), 3.7 MI NNE OF CLINTON
B-072	P/BIO	FW	DUNCAN CREEK AT US 176, 1.5 MI SE OF WHITMIRE

03050108-050

B-071	BIO	FW	INDIAN CREEK AT US 176
B-054	P	FW	ENOREE RIVER AT S-36-45, 3.5 MI ABOVE CONFLUENCE WITH BROAD R.

03050107-010

B-317	P	FW	MUSH CREEK AT SC 253, BELOW TIGERVILLE
B-741	BIO	FW	SOUTH TYGER RIVER AT UNNUMBERED ROAD, S OF S-23-569
CL-100	W	FW	LAKE ROBINSON IN FOREBAY NEAR DAM
B-341	W	FW	LAKE CUNNINGHAM IN FOREBAY NEAR DAM

B-149	S	FW	SOUTH TYGER RIVER AT SC 14, 2.9 MI NNW OF GREER
B-263	S	FW	SOUTH TYGER RIVER AT SC 290, 3.7 MI E OF GREER
B-005A	BIO	FW	SOUTH TYGER RIVER AT S-42-242
B-005	S	FW	SOUTH TYGER RIVER AT S-42-63
B-332	W	FW	SOUTH TYGER RIVER AT S-42-86, 5 MI NE OF WOODRUFF
03050107-020			
B-348	W	FW	LAKE COOLEY IN FOREBAY NEAR DAM
B-315	S	FW	TRIBUTARY TO N.TYGER RIVER AT UNNUMBERED ROAD BELOW JACKSON #2 EFFLUENT
B-219	S	FW	NORTH TYGER RIVER AT US 29, 7.2 MI W OF SPARTANBURG
03050107-030			
B-017	BIO	FW	NORTH TYGER RIVER AT SC 296
B-162	I	FW	NORTH TYGER RIVER AT US 221, 7.6 MI NNE OF WOODRUFF
B-018A	S	FW	NORTH TYGER RIVER AT S-42-231, 11 MI S OF SPARTANBURG
03050107-040			
B-148	P/BIO	FW	MIDDLE TYGER RIVER AT SC 14, 2 MI SSW GOWANSVILLE
B-012	S	FW	MIDDLE TYGER RIVER AT S-42-63
B-014	W/BIO	FW	MIDDLE TYGER RIVER AT S-42-64
03050107-050			
B-008	P	FW	TYGER RIVER AT S-42-50, E OF WOODRUFF
B-019	S	FW	JIMMIES CREEK AT S-42-201, 2 MI E OF WOODRUFF
B-733	BIO	FW	DUTCHMAN CREEK AT S-42-511
B-051	P	FW	TYGER RIVER AT SC 72, 5.5 MI SW OF CARLISLE
03050107-060			
B-321	P	FW	TRIBUTARY TO FAIRFOREST CREEK, 200 FEET BELOW S-42-65
B-020	S	FW	FAIRFOREST CREEK AT US 221, S OF SPARTANBURG
B-164	S	FW	FAIRFOREST CREEK AT S-42-651, 3.5 MI SSE OF SPARTANBURG
B-021	P/BIO	FW	FAIRFOREST CREEK AT SC 56
B-235	S	FW	KELSEY CREEK AT S-42-321
CL-035	W	FW	LAKE JOHNSON AT SPILLWAY AT S-42-359
CL-033	W	FW	LAKE CRAIG 45 METERS NW OF DAM
BF-007	S	FW	FAIRFOREST CREEK ON COUNTY ROAD 12, SW OF JONESVILLE
B-199	S	FW	MITCHELL CREEK AT COUNTY ROAD 233, 2.3 MI SSW OF JONESVILLE
B-067A	S	FW	TOSCHS CREEK AT US 176, 2 MI SW OF UNION
B-067B	S	FW	TOSCHS CREEK AT ROAD TO TREATMENT PLANT OFF S-44-92, SW OF UNION
BF-008	S/BIO	FW	FAIRFOREST CREEK AT S-44-16, SW OF UNION
B-286	S	FW	TINKER CREEK AT ROAD TO TREATMENT PLANT, 1.3 MI SSE OF UNION
B-287	S	FW	TINKER CREEK AT UNNUMBERED COUNTY ROAD, 1.7 MI SSE OF UNION
B-336	W/BIO	FW	TINKER CREEK AT S-44-278, 9 MI SSE OF UNION

Water Quality Trends and Status by Station

Mean Seasonal Water Quality Values

BROAD BASIN WMU-0501

PARAMETER	STAT	SPRING (Mar-May)	SUMMER (Jun-Sep)	FALL (Oct-Nov)	WINTER (Dec-Feb)
TEMPERATURE (°C)	Mean	16.6	22.5	15.2	8.3
	Max	27.5	32.0	22.0	18.0
	Min	7.0	15.5	7.5	1.0
	Med	17.0	22.0	15.5	8.0
	95%	21.5	27.0	20.0	13.5
	N	338	832	267	202
DISSOLVED OXYGEN (mg/l)	Mean	8.6	7.6	8.8	10.5
	Max	10.8	11.0	11.2	14.1
	Min	4.0	1.5	4.7	4.8
	Med	8.6	7.6	8.8	10.4
	5%	6.8	5.9	7.3	8.7
	N	338	828	267	202
pH (SU)	Mean	6.7	6.8	6.8	6.7
	Max	9.1	9.6	8.1	8.9
	Min	5.1	5.0	5.8	5.1
	Med	6.7	6.7	6.8	6.7
	95%	7.4	7.4	7.4	7.4
	N	334	824	267	195
BOD_5 (mg/l)	Mean	1.7	1.2	1.3	1.5
	Max	29.0	7.4	7.8	11.0
	Min	0.1	0.1	0.1	0.0
	Med	1.2	1.0	1.0	1.1
	95%	4.2	2.8	3.3	4.0
	N	330	805	263	198
TURBIDITY (NTU)	Mean	26.5	22.5	30.4	31.9
	Max	310.0	400.0	600.0	320.0
	Min	1.0	0.5	0.7	1.0
	Med	17.0	14.0	10.0	18.0
	95%	76.0	66.0	150.0	100.0
	N	330	807	265	202
AMMONIA (mg/l)	Mean	0.19	0.17	0.26	0.18
	Max	0.83	1.13	1.30	0.85
	Min	0.05	0.05	0.05	0.05
	Med	0.13	0.08	0.10	0.11
	95%	0.49	0.74	1.30	0.44
	N	25	32	12	30

BROAD BASIN WMU-0501

PARAMETER	STAT	SPRING (Mar-May)	SUMMER (Jun-Sep)	FALL (Oct-Nov)	WINTER (Dec-Feb)
TKN (mg/l)	Mean	0.43	0.44	0.49	0.47
	Max	2.02	3.50	3.95	3.60
	Min	0.10	0.07	0.09	0.10
	Med	0.33	0.36	0.33	0.34
	95%	1.04	0.95	1.26	1.15
	N	171	248	127	190
NITRITE-NITRATE (mg/l)	Mean	0.79	0.91	0.88	0.78
	Max	10.00	9.40	9.80	6.10
	Min	0.02	0.02	0.02	0.07
	Med	0.55	0.55	0.49	0.57
	95%	2.70	3.20	3.00	3.00
	N	318	762	242	198
TOTAL PHOSPHORUS (mg/l)	Mean	0.16	0.18	0.26	0.13
	Max	4.80	1.72	6.80	0.92
	Min	0.02	0.02	0.02	0.02
	Med	0.07	0.08	0.10	0.08
	95%	0.55	0.75	0.90	0.46
	N	284	657	192	177
TOTAL ORGANIC CARBON (mg/l)	Mean	5.3	4.7	3.9	7.7
	Max	64.0	20.0	13.8	185.0
	Min	0.9	1.2	1.1	1.0
	Med	4.0	4.0	3.4	4.1
	95%	9.7	8.5	8.9	15.3
	N	71	83	62	73
FECAL COLIFORM BACTERIA (#/100ml)	Mean	309	550	326	184
	Max	160,000	4,000,000	100,000	8,000
	Min	2	1	2	2
	Med	290	460	310	220
	95%	4,000	8,700	3,500	2,000
	N	332	811	266	202

APPENDIX B. WMU-0502

Monitoring Station Descriptions

STATION TYPES (P=PRIMARY, S=SECONDARY, W=WATERSHED, BIO=BIOLOGICAL, I=INACTIVE)
CLASS (FW=FRESHWATER, ORW=OUTSTANDING RESOURCE WATERS)

03050105-090			
B-042	P	FW	BROAD RIVER AT SC 18, 4 MI NE GAFFNEY
B-088	S	FW	CANOE CREEK AT S-11-245, 1/2 MI W OF BLACKSBURG
B-211	S	FW	PEOPLES CREEK AT UNIMPROVED ROAD, 2.3 MI E OF GAFFNEY
B-100	S	FW	FURNACE CREEK AT S-11-50, 6 MI E OF GAFFNEY
B-323	S	FW	DOOLITTLE CREEK AT S-11-100, 1.25 MI SE OF BLACKSBURG
B-343	W	FW	LAKE CHEROKEE IN FOREBAY NEAR DAM
B-330	S	FW	GUYONMOORE CREEK AT S-46-233
B-044	P	FW	BROAD RIVER AT SC 211, 12 MI SE OF GAFFNEY
03050105-100			
B-740	BIO	FW	BUFFALO CREEK AT SC 198
B-119	S	FW	BUFFALO CREEK AT S-11-213, 2.2 MI NNW OF BLACKSBURG
B-057	S	FW	BUFFALO CREEK AT SC 5, 1 MI W OF BLACKSBURG
03050105-110			
B-056	S	FW	CHEROKEE CREEK AT US 29, 3 MI E OF GAFFNEY
03050105-120			
B-333	W/BIO	FW	KINGS CREEK AT S-11-209, 3 MI W OF SMYRNA
03050105-130			
B-342	W	FW	LAKE THICKETTY IN FOREBAY NEAR DAM
B-059	S	FW	IRENE CREEK AT S-11-307, 2.5 MI W OF GAFFNEY
B-095	S	FW	THICKETTY CREEK AT S-11-164
B-128	S	FW	LIMESTONE CREEK AT S-11-301
B-133	S/BIO	FW	THICKETTY CREEK AT SC 18, 8.3 MI S OF GAFFNEY
B-334	W/BIO	FW	GILKEY CREEK AT S-11-231, 9 MI SE OF GAFFNEY
B-062	S	FW	THICKETTY CREEK AT SC 211, 2 MI ABOVE JUNCTION WITH BROAD RIVER
03050105-140			
B-739	BIO	FW	BULLOCK CREEK AT S-46-40
B-325	S	FW	CLARK FORK INTO CRAWFORD LAKE ON UNNUMBERED ROAD NEAR SC 161 & 705
B-737	W	FW	LAKE YORK IN KINGS MOUNTAIN STATE PARK
B-326	S	FW	LONG BRANCH ON SC 216, BELOW KINGS MOUNTAIN PARK RECREATION AREA
B-157	BIO	FW	CLARK FORK AT S-46-63
B-159	S	FW	BULLOCK CREEK AT SC 97, 4.8 MI S OF HICKORY GROVE
03050105-150			
B-099-7	BIO	ORW	VAUGHN CREEK AT UNNUMBERED ROAD, 0.4 MI S OF S-23-319
B-099A	S	FW	LAKE LANIER ON # 1 INLET IN GREENVILLE COUNTY
B-099B	S	FW	LAKE LANIER AT DAM IN GREENVILLE COUNTY
B-719	BIO	FW	NORTH PACOLET RIVER AT S-42-128
B-301	S	FW	PAGE CREEK AT S-42-1258, 1.7 MI SE LANDRUM
B-026	P	FW	NORTH PACOLET RIVER AT S-42-956, 6.5 MI E LANDRUM
B-126	W	FW	NORTH PACOLET RIVER AT S-42-978, 1 MI SE OF FINGERVILLE

03050105-160			
B-720	BIO	FW	SOUTH PACOLET RIVER AT S-42-183
B-103	S	FW	SPIVEY CREEK AT S-42-208, 2.5 MI SSE OF LANDRUM
B-302	S	FW	SOUTH PACOLET RIVER AT S-42-866, 1 MI SE CAMPOBELLO
B-340	W	FW	LAKE BOWEN NEAR HEADWATERS, 0.4 KM W OF S-42-37
B-339	W	FW	LAKE BOWEN IN FOREBAY NEAR DAM
B-113	S	FW	SPARTANBURG RESERVOIR #1 ON S-42-213 NE OF INMAN
03050105-170			
B-028	S	FW	PACOLET RIVER AT S-42-55, BELOW CONFLUENCE OF NORTH & SOUTH PACOLET RIVERS
B-259	S	FW	LITTLE BUCK CREEK AT UNNUMBERED COUNTY ROAD, 2.3 MI SW OF CHESNEE
B-347	W	FW	LAKE BLALOCK IN FOREBAY NEAR DAM
B-163A	S	FW	PACOLET RIVER AT BRIDGE ON S-42-737, 2.9 MI NW OF COWPENS
B-191	S	FW	POTTER BRANCH ON ROAD 30, BELOW OUTFALL FROM HOUSING PROJECT, COWPENS
B-331	W	FW	PACOLET RIVER AT S-42-59, BEACON LIGHT ROAD IN CLIFTON
03050105-180			
B-221	S/BIO	FW	LAWSONS FORK CREEK AT S-42-40, BELOW INMAN MILL EFFLUENT
B-277	S	FW	LAWSONS FORK CREEK AT S-42-218, 2.7 MI SSE OF INMAN
B-278	S	FW	LAWSONS FORK CREEK AT UNNUMBERED ROAD BELOW MILLIKEN CHEMICAL
BL-005	S	FW	LAWSONS FORK CREEK AT S-42-79 AT VALLEY FALLS
BL-001	P/BIO	FW	LAWSONS FORK CREEK AT S-42-108
03050105-190			
BP-001	S	FW	PACOLET RIVER ABOVE DAM AT PACOLET MILLS
B-048	P	FW	PACOLET RIVER AT SC 105, 6 MI ABOVE CONFLUENCE WITH BROAD RIVER
03050106-010			
B-344	W	FW	LAKE JOHN D. LONG IN FOREBAY NEAR DAM
B-046	P	FW	BROAD RIVER AT SC 72/215/121, 3 MI E OF CARLISLE
03050106-020			
B-086	S	FW	ROSS BRANCH AT SC 49, SW OF YORK
B-136	W/BIO	FW	TURKEY CREEK AT SC 9, 14 MI NW OF CHESTER
03050106-030			
B-064	S	FW	MENG CREEK AT SC 49, 2.5 MI E OF UNION
B-243	S	FW	TRIBUTARY TO MENG CREEK AT CULVERT ON S-44-384, 3 MI E OF UNION
B-155	W/BIO	FW	BROWNS CREEK AT S-44-86, 8 MI E OF UNION
B-335	W	FW	GREGORYS CREEK AT S-44-86, 8 MI E OF UNION
03050106-040			
CL-023	W	FW	CHESTER STATE PARK LAKE, 100 M E OF SPILLWAY
B-074	S	FW	DRY FORK AT S-12-304, 2 MI SW OF CHESTER
B-075	S/BIO	FW	SANDY RIVER AT SC 215, 2.5 MI ABOVE CONFLUENCE WITH BROAD RIVER
03050106-050			
B-143	BIO	FW	BEAVER CREEK AT S-20-99
B-047	S	FW	BROAD RIVER AT SC 34, 14 MI NE OF NEWBERRY
B-346	W	FW	PARR RESERVOIR 4.8 KM N OF DAM, UPSTREAM OF MONTICELLO RESERVOIR

B-751	BIO	FW	CANNONS CREEK AT US 176
B-328	P	FW	MONTICELLO RESERVOIR, UPPER IMPOUNDMENT AT BUOY IN MIDDLE OF LAKE
B-327	P	FW	MONTICELLO RESERVOIR, LOWER IMPOUNDMENT BETWEEN LARGE ISLANDS
B-345	W	FW	PARR RESERVOIR IN FOREBAY NEAR DAM
03050106-060			
B-236	P	FW	BROAD RIVER AT SC 213, 2.5 MI SW OF JENKINSVILLE
B-110	S	FW	ELIZABETH LAKE AT SPILLWAY ON US 21
B-081	BIO	FW	CRANE CREEK AT US 321
B-316	P	FW	CRANE CREEK AT S-40-43 UNDER I-20, NORTH COLUMBIA
B-280	P/BIO	FW	SMITH BRANCH AT N MAIN ST (US 21) IN COLUMBIA
B-337	W	FW	BROAD RIVER AT US 176 (BROAD RIVER ROAD) IN COLUMBIA
B-080	P	FW	BROAD RIVER DIVERSION CANAL AT COLUMBIA WATER PLANT
03050106-070			
B-145	S/BIO	FW	LITTLE RIVER AT S-20-60, 3.1 MI SW OF JENKINSVILLE
03050106-080			
B-123	S	FW	WINNSBORO BRANCH AT US 321, ABOVE WINNSBORO MILLS OUTFALL
B-077	S	FW	WINNSBORO BRANCH BELOW PLANT OUTFALL
B-102	W/BIO	FW	JACKSON CREEK AT S-20-54, 5 MI W OF WINNSBORO
B-338	W	FW	MILL CREEK AT S-20-48, 10 MI SW OF WINNSBORO
03050106-090			
B-320	W/BIO	FW	BIG CEDAR CREEK AT SC 215

Water Quality Trends and Status by Station

Mean Seasonal Water Quality Values

BROAD BASIN WMU-0502

PARAMETER	STAT	SPRING (Mar-May)	SUMMER (Jun-Sep)	FALL (Oct-Nov)	WINTER (Dec-Feb)
TEMPERATURE (°C)	Mean	17.2	23.0	15.4	8.6
	Max	29.5	33.0	24.0	18.0
	Min	7.5	6.9	7.0	1.0
	Med	18.0	23.0	15.0	9.0
	95%	23.0	29.0	21.0	13.0
	N	448	1077	350	260
DISSOLVED OXYGEN (mg/l)	Mean	8.7	7.5	8.7	10.5
	Max	12.0	17.0	11.6	14.6
	Min	2.3	1.4	1.7	2.8
	Med	8.6	7.5	8.8	10.5
	5%	6.8	6.0	6.8	8.3
	N	448	1079	350	258
pH (SU)	Mean	6.9	6.9	6.9	7.0
	Max	9.5	9.5	7.9	9.1
	Min	5.7	5.2	5.5	4.6
	Med	6.9	6.9	6.9	7.0
	95%	7.8	7.7	7.6	8.0
	N	445	1078	350	260
BOD_5 (mg/l)	Mean	1.6	1.5	1.5	1.4
	Max	8.9	11.0	15.0	7.9
	Min	0.3	0.1	0.1	0.1
	Med	1.3	1.1	1.1	1.1
	95%	3.7	4.0	4.0	3.5
	N	414	1021	335	244
TURBIDITY (NTU)	Mean	24.1	21.1	14.1	23.6
	Max	288.0	500.0	260.0	180.0
	Min	0.5	1.1	0.7	1.6
	Med	13.0	12.0	7.8	14.0
	95%	80.0	64.0	43.0	81.0
	N	430	1046	344	254
AMMONIA (mg/l)	Mean	0.13	0.33	0.37	0.17
	Max	0.52	6.70	2.64	1.20
	Min	0.05	0.05	0.05	0.05
	Med	0.10	0.07	0.18	0.08
	95%	0.35	1.12	2.64	0.50
	N	45	36	15	40

BROAD BASIN WMU-0502

PARAMETER	STAT	SPRING (Mar-May)	SUMMER (Jun-Sep)	FALL (Oct-Nov)	WINTER (Dec-Feb)
TKN (mg/l)	Mean	0.41	0.45	0.41	0.40
	Max	1.72	8.60	3.43	1.76
	Min	0.09	0.10	0.06	0.11
	Med	0.32	0.37	0.31	0.33
	95%	1.00	1.00	1.08	0.93
	N	241	372	177	244
NITRITE-NITRATE (mg/l)	Mean	0.66	0.85	0.76	0.49
	Max	13.30	14.00	10.80	2.90
	Min	0.02	0.02	0.02	0.02
	Med	0.38	0.41	0.33	0.37
	95%	1.85	3.30	2.50	1.56
	N	404	941	303	251
TOTAL PHOSPHORUS (mg/l)	Mean	0.14	0.20	0.18	0.08
	Max	3.30	3.00	1.65	0.84
	Min	0.02	0.02	0.02	0.02
	Med	0.07	0.07	0.08	0.06
	95%	0.47	0.94	0.81	0.19
	N	388	857	259	233
TOTAL ORGANIC CARBON (mg/l)	Mean	4.9	4.9	4.9	4.4
	Max	15.3	18.9	28.0	22.0
	Min	1.0	0.9	1.3	1.4
	Med	4.0	3.7	4.2	3.5
	95%	11.2	12.9	11.0	10.9
	N	118	170	70	112
FECAL COLIFORM BACTERIA (#/100ml)	Mean	224	357	219	119
	Max	90,000	200,000	420,000	170,000
	Min	1	1	1	1
	Med	280	420	250	170
	95%	5,100	6,600	4,000	2,500
	N	417	1032	340	246

Waterbody Index

Facility Index

SCDNR 2005

Sec 2.4 Ref 37

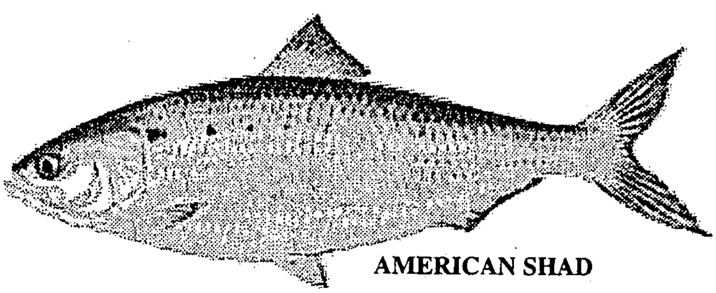
SCEG-274

Santee Cooper Anadromous Fish

Fish Passage & Restoration

ANADROMOUS FISH

Anadromous fish are fish that spend most of their lives in the saltwater environment of oceans and bays, but return to the freshwater environment of rivers and streams to spawn. Some of the best known anadromous fish are salmon and trout, which are often shown jumping over rapids as they migrate up streams to their spawning areas.



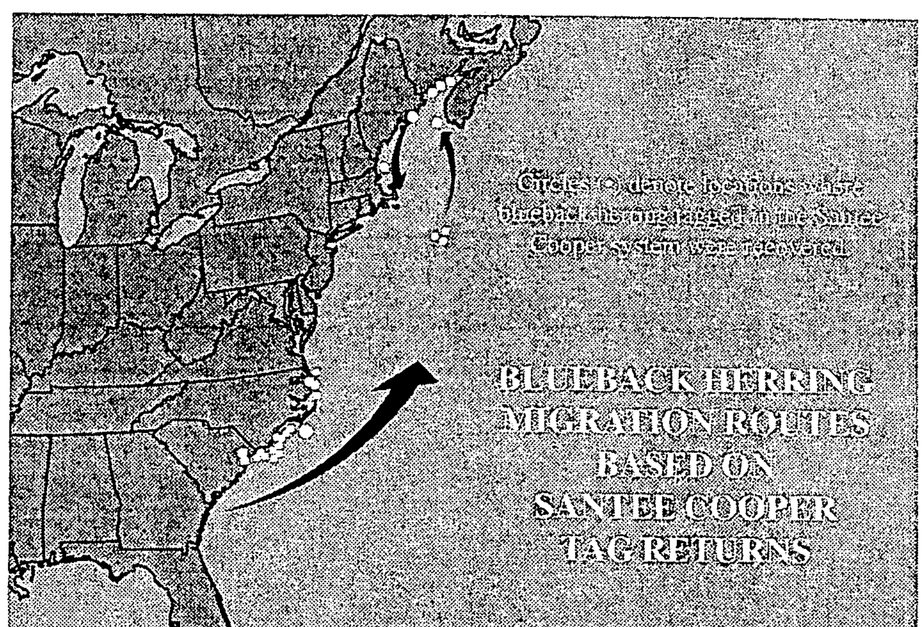
AMERICAN SHAD

Several species of anadromous fish use the Santee-Cooper system. Some of these are blueback herring, American shad, striped bass, hickory shad, shortnose sturgeon and Atlantic sturgeon. Of these, the blueback herring and American shad are quite abundant, while the shortnose sturgeon is so rare that it is considered an endangered species. Each spring these fish make their migration runs up our rivers in search of suitable spawning habitat.

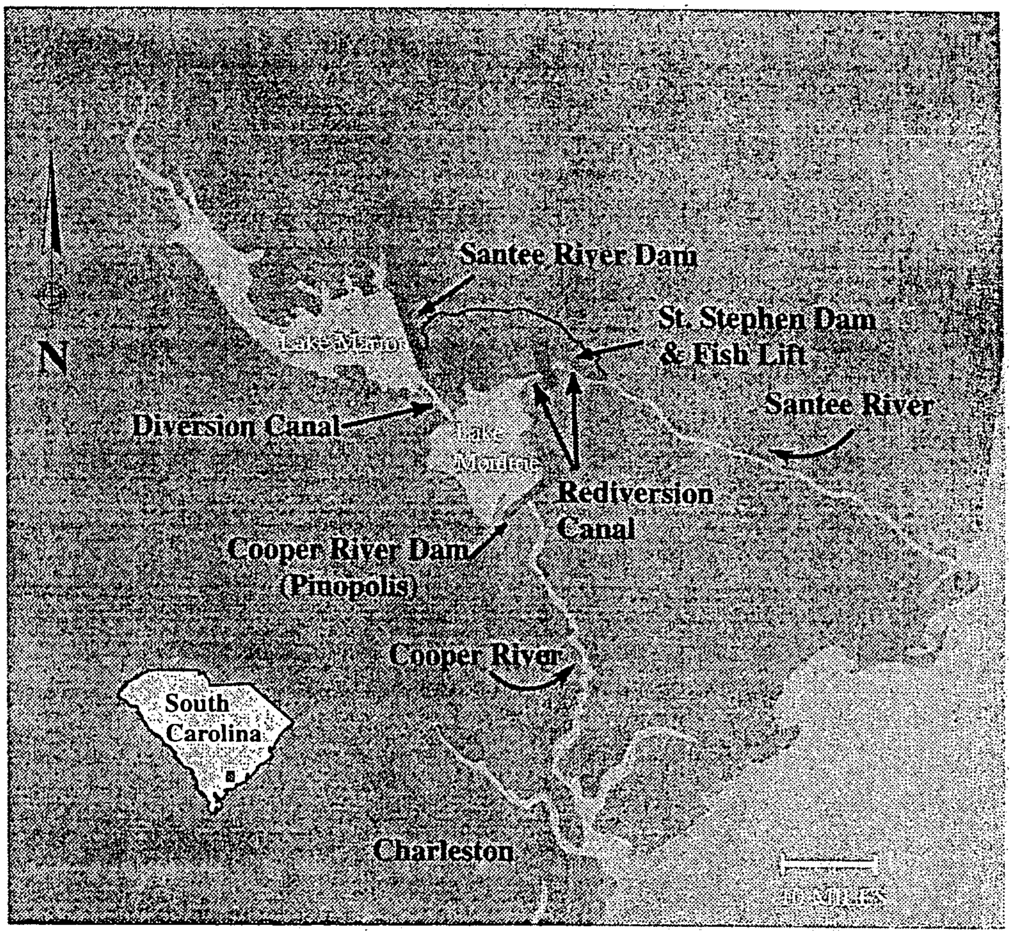
Between spawning runs, some species of anadromous fish make extensive ocean migrations. Biologists have found that blueback herring and American shad spawned in the Santee-Cooper system may migrate over 1,000 miles to the Bay of Fundy in Canada's Atlantic Provinces. Here shad and herring from stocks along the Atlantic Seaboard congregate to spend autumns feeding on the Bay's abundant plankton. As a result, Santee-Cooper anadromous fish contribute to recreational and commercial fisheries in other states and Canada while at the same time returning fish have grown by consuming food from those distant estuaries and coasts.

The fish continue to make annual migrations along the East Coast until they reach maturity around the age of four. At this time, each stock seeks out the river in which they were spawned. The mechanism that anadromous fish use to guide them on these homecoming journeys is not fully understood. It is believed that the young fish actually memorize a particular "smell" or taste of the river and they use this smell to guide them to their natal river as they get closer to it's mouth when they return to spawn.

As the fish leave saltwater and ascend to freshwater streams, various physiological processes take place. These adaptations are unique to anadromous fish, as changes from saltwater to freshwater would be lethal to most other species of fish. The fish may travel over 100 miles up freshwater rivers to reach their spawning grounds, and have evolved the ability



to navigate rapids and many other natural obstructions. Man-made obstructions such as dams, however, can completely block access to the spawning grounds. In these cases a man-made passageway, called a fishway, is needed so fish may pass around the obstruction.



FISHWAYS

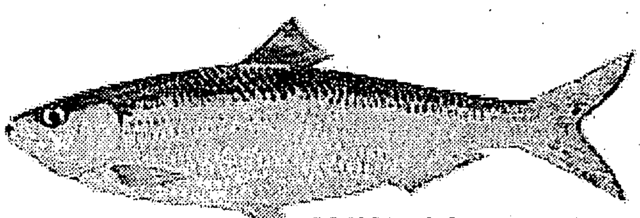
Fishways have been constructed for hundreds of years to allow migrating fish to pass dams on rivers and streams. Many of the earlier fishways did not function well because the designers did not understand the particular attraction flow requirements or swimming ability of the fish, or the flow characteristics of the site. While much progress has been made in this area through research and experimentation, biologists and engineers are still working on resolving various problems to allow fish to freely migrate to and from their spawning areas. The St. Stephen fishlift is a good example of a fishway where data collected at the site is used to implement improvements.

There are many types of facilities designed to pass fish around dams such as fish ladders, fish lifts, and navigation locks. In the Santee-Cooper system a fish lift and a navigation (boat) lock are used by migrating fish to pass from the Santee and Cooper rivers into the lakes and rivers beyond.

CHANGES TO THE SANTEE AND COOPER RIVERS

The Santee Canal

The water of the Santee and Cooper rivers has been manipulated by man for several uses. When Europeans first settled this region, low marshy areas along the rivers were diked and flooded to produce rice fields. The success of this crop gave rise to many of the plantations that were so prevalent in the Lowcountry. In 1800 a newly constructed 22-mile long, 10-lock canal first connected the Santee and Cooper rivers. This canal allowed goods from the plantations to be delivered from the central Carolinas to Charleston on barges drawn by horses or mules. By using the canal, the boats avoided a perilous journey down the Santee River and along the coast to Charleston Harbor. The canal closed in the 1850's and is now overgrown or flooded by the Santee-Cooper Lakes. For more information on the canal a visit to The Old Santee Canal Park in Moncks Corner is recommended.



BLUEBACK HERRING

Diversion

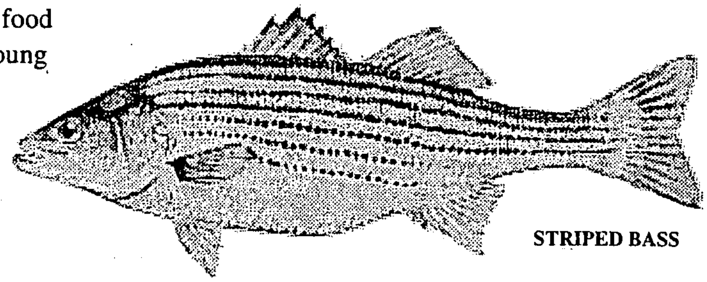
The most significant change to the Santee and Cooper rivers occurred in 1941 when Santee River was dammed, and Lakes Moultrie and Marion were created. The water from Santee River, one of the largest drainages on the East Coast, was diverted to the small tidal Cooper River. The project was constructed by the South Carolina Public Service Authority, now known as Santee Cooper.

The goals of the Diversion project were to provide hydroelectric power to rural Lowcountry residents, provide flood control for the Santee River basin, and to provide a navigation route from Charleston to Columbia. Following the commerce principles behind construction of the Old Santee

Canal, a lock was installed at the dam on the Cooper River. It was designed to allow boat traffic to pass from the river to Lake Moultrie and back, and at the time of its construction this was the world's highest single lift lock.

An unanticipated result of this project was to create the country's first landlocked striped bass fishery in the newly formed lakes. Unfortunately, the damming of the river also blocked hundreds of miles of migration routes for anadromous fish returning to the system. However, while commercial use of the lock never developed, operation of the lock in conjunction with high springtime discharges of water from the Cooper River dam allowed fish to pass into the lake system.

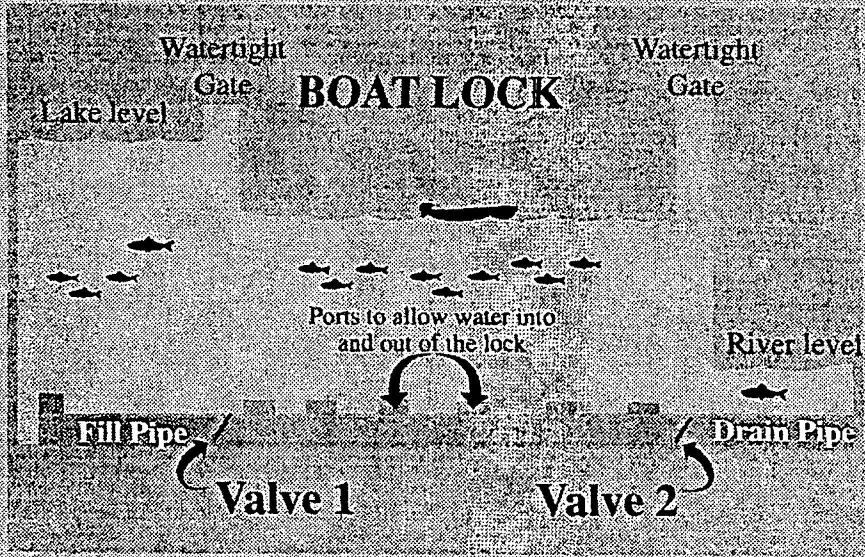
Each spring anadromous fish concentrated at the base of the dam as their upstream migrations were blocked by it, and the lock was operated several times a day to allow fish to be passed into the lakes. This provided the fish with access to their spawning and nursery grounds in the lakes and rivers above the dam. Fish that live in the lakes year-round, called resident fish, such as striped bass also benefited from a supply of food fish as they fed on the adult blueback herring which migrated into the lakes and the young anadromous fish that were hatched in the Santee-Cooper system. This was important to the ecology of the lake because other species of forage fish are resident species and must compete for food even with young game fish. On the other hand, anadromous fish, since they have grown in the ocean for most of their lives provide the lake with a nutritional supplement. Not only do resident fish benefit by directly consuming anadromous fish, but the decaying bodies of dead anadromous fish also enrich the entire food web in the lake ecosystem. This nutritional enrichment is analogous to a farmer fertilizing his fields with manure trucked in from another farm.



STRIPED BASS

While the lock worked well in passing fish above the new dam and the ecosystem created by the new lakes seemed to be stabilizing, a problem arose as a result of diversion. The Cooper River, previously a small tidal creek terminating at Charleston Harbor, was now carrying the combined flows and sediments of the Cooper and the much larger Santee rivers. The increased flow created shoaling problems in the harbor that interfered with Navy and commercial shipping traffic. Dredging costs dramatically increased and sites to deposit the removed sediments began filling up quickly. To address this

A Shortnose Sturgeon caught at the Cooper River Dam.



To bring a boat from the river to the lake, the boat enters the lock and the gates are closed. Valve 1 is then opened while valve 2 is closed, allowing the boat lock to fill with water to the level of the lake. The lake side gate is then opened and the boat can enter the lake.
To bring a boat from the lake to the river, the opposite occurs. Valve 1 is closed while valve 2 is opened. When the water drains to the river level, the river side gate can then be opened. The fish lift operates on a similar principle, with the addition of various devices for attracting fish into and through the facility.

problem without losing the fish passage and the hydroelectric power generation provided by Diversion, the U.S. Army Corps of Engineers proposed the Cooper River Rediversion Project.

Rediversion

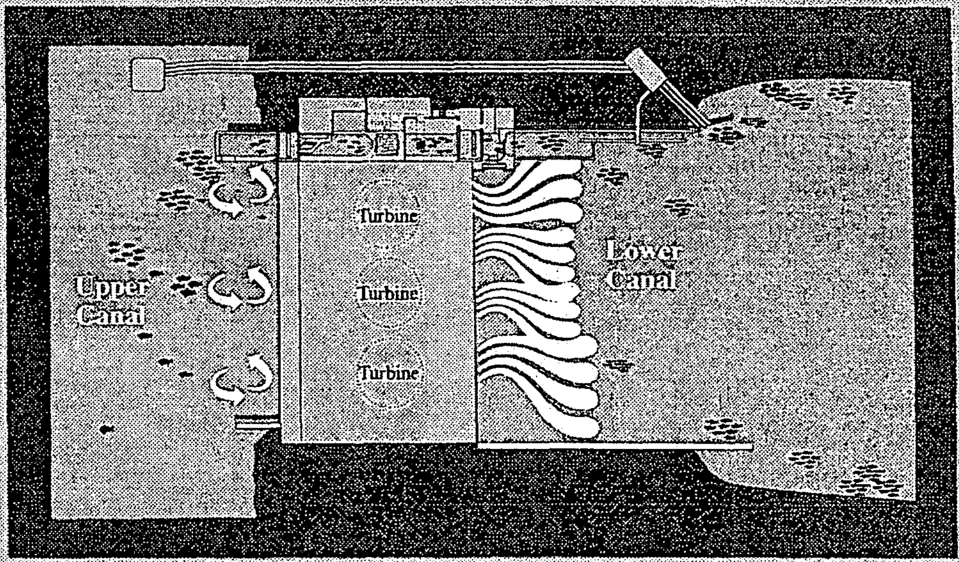
Beginning in 1985, Rediversion allowed Santee River water to continue to be diverted to Lake Moultrie, but instead of discharging all of the water into Cooper River through Pinopolis Dam, the majority of the water was now re-diverted back to the Santee River via a new canal, the Rediversion Canal. A dam was constructed on the Rediversion Canal near St. Stephen, South Carolina to maintain discharge control and hydroelectric power generation. To allow upstream migrating fish to pass beyond the new dam and into the lake system, a lock was specifically designed and built into the dam. This lock came to be known as the St. Stephen fish lift.

The new fish lock, or fish lift, was much smaller than the original navigation lock on Cooper River, which was constructed for boat passage. Special gates were designed to create and adjust flows that would attract fish into a long entrance channel on the downstream side of the dam. Once in this channel, a gate closes behind the fish and drives them into the lock chamber. The lock then floods to lake level just as a boat lock does. The fish are then prompted to swim up and out of the lift chamber by a slowly lifted basket known as a brail basket. As the fish exit toward the lake system they pass by viewing windows where they can be identified and counted. This allows biologists to collect data on the various species of migrating fish entering the lake. This information is important to the proper management of the fisheries. The viewing windows also provide an underwater parade for visitors to watch as hundreds of thousands of fish pass each spring.

WORKING TOGETHER

After Rediversion the numbers of fish passed into the lakes drastically declined. The U.S. Army Corps of Engineers and Santee Cooper have been working closely with Department of Natural Resources personnel over

Aerial view of St. Stephen Power Plant and Fish Lock Facilities



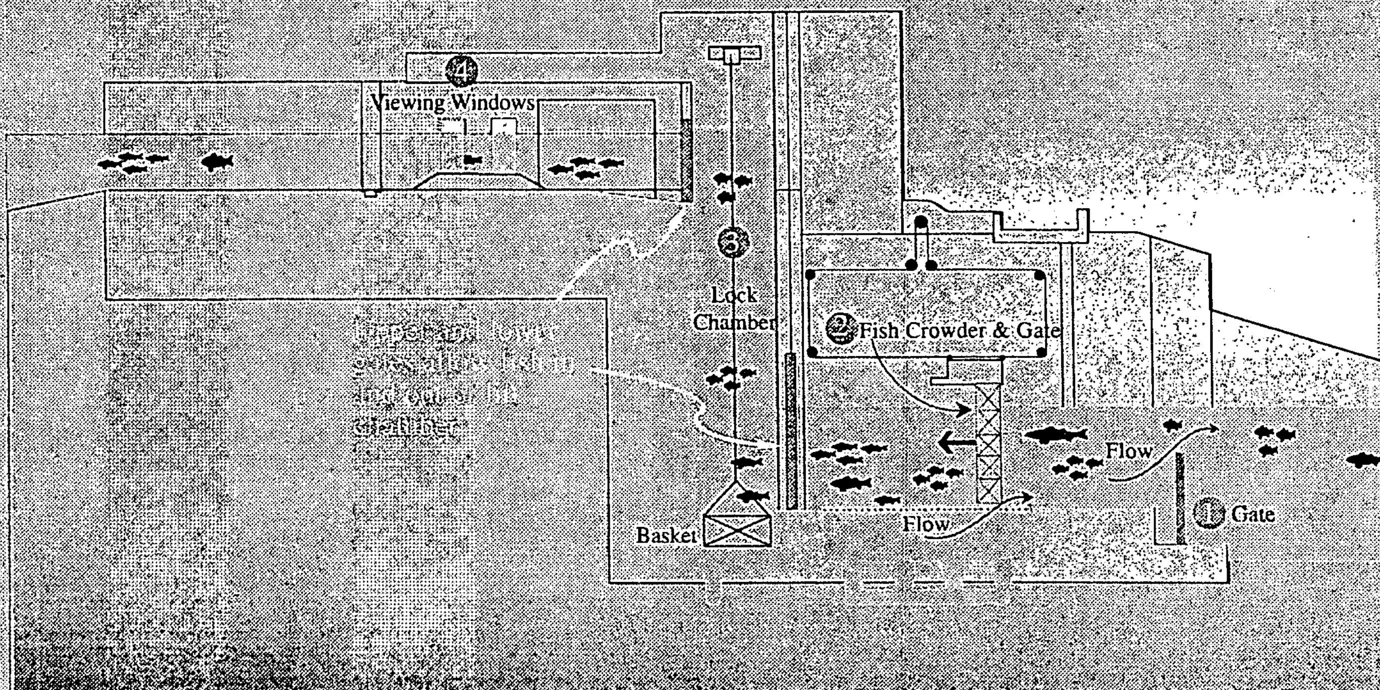
the past several years to restore fish passage numbers to pre-Rediversion levels. The Corps of Engineers, who constructed and maintain the fish lift, has been funding ongoing fishery studies to provide the best possible access to the lakes for the migrating fish. Numerous modifications to the fish lift have taken place since its original construction. In 2000, the most recent modification to the lift was completed. This modification allowed for a larger volume of attraction flow, which is vital to guide fish into the entrance channels. The modification also provided a downstream bypass structure, an alternative to passing through the hydroelectric turbines of the dam for juvenile anadromous fish migrating to saltwater and continuing their life cycle. More structural changes are currently being studied. These changes will increase the lift's efficiency in terms of the number of fish passed and the reliability of its operations.

Santee Cooper, who constructed and maintains the boat lock on the Cooper River, has operated that lock for fish passage for the past several decades. They have also provided favorable water discharges to allow the fish access to both facilities. Modifications to the lock designed to enhance fish passage are currently being explored.

An American Shad caught at the Cooper River Dam.
Photo: Walt Rhodes

It is hoped that through these cooperative efforts, anadromous fish populations will return to their previous abundance. As more adult fish are allowed access to the thousands of acres of spawning and nursery grounds in the lake system and beyond, more young fish will be spawned, which in turn will come back in four to five years to spawn themselves. The resident fish, such as striped bass and largemouth bass, benefit from the increased forage in the lake, while fishermen benefit both directly as they fish for anadromous fish and indirectly as they harvest fish that eat the anadromous fish.

St. Stephen Power Plant
FISH LOCK FACILITIES



1. As the fish are migrating upstream, they are attracted to a downstream flow at the entrance gates of the lift.
2. The migrating fish pass through another gate on a wall, known as a fish crowder. Once a lift cycle is started, this gate closes and the crowder moves forward, forcing the fish into the lock chamber.
3. The lock then floods, just as a boat lock does, and a basket forces the fish up to the lake level.
4. As the fish exit into the lake system, they pass by viewing windows where they can be identified and counted.

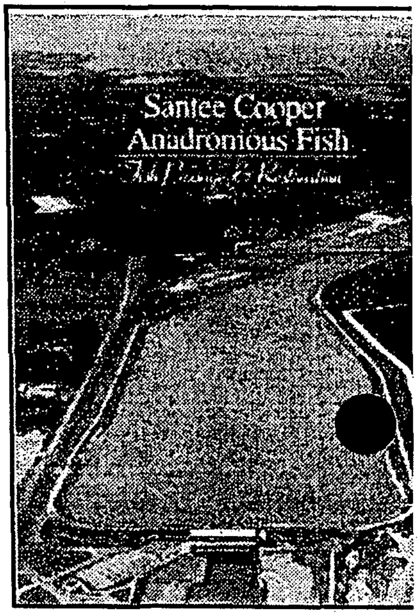
DNR

US Army Corps of Engineers

Santee Cooper

St. Stephen Fish Lift

SC's Only Fish Lift Offers Underwater View



Video of Fish Lift

Unique to the state and the Southeast, the fish lift at St. Stephen dam affords safe passage for fish migrating upstream to spawn and permits visitors a close-up, underwater view through a glass window. The fish lift, actually a lock designed specifically for fish passage at the site, was built by the U.S. Army Corps of Engineers in 1985 as part of the St. Stephen Powerhouse on the Rediversion Canal in Berkeley County. The lift is operated by the South Carolina Department of Natural Resources (DNR). It allows migratory fish like American shad and blueback herring to move from the Santee River to Lakes Moultrie and Marion and into the Congaree and Wateree rivers during their annual migration. This opens large areas of spawning and nursery grounds allowing fish populations to expand in numbers. These fish provide recreational and commercial fishing opportunities as well as a primary food source for game fish such as Santee-Cooper striped bass.

The fish lift is capable of transporting thousands of fish over the dam daily, and a viewing window gives visitors a unique underwater view of fish migration while allowing biologists to monitor fish passage into the lakes. Fish migration is a natural phenomenon though, and so is subject to changing environmental conditions including water discharge. Passage of fist specific time cannot be guaranteed.

The fish lift is open to visitors from March 15 – April 15 each spring. Visitors must call in advance to make a reservatior free tour. Reservations will be accepted beginning January for the upcoming season. For further information regarding t please contact Sabrina Wright at DNR's Dennis Wildlife Center in Bonneau at (843) 825-3387.

For more information about the fish lift, see the St. Stephen Fish Lift brochure (file size 600 Kb) which is in the Adobe F format. Adobe® Reader® is required to open the files and is available as a free download from the Adobe® Web site.

Get Acrobat Reader

Fish Passage Results

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Sec. 2.4 Ref 38 SCDNR 2005 608

DNR News

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P O Box 167
Columbia, SC 29202

DNR Media Contacts:
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Columbia - Brett Witt (803) 734-3815
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Spokesman - Mike Willis (803) 734 - 4133
After Hours Radio Room - (803) 955-4000

#05-237 November 7, 2005

State DNR Stocks Robust Redhorse,'Fish Lost To Science,' In S.C. Waters

The Freshwater Fisheries Section of the S.C. Department of Natural Resources harvested, tagged and stocked robust redhorse recently in South Carolina waters. These activities were part of a three-state effort to restore robust redhorse populations to the Atlantic slope rivers in Georgia, North Carolina and South Carolina.

Fish harvest occurred on Oct. 31, and tagging activities were carried out Nov. 1 and 2. Both harvest and tagging were conducted at the S.C. Department of Natural Resources (DNR) Dennis Wildlife Center in Bonneau. Fish were stocked on Nov. 2 and 3 in sections of the Broad River north of Columbia and the Wateree River between Camden and the Lake Wateree Dam.

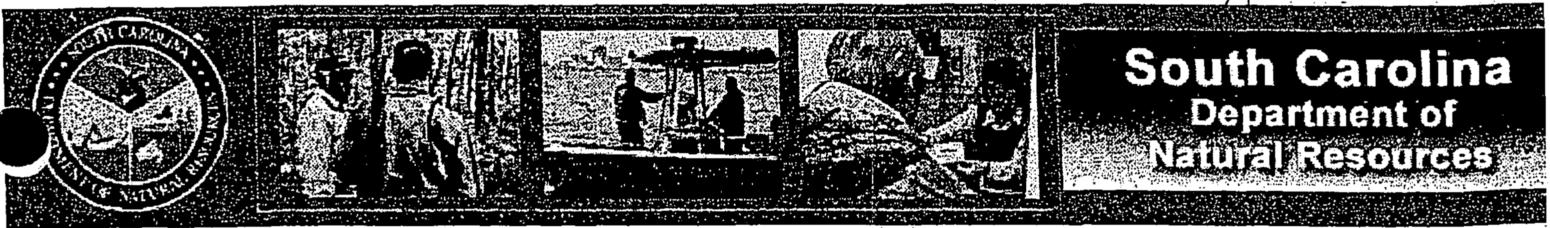
The robust redhorse is a large, long-lived member of the redhorse sucker family. Adults can reach 30 inches in length and weigh up to 17 pounds, although the average length in sample populations is 25 inches and the average weight is 9 pounds. The maximum known age is 27 years. The fish has a thick, robust body with rose-colored fins and a fleshy lower lip.

Master naturalist Edward Drinker Cope first described the robust redhorse in 1870 based on a single 6-pound specimen that had been collected from the Yadkin River in North Carolina. The specimen was apparently destroyed and by the late 1800s all mention of the robust redhorse had dropped from the scientific literature.

The collection of robust redhorse from the Oconee River in Georgia signified the rediscovery of a species that had been lost to science for 122 years. A cooperative effort was initiated in 1995 between state, federal and private groups and organizations under a memorandum of understanding to work to recovery and conserve the species in order to avoid its listing as a federal threatened and endangered species.

For more information about the robust redhorse, call the DNR's Dennis Wildlife Center in Bonneau at (843) 825-3387.

3-648



Regulations

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South Carolina Rare, Threatened, & Endangered Species Inventory County Selection From List

Please click on a county of interest to view its species data, or click hei to list all species found in South Carolina.

Counties A - C	Counties D - L	Counties M - Y
Abbeville	Darlington	Lexington
Aiken	Dillion	Marion
Allendale	Dorchester	Malboro
Anderson	Edgefield	McCormick
Bamberg	Fairfield	Newberry
Barnwell	Florence	Oconee
Beaufort	Georgetown	Orangeburg
Berkeley	Greenville	Pickens
Calhoun	Greenwood	Richland
Charleston	Hampton	Saluda
Chereokee	Horry	Spartanburg
Chester	Jasper	Sumter
Chesterfield	Kershaw	Union
Clarendon	Lancaster	Williamsburg
Colleton	Laurens	York
	Lee	

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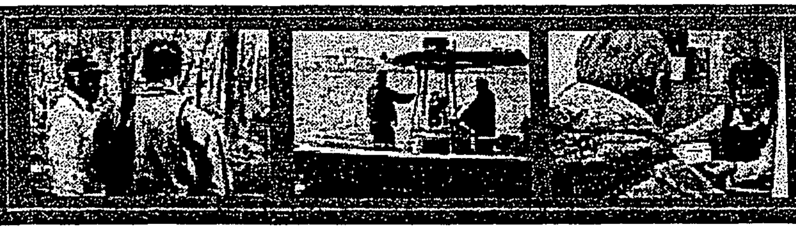

South Carolina Department of Natural Resources

Regulations

South Carolina Rare, Threatened, & Endangered Species Inventory KEY

Return to species data...

STATUS - legal status:

FE -
Federal Endangered

FT -
Federal Threatened

PE -
Proposed for Federal listing as Endangered

PT -
Proposed for Federal listing as Threatened

C -
Candidate for Federal listing

NC -
Of Concern, National (unofficial - plants only)

RC -
Of Concern, Regional (unofficial - plants only)

SE -
State Endangered (official state list - animals only)

ST -
State Threatened (official state list - animals only)

SC -
Of Concern, State

SX -
State Extirpated

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South Carolina Department of Natural Resources

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Aiken County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATU
ACIPENSER BREVIROSTRUM	SHORTNOSE STURGEON	G3	S3	FE/SE
AESCULUS PARVIFLORA	SMALL-FLOWERED BUCKEYE	G2G3	S1	RC
AGALINIS LINIFOLIA	FLAX LEAF FALSE-FOXGLOVE	G4?	S?	SC
ALLIUM CUTHBERTII	STRIPED GARLIC	G3	S?	SC
AMBYSTOMA TIGRINUM TIGRINUM	EASTERN TIGER SALAMANDER	G5T5	S2S3	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTRAGALUS VILLOSUS	A MILK-VETCH	G4	S?	SC
ATRYTONE AROGOS	AROGOS SKIPPER	G3G4	S?	SC
BOTRYCHIUM LUNARIOIDES	WINTER GRAPE-FERN	G4?	S?	SC
CALAMOVILFA BREVIPILIS	PINE-BARRENS REED-GRASS	G4	S?	NC
CAREX CHEROKEENSIS	CHEROKEE SEDGE	G4G5	SR	SC
CAREX COLLINSII	COLLINS' SEDGE	G4	S1	SC
CAREX ELLIOTTII	ELLIOTT'S SEDGE	G4?	S?	SC
CAREX FOLLICULATA	LONG SEDGE	G4G5	S1	SC
CAREX SOCIALIS	SOCIAL SEDGE	G4	S?	SC
CAROLINA BAY		G?	S?	SC
CLADRASTIS KENTUKEA	YELLOWWOOD	G4	S1	RC
CLEMMYS GUTTATA	SPOTTED TURTLE	G5	S5	ST
COLONIAL WATERBIRD		G?	S?	SC
CONDYLURA CRISTATA	STAR-NOSED MOLE	G5	S3?	SC
COREOPSIS ROSEA	ROSE COREOPSIS	G3	S2	RC
CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT	G3G4	S2?	SI
CROTON ELLIOTTII	ELLIOTT'S CROTON	G2G3	S?	S
CYSTOPTERIS PROTRUSA	LOWLAND BRITTLE FERN	G5	S?	S
DELPHINIUM CAROLINIANUM	CAROLINA LARKSPUR	G5	S?	S

DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
ECHINACEA LAEVIGATA	SMOOTH CONEFLOWER	G2	S1	FE/SE
ECHINODORUS PARVULUS	DWARF BURHEAD	G3Q	S2	[illegible]
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ENEMION BITERNATUM	FALSE RUE-ANEMONE	G5	S1	RC
EUONYMUS ATROPURPUREUS	WAHOO	G5	S1	SC
FORESTIERA LIGUSTRINA	UPLAND SWAMP PRIVET	G4G5	S1	SC
GAURA BIENNIS	BIENNIAL GAURA	G5	S?	SC
GOPHERUS POLYPHEMUS	GOPHER TORTOISE	G3	S1	SE
HALESIA PARVIFLORA	SMALL-FLOWERED SILVERBELL-TREE	G?	S?	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	SC
HYLA AVIVOCA	BIRD-VOICED TREEFROG	G5	S5	SC
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
ILEX AMELANCHIER	SARVIS HOLLY	G4	S3	SC
IPOMOPSIS RUBRA	RED STANDING-CYPRESS	G4G5	S?	SC
JUNIPERUS COMMUNIS	GROUND JUNIPER	G5	S?	SC
KALMIA CUNEATA	WHITE-WICKY	G3	S1	NC
LASIURUS CINEREUS	HOARY BAT	G5	S?	SC
LINDERA SUBCORIACEA	BOG SPICEBUSH	G2	S?	RC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	[illegible]
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	[illegible]
MAGNOLIA CORDATA	PIEDMONT CUCUMBER TREE	G?Q	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MICRURUS FULVIUS	EASTERN CORAL SNAKE	G5	S2	SC
MYRIOPHYLLUM LAXUM	PIEDMONT WATER-MILFOIL	G3	S2	RC
NEOTOMA FLORIDANA	EASTERN WOODRAT	G5	S3S4	SC
NEOTOMA FLORIDANA FLORIDANA	EASTERN WOODRAT	G5T5	S3S4	SC
NERODIA FLORIDANA	FLORIDA GREEN WATER SNAKE	G5	S2	SC
NESTRONIA UMBELLULA	NESTRONIA	G4	S2	SC
NOLINA GEORGIANA	GEORGIA BEARGRASS	G3G5	S?	SC
PARONYCHIA AMERICANA	AMERICAN NAILWORT	G3?	S?	SC
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	G3	S2	FE/S
PITUOPHIS MELANOLEUCUS	PINE OR GOPHER SNAKE	G4	S3S4	SC
PITYOPSIS PINIFOLIA	PINE-LEAVED GOLDEN ASTER	G4	S?	SC
PLATANTHERA LACERA	GREEN-FRINGE ORCHIS	G5	S1	SC
PTILIMNIUM NODOSUM	HARPERELLA	G2	S1	[illegible]
RANA CAPITO	GOPHER FROG	G3	S1	[illegible]
RHODODENDRON FLAMMEUM	PIEDMONT AZALEA	G3	S2	S
RHYNCHOSPORA INUNDATA	DROWNED HORNEDRUSH	G3G4	S?	S
RORIPPA SESSILIFLORA	STALKLESS YELLOWCRESS	G5	S?	S

RUELLIA CAROLINIENSIS SSP CILIOSA	A PETUNIA	G5T3T4	S?	SC
SAGITTARIA ISOETIFORMIS	SLENDER ARROW-HEAD	G4?	S2	SC
SARRACENIA RUBRA	SWEET PITCHER-PLANT	G3	S4	SC
SCIRPUS ETUBERCULATUS	CANBY BULRUSH	G3G4	S?	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SEMINATRIX PYGAEA	BLACK SWAMP SNAKE	G5	S?	SC
SOLIDAGO AURICULATA	EARED GOLDENROD	G4	S?	SC
SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
SPOROBOLUS PINETORUM	CAROLINA DROPSEED	G3	SR	SC
STYLISMA PICKERINGII VAR PICKERINGII	PICKERING'S MORNING-GLORY	G4T2T3	S1	SC
SYNGONANTHUS FLAVIDULUS	YELLOW PIPEWORT	G5	S1	RC
TREPOCARPUS AETHUSAE	AETHUSA-LIKE TREPOCARPUS	G4G5	S?	SC
TRILLIUM DISCOLOR	FADED TRILLIUM	G3	S?	SC
TRILLIUM LANCIFOLIUM	NARROW-LEAVED TRILLIUM	G3	S1	NC
TRILLIUM PUSILLUM VAR PUSILLUM	LEAST TRILLIUM	G3T2	S1	NC
TRILLIUM RELIQUUM	RELICT TRILLIUM	G2	S1	FE/SE
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
XYRIS BREVIFOLIA	SHORT-LEAVED YELLOW-EYED GRASS	G4G5	S?	SC

For detailed location information about rare & endangered species, please contact Julie Holling .

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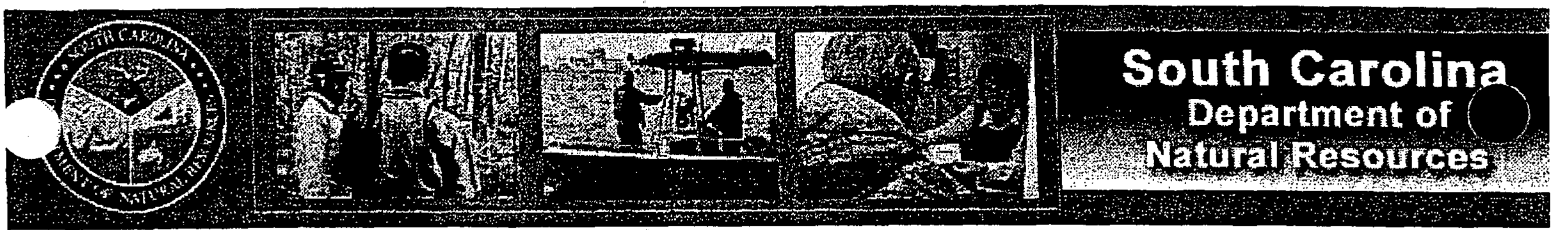

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Edgefield County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
ACCIPITER COOPERII	COOPER'S HAWK	G5	S3?	SC
ALASMIDONTA VARICOSA	BROOK FLOATER	G3	S?	SC
AMORPHA GLABRA	SMOOTH INDIGOBUSH	G4?	S?	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	[illegible]
CAREX AMPHIBOLA	NARROWLEAF SEDGE	G5	S?	SC
CAREX GRACILESCENS	SLENDER SEDGE	G5?	S?	SC
COREOPSIS ROSEA	ROSE COREOPSIS	G3	S2	RC
DELPHINIUM CAROLINIANUM	CAROLINA LARKSPUR	G5	S?	SC
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
ETHEOSTOMA HOPKINSI	CHRISTMAS DARTER	G4G5	S4	SC
FORESTIERA LIGUSTRINA	UPLAND SWAMP PRIVET	G4G5	S1	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/S
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
JUGLANS CINEREA	BUTTERNUT	G3G4	S?	SC
LAMPSILIS CARIOSA	YELLOW LAMPMUSSEL	G3G4	S?	SC
LASMIGONA DECORATA	CAROLINA HEELSPLITTER	G1	S1	FE/S
LITHOSPERMUM TUBEROSUM	TUBEROUS GROMWELL	G4	S1	SC
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OENOTHERA LINIFOLIA	THREAD-LEAF SUNDROPS	G5	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OUTCROP		G?	S?	SC

PANAX QUINQUEFOLIUS	AMERICAN GINSENG	G3G4	S2S3	RC
PARONYCHIA AMERICANA	AMERICAN NAILWORT	G3?	S?	SC
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
PLETHODON WEBSTERI	WEBSTER'S SALAMANDER	G3	S2	SE
PYGANODON CATARACTA	EASTERN FLOATER	G5	S?	SC
QUERCUS OGLETHORPENSIS	OGLETHORPE'S OAK	G3	S3	SC
QUERCUS SINUATA	DURAND'S WHITE OAK	G5	S1	SC
SCHOENOLIRION CROCEUM	YELLOW SUNNYBELL	G4	S1	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	SC
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
SOLIDAGO AURICULATA	EARED GOLDENROD	G4	S?	SC
SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
SYLVILAGUS AQUATICUS	SWAMP RABBIT	G5	S2S3	SC
TRILLIUM DISCOLOR	FADED TRILLIUM	G3	S?	SC
TRILLIUM LANCIFOLIUM	NARROW-LEAVED TRILLIUM	G3	S1	NC
TRILLIUM RELIQUUM	RELICT TRILLIUM	G2	S1	FE/SE
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
VILLOSA VIBEX	SOUTHERN RAINBOW	G4Q	S?	SC

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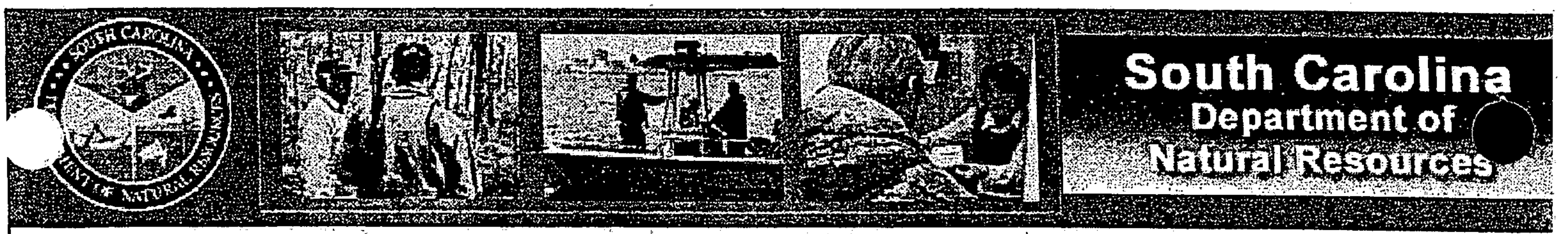

Regulations

Google Search

South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Fairfield County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	SC
CAREX OLIGOCARPA	EASTERN FEW-FRUIT SEDGE	G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DODECATHEON MEADIA	SHOOTING-STAR	G5	S?	[illegible]
ETHEOSTOMA COLLIS	CAROLINA DARTER	G3	S?	[illegible]
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY	G5	S?	SC
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
PYGANODON CATARACTA	EASTERN FLOATER	G5	S?	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	SC
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC

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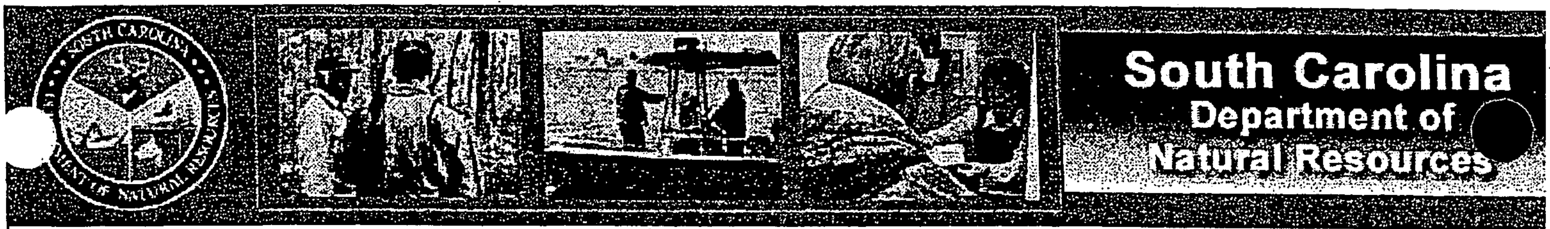

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Newberry County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATU:
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DISTOCAMBARUS YOUNGINERI	A CRAYFISH	G1	S1	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
EUPATORIUM FISTULOSUM	HOLLOW JOE-PYE WEED	G5?	S?	[illegible]
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERANTHERA RENIFORMIS	KIDNEYLEAF MUD-PLANTAIN	G5	S?	SC
JUGLANS CINEREA	BUTTERNUT	G3G4	S?	SC
LIPARIS LILIIFOLIA	LARGE TWAYBLADE	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MONOTROPSIS ODORATA	SWEET PINESAP	G3	S1	RC
MYCTERIA AMERICANA	WOOD STORK	G4	S1S2	FE/S
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET	G5T5	S?	SC

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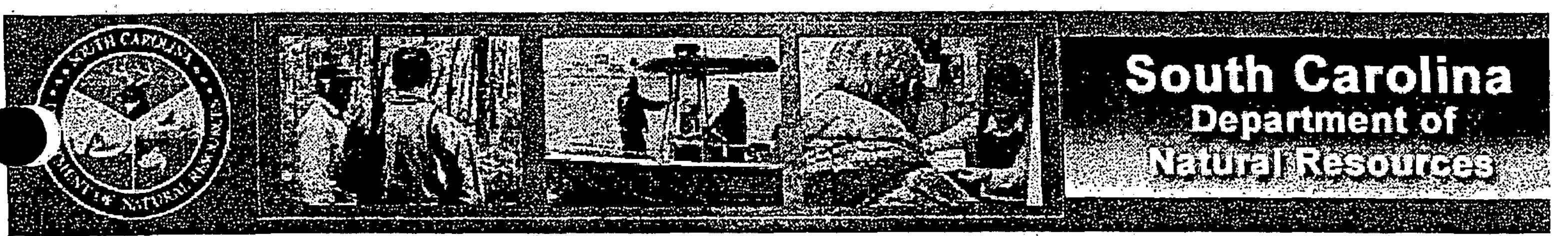

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South Carolina Rare, Threatened, & Endangered Species Inventory
Species Found In Saluda County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATU
AMPHIANTHUS PUSILLUS	POOL SPRITE	G2	S1	FT/ST
ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	SC
CAROLINA BAY	--	G?	S?	SC
COREOPSIS ROSEA	ROSE COREOPSIS	G3	S2	RC
CUSCUTA CEPHALANTHI	DODDER; LOVE-VINE	G5	S?	SC
DODECATHEON MEADIA	SHOOTING-STAR	G5	S?	SC
ECHINODORUS PARVULUS	DWARF BURHEAD	G3Q	S2	SC
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
ETHEOSTOMA HOPKINSI	CHRISTMAS DARTER	G4G5	S4	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SI
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	SC
HYPERICUM ADPRESSUM	CREEPING ST. JOHN'S-WORT	G2G3	S1	RC
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
LAMPSILIS SPLENDIDA	RAYED PINK FATMUCKET	G3	S?	SC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OENOTHERA LINIFOLIA	THREAD-LEAF SUNDROPS	G5	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY	G5	S?	SC
OUTCROP		G?	S?	SC
PLATANTHERA LACERA	GREEN-FRINGE ORCHIS	G5	S1	SC
PLETHODON WEBSTERI	WEBSTER'S SALAMANDER	G3	S2	SE
PTILIMNIUM NODOSUM	HARPERELLA	G2	S1	FE/
PYGANODON CATARACTA	EASTERN FLOATER	G5	S?	S

QUERCUS OGLETHORPENSIS	OGLETHORPE'S OAK	G3	S3	SC
SAGITTARIA ISOETIFORMIS	SLENDER ARROW-HEAD	G4?	S2	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	S[illegible]
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
TOXOLASMA PULLUS	SAVANNAH LILLIPUT	G2	S1S3	SC
UTTERBACKIA IMBECILLIS	PAPER PONDSHELL	G5	S?	SC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET	G5T5	S?	SC

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SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGA STATU
AGALINIS TENELLA		G4Q	S?	SC
ANDROPOGON PERANGUSTATUS	NARROW LEAVED BLUESTEM	G5T3T4	S1	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTER ELLIOTTII	ELLIOTT'S ASTER	G3G4	S?	SC
ASTRAGALUS MICHAUXII	SANDHILLS MILKVETCH	G3	S?	SC
BALDUINA ATROPURPUREA	PURPLE BALDUINA	G2G3	S?	SC
BOTRYCHIUM LUNARIOIDES	WINTER GRAPE-FERN	G4?	S?	SC
CALAMOVILFA BREVIPILIS	PINE-BARRENS REED-GRASS	G4	S?	NC
CAREX CHEROKEENSIS	CHEROKEE SEDGE	G4G5	SR	SC
CAREX COLLINSII	COLLINS' SEDGE	G4	S1	SC
CAREX CRUS-CORVI	RAVENFOOT SEDGE	G5	S?	SC
CAREX ELLIOTTII	ELLIOTT'S SEDGE	G4?	S?	SC
CAREX SOCIALIS	SOCIAL SEDGE	G4	S?	SC
CAROLINA BAY		G?	S?	SC
CAYAPONIA BOYKINII	CAYAPONIA	G4	S?	SC
COLLINSONIA SEROTINA	SOUTHERN HORSE-BALM	G3G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
CONDYLURA CRISTATA	STAR-NOSED MOLE	G5	S3?	S
COREOPSIS GLADIATA	SOUTHEASTERN TICKSEED	G3G5	S?	S
CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT	G3G4	S2?	S
DRYOPTERIS CARTHUSIANA	SPINULOSE SHIELD FERN	G5	S?	S
ECHINACEA LAEVIGATA	SMOOTH CONEFLOWER	G2	S1	FE,
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	S
ELIMIA CATENARIA	GRAVEL ELIMIA	G4	S?	S
ETHEOSTOMA COLLIS	CAROLINA DARTER	G3	S?	S

FUNDULUS DIAPHANUS	BANDED KILLIFISH	G5	S1	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	[illegible]
HYLA ANDERSONII	PINE BARRENS TREEFROG	G4	S2S3	ST
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
HYPERICUM ADPRESSUM	CREEPING ST. JOHN'S-WORT	G2G3	S1	RC
HYPERICUM NITIDUM	CAROLINA ST. JOHN'S-WORT	G4	S?	SC
ILEX AMELANCHIER	SARVIS HOLLY	G4	S3	SC
IPOMOPSIS RUBRA	RED STANDING-CYPRESS	G4G5	S?	SC
JUNCUS ABORTIVUS	PINEBARREN RUSH	G4G5	S?	SC
LECHEA TORREYI	PIEDMONT PINWEED	G4G5	S?	SC
LIATRIS MICROCEPHALA	SMALL-HEAD GAYFEATHER	G3G4	S?	SC
LINDERA SUBCORIACEA	BOG SPICEBUSH	G2	S?	RC
LOBELIA SP 1	LOBELIA	G?	S?	SC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	SC
LYCOPUS COKERI	CAROLINA BUGLEWEED	G3	S?	SC
LYSIMACHIA ASPERULIFOLIA	ROUGH-LEAVED LOOSESTRIFE	G3	S1	FE/SE
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	[illegible]
MAGNOLIA MACROPHYLLA	BIGLEAF MAGNOLIA	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MYRIOPHYLLUM LAXUM	PIEDMONT WATER-MILFOIL	G3	S2	RC
NESTRONIA UMBELLULA	NESTRONIA	G4	S2	SC
NOTROPIS CHILITICUS	REDLIP SHINER	G4	S1?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OXYPOLIS CANBYI	CANBY'S DROPWORT	G2	S1	FE/S
PASPALUM BIFIDUM	BEAD-GRASS	G5	S?	SC
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	G3	S2	FE/S
PITYOPSIS PINIFOLIA	PINE-LEAVED GOLDEN ASTER	G4	S?	SC
PLAGIOCHILA SULLIVANTII		G2	S?	SC
POTAMOGETON CONFERVOIDES	ALGAE-LIKE PONDWEED	G4	S1	SC
PRUNUS ALABAMENSIS	ALABAMA BLACK CHERRY	G4	S?	SC
PSILOTUM NUDUM	WHISK FERN	G5	S1S2	SC
PTEROGLOSSASPIS ECRISTATA	CRESTLESS PLUME ORCHID	G2	S2	SC
RHEXIA ARISTOSA	AWNED MEADOWBEAUTY	G3	S2	SC
RHINICHTHYS ATRATULUS	BLACKNOSE DACE	G5	S1	[illegible]
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	S
RHYNCHOSPORA INUNDATA	DROWNED HORNEDRUSH	G3G4	S?	S
RHYNCHOSPORA MACRA	BEAK RUSH	G3	S?	S

RHYNCHOSPORA OLIGANTHA	FEW-FLOWERED BEAKED-RUSH	G4	S?	SC
RHYNCHOSPORA PALLIDA	PALE BEAKRUSH	G3	S?	SC
RHYNCHOSPORA STENOPHYLLA	CHAPMAN BEAKRUSH	G4	S?	SC
SARRACENIA RUBRA	SWEET PITCHER-PLANT	G3	S4	SC
SCIRPUS ETUBERCULATUS	CANBY BULRUSH	G3G4	S?	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
SYLVILAGUS AQUATICUS	SWAMP RABBIT	G5	S2S3	SC
TOFIELDIA GLABRA	WHITE FALSE-ASPHODEL	G3	S?	SC
TREPOCARPUS AETHUSAE	AETHUSA-LIKE TREPOCARPUS	G4G5	S?	SC
TRIDENS CHAPMANII	CHAPMAN'S REDTOP	G?	S?	SC
TYTO ALBA	BARN-OWL	G5	S4	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
URTICA CHAMAEDRYOIDES	WEAK NETTLE	G4G5	S?	SC
VACCINIUM CRASSIFOLIUM SSP SEMPERVIRENS	RAYNER'S BLUEBERRY	G4G5T1	S1	NC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
WAREA CUNEIFOLIA	NUTTALL WAREA	G4	S?	SC

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ASTER GEORGIANUS	GEORGIA ASTER	G2G3	S?	SC
CAREX OLIGOCARPA	EASTERN FEW-FRUIT SEDGE	G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DODECATHEON MEADIA	SHOOTING-STAR	G5	S?	SC
ETHEOSTOMA COLLIS	CAROLINA DARTER	G3	S?	SC
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
ISOETES PIEDMONTANA	PIEDMONT QUILLWORT	G3	S2	SC
MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT	G4	S?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY	G5	S?	SC
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
PYGANODON CATARACTA	EASTERN FLOATER	G5	S?	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC
SCUTELLARIA PARVULA	SMALL SKULLCAP	G4	S?	SC
SEDUM PUSILLUM	GRANITE ROCK STONECROP	G3	S2	NC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC

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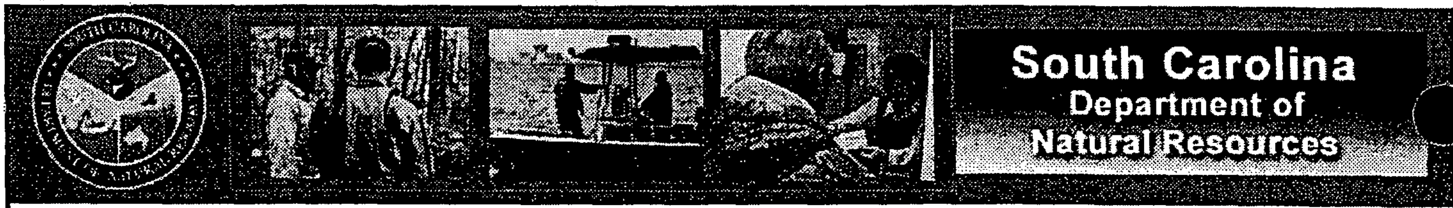

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Species Found In Newberry County
Data Last Updated January 17th, 2006.

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
COLONIAL WATERBIRD		G?	S?	SC
DIRCA PALUSTRIS	EASTERN LEATHERWOOD	G4	S?	SC
DISTOCAMBARUS YOUNGINERI	A CRAYFISH	G1	S1	SC
ELLIPTIO LANCEOLATA	YELLOW LANCE	G2G3	S?	SC
EUPATORIUM FISTULOSUM	HOLLOW JOE-PYE WEED	G5?	S?	SC
FRASERA CAROLINIENSIS	COLUMBO	G5	S1	RC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERANTHERA RENIFORMIS	KIDNEYLEAF MUD-PLANTAIN	G5	S?	SC
JUGLANS CINEREA	BUTTERNUT	G3G4	S?	SC
LIPARIS LILIIFOLIA	LARGE TWAYBLADE	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MONOTROPSIS ODORATA	SWEET PINESAP	G3	S1	RC
MYCTERIA AMERICANA	WOOD STORK	G4	S1S2	FE/SE
PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE	G5	S1	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET	G5T5	S?	SC

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SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	LEGAL STATUS
AGALINIS TENELLA		G4Q	S?	SC
ANDROPOGON PERANGUSTATUS	NARROW LEAVED BLUESTEM	G5T3T4	S1	SC
ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS	G4?	S?	SC
ASTER ELLIOTTII	ELLIOTT'S ASTER	G3G4	S?	SC
ASTRAGALUS MICHAUXII	SANDHILLS MILKVETCH	G3	S?	SC
BALDUINA ATROPURPUREA	PURPLE BALDUINA	G2G3	S?	SC
BOTRYCHIUM LUNARIOIDES	WINTER GRAPE-FERN	G4?	S?	SC
CALAMOVILFA BREVIPILIS	PINE-BARRENS REED-GRASS	G4	S?	NC
CAREX CHEROKEENSIS	CHEROKEE SEDGE	G4G5	SR	SC
CAREX COLLINSII	COLLINS' SEDGE	G4	S1	SC
CAREX CRUS-CORVI	RAVENFOOT SEDGE	G5	S?	SC
CAREX ELLIOTTII	ELLIOTT'S SEDGE	G4?	S?	SC
CAREX SOCIALIS	SOCIAL SEDGE	G4	S?	SC
CAROLINA BAY		G?	S?	SC
CAYAPONIA BOYKINII	CAYAPONIA	G4	S?	SC
COLLINSONIA SEROTINA	SOUTHERN HORSE-BALM	G3G4	S?	SC
COLONIAL WATERBIRD		G?	S?	SC
CONDYLURA CRISTATA	STAR-NOSED MOLE	G5	S3?	SC
COREOPSIS GLADIATA	SOUTHEASTERN TICKSEED	G3G5	S?	SC
CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT	G3G4	S2?	SE
DRYOPTERIS CARTHUSIANA	SPINULOSE SHIELD FERN	G5	S?	SC
ECHINACEA LAEVIGATA	SMOOTH CONEFLOWER	G2	S1	FE/SE
ELEOCHARIS ROBBINSII	ROBBINS SPIKERUSH	G4G5	S?	SC
ELIMIA CATENARIA	GRAVEL ELIMIA	G4	S?	SC
ETHEOSTOMA COLLIS	CAROLINA DARTER	G3	S?	SC
FUNDULUS DIAPHANUS	BANDED KILLIFISH	G5	S1	SC
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	G4	S2	FT/SE
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	S?	SC

HYLA ANDERSONII	PINE BARRENS TREEFROG	G4	S2S3	ST
HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY	G2Q	S2	NC
HYPERICUM ADPRESSUM	CREEPING ST. JOHN'S-WORT	G2G3	S1	RC
HYPERICUM NITIDUM	CAROLINA ST. JOHN'S-WORT	G4	S?	SC
ILEX AMELANCHIER	SARVIS HOLLY	G4	S3	SC
IPOMOPSIS RUBRA	RED STANDING-CYPRESS	G4G5	S?	SC
JUNCUS ABORTIVUS	PINEBARREN RUSH	G4G5	S?	SC
LECHEA TORREYI	PIEDMONT PINWEED	G4G5	S?	SC
LIATRIS MICROCEPHALA	SMALL-HEAD GAYFEATHER	G3G4	S?	SC
LINDERA SUBCORIACEA	BOG SPICEBUSH	G2	S?	RC
LOBELIA SP 1	LOBELIA	G?	S?	SC
LUDWIGIA SPATHULATA	SPATULATE SEEDBOX	G3G4	S?	SC
LYCOPUS COKERI	CAROLINA BUGLEWEED	G3	S?	SC
LYSIMACHIA ASPERULIFOLIA	ROUGH-LEAVED LOOSESTRIFE	G3	S1	FE/SE
MACBRIDEA CAROLINIANA	CAROLINA BIRD-IN-A-NEST	G2G3	S?	SC
MAGNOLIA MACROPHYLLA	BIGLEAF MAGNOLIA	G5	S?	SC
MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA	G4	S1	RC
MYRIOPHYLLUM LAXUM	PIEDMONT WATER-MILFOIL	G3	S2	RC
NESTRONIA UMBELLULA	NESTRONIA	G4	S2	SC
NOTROPIS CHILITICUS	REDLIP SHINER	G4	S1?	SC
OPHIOGLOSSUM VULGATUM	ADDER'S-TONGUE	G5	S?	SC
OXYPOLIS CANBYI	CANBY'S DROPWORT	G2	S1	FE/SE
PASPALUM BIFIDUM	BEAD-GRASS	G5	S?	SC
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	G3	S2	FE/SE
PITYOPSIS PINIFOLIA	PINE-LEAVED GOLDEN ASTER	G4	S?	SC
PLAGIOCHILA SULLIVANTII		G2	S?	SC
POTAMOGETON CONFERVOIDES	ALGAE-LIKE PONDWEED	G4	S1	SC
PRUNUS ALABAMENSIS	ALABAMA BLACK CHERRY	G4	S?	SC
PSILOTUM NUDUM	WHISK FERN	G5	S1S2	SC
PTEROGLOSSASPIS ECRISTATA	CRESTLESS PLUME ORCHID	G2	S2	SC
RHEXIA ARISTOSA	AWNED MEADOWBEAUTY	G3	S2	SC
RHINICHTHYS ATRATULUS	BLACKNOSE DACE	G5	S1	SC
RHODODENDRON EASTMANII	MAY WHITE	G2	S2	SC
RHYNCHOSPORA INUNDATA	DROWNED HORNEDRUSH	G3G4	S?	SC
RHYNCHOSPORA MACRA	BEAK RUSH	G3	S?	SC
RHYNCHOSPORA OLIGANTHA	FEW-FLOWERED BEAKED-RUSH	G4	S?	SC
RHYNCHOSPORA PALLIDA	PALE BEAKRUSH	G3	S?	SC
RHYNCHOSPORA STENOPHYLLA	CHAPMAN BEAKRUSH	G4	S?	SC
SARRACENIA RUBRA	SWEET PITCHER-PLANT	G3	S4	SC
SCIRPUS ETUBERCULATUS	CANBY BULRUSH	G3G4	S?	SC
SCIURUS NIGER	EASTERN FOX SQUIRREL	G5	S4	SC

SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK	G5	S4	SC
STROPHITUS UNDULATUS	SQUAWFOOT	G5	S?	SC
SYLVILAGUS AQUATICUS	SWAMP RABBIT	G5	S2S3	SC
TOFIELDIA GLABRA	WHITE FALSE-ASPHODEL	G3	S?	SC
TREPOCARPUS AETHUSAE	AETHUSA-LIKE TREPOCARPUS	G4G5	S?	SC
TRIDENS CHAPMANII	CHAPMAN'S REDTOP	G?	S?	SC
TYTO ALBA	BARN-OWL	G5	S4	SC
URSUS AMERICANUS	BLACK BEAR	G5	S3?	SC
URTICA CHAMAEDRYOIDES	WEAK NETTLE	G4G5	S?	SC
VACCINIUM CRASSIFOLIUM SSP SEMPERVIRENS	RAYNER'S BLUEBERRY	G4G5T1	S1	NC
VILLOSA DELUMBIS	EASTERN CREEKSHELL	G4	S?	SC
WAREA CUNEIFOLIA	NUTTALL WAREA	G4	S?	SC

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SCE&G 2002

Sec 2.4 Ref 40

SCE&G

Appendix E

Applicant's Environmental Report

Operating License Renewal Stage

Virgil C. Summer Nuclear Station

South Carolina Electric & Gas Company

Docket No. 50-395

License No. NPF-12

August 2002

2.0 SITE AND ENVIRONMENTAL INTERFACES

2.1 Location and Features

Virgil C. Summer Nuclear Station (VCSNS) is located in Fairfield County, South Carolina, approximately 15 miles west of the county seat of Winnsboro and 26 miles northwest of Columbia, the state capital (Figure 2-1). The site is in a sparsely-populated, largely rural area, with forests and small farms comprising the dominant land use. The Broad River flows in a northwest-to-southeast direction approximately one mile west of the site and serves as the boundary between Fairfield County (to the east) and Newberry County (to the west).

This reach of the Broad River, impounded for a small, run-of-the-river hydroelectric plant (Parr Hydro) in 1914, is known as Parr Reservoir (Figure 2-2). Originally 1,850 acres, Parr Reservoir was enlarged to approximately 4,400 acres in 1977 by raising the level of the dam by 9 feet (SCE&G 1978, pg. 2.1-16). This modification was necessary to support the development of the Fairfield Pumped Storage Facility (FPSF) (Figure 2-2), which was built on Frees Creek, a small tributary of the Broad River. In addition, Monticello Reservoir, a 6,500-acre impoundment, was built in the Frees Creek valley to serve as the upper pool for FPSF and the cooling water source for VCSNS. Parr Reservoir, which had historically been the source of water for Parr Hydro, assumed a dual function, providing water for both Parr Hydro and FPSF.

The VCSNS powerblock area (generating facilities and switchyard) is located on the south shore of Monticello Reservoir (Figure 2-3). A nuclear exclusion zone, defined as the area within approximately one mile of the reactor building, is posted and access to land portions of this area is controlled. The nuclear exclusion zone is not a perfect circle; its western axis is slightly longer (5,850 feet, or 1.11 mile) than its eastern axis (5,350 feet, or 1.01 mile) (SCE&G 1978, pg. 2.1-2). The boundary of the exclusion zone also represents the site boundary. The VCSNS property, thus defined, covers approximately 2,245 acres, and includes the southern portion of Monticello Reservoir and parts of the FPSF (Figure 2-3).

Section 3.1 describes key features of the station, including reactor and containment systems, cooling and auxiliary water systems, and transmission facilities.

2.2 Aquatic and Riparian Ecological Communities

Aquatic and riparian communities in the vicinity of VCSNS are influenced by the hydrology and water quality of the Broad River and movement of water between the Broad River/Parr Reservoir and Monticello Reservoir. This section characterizes both the hydrology and water quality of these waterbodies and the distribution and abundance of organisms within them.

Broad River and Parr Reservoir Hydrology and Water Quality

The Broad River originates on the eastern slope of the Blue Ridge Mountains near Lake Lure, North Carolina, and flows 220 miles southeast into South Carolina before joining the Saluda River at Columbia, South Carolina, to form the Congaree River. In South Carolina, the Broad River basin encompasses an approximately 4,500-square-mile watershed drained by 4,719 miles of streams (SCDHEC 1998, pg. 21). Major tributaries include the Pacolet, Tyger, and Enoree Rivers, all of which enter the Broad River from the west (Figure 2-1). The Broad River Basin in South Carolina is entirely within the Piedmont region, which is an area of gently rolling to hilly terrain with relatively broad stream valleys; elevations range from 376 to 1,000 feet above mean sea level (SCDHEC 1998, pg. 22). For most of its length in South Carolina, the Broad River flows through agricultural and forested land, including the Sumter National Forest, which bounds the river for some 30 miles above Parr Reservoir.

The 1998 South Carolina Department of Health and Environmental Control (SCDHEC) report contains additional information on land use in the Broad River Basin, its sub-basins (upper Broad, Pacolet, Tyger, and Enoree), and watersheds within these sub-basins. In addition, it provides details on stream classifications and water quality of all major streams in the region, and describes potential threats to water quality (point sources and non-point sources). The SCDHEC report notes that water quality in the Broad River from the Tyger River to the Parr Shoals dam is suitable for a range of aquatic life, but is experiencing "a significantly increasing trend" in total phosphorous concentrations (SCDHEC 1998, pg. 113) from upstream (agricultural and municipal) sources. In addition, fecal coliform bacteria levels are occasionally elevated in this stretch of the river.

The U.S. Geological Survey (USGS) operates and maintains gauging stations on the Broad River upstream and downstream of Parr Reservoir. Mean daily flow at the Carlisle gauging station (approximately 20 miles upstream of Parr Reservoir) over the 1939-2000 period ranged from 44 to 114,000 cubic feet per second (cfs) and averaged 3,933 cfs (Cooney et al. 2001, pg. 179). At the Alston gauging station, 1.2 miles downstream of Parr Shoals Dam, flows over the period of record (1896-1907; 1980-2000) ranged from 235 to 130,000 cfs and averaged 6,535 cfs (Cooney et al. 2001, pg. 226). Substantially higher flows at Alston, SC, reflect Tyger and Enoree River inflows. These streams enter the Broad River 18 and 13.5 miles, respectively, above the Parr Shoals dam, significantly increasing flows in the main stem of the river.

Parr Reservoir (see Figure 2-2) was created in 1914 by damming the Broad River at Parr Shoals, approximately 26 miles upstream of the confluence of the Broad and Saluda Rivers for Parr Hydro, a small (15 megawatt) run-of-the-river hydroelectric facility (SCE&G 2000). Prior to 1977, the reservoir's surface area was 1,850 acres (SCE&G 1978, pg. 2.1-16). In 1977, the level of Parr Reservoir was raised by 9 feet, which increased its surface area to approximately 4,400 acres. This modification was necessary to support the development of FPSF, which was built on Frees Creek, a small tributary of the Broad River. In addition, Monticello Reservoir was created to serve as the upper reservoir for FPSF and the cooling water source for VCSNS. Parr Reservoir, which had historically been the source of water for Parr Hydro, assumed a dual function, providing a headwater pool for Parr Hydro and a tailwater pool for FPSF.

The daily cycle of operation at the FPSF transfers up to 29,000 acre-feet per day (9.5×10^9 gallons per day) of water from Parr Reservoir to Monticello Reservoir and back (NRC 1981, pg. 2-10). Operations vary, depending on the season and system needs. In summer, FPSF generally pumps water from Parr Reservoir to Monticello Reservoir between the hours of 11 pm and 8 am and generates power (by releasing water) between the hours of 10 am and 11 pm. In winter, FPSF generally pumps water from Parr Reservoir to Monticello Reservoir between 11 pm and 6 am and generates between the hours of 6 am and 1 pm. The level of generation varies from one generator up to the maximum output of eight, depending on demand. Maximum output may not be necessary on all days. Pumping is normally done at maximum capacity. FPSF is normally operated seven days a week.

As a result of FPSF operations, Parr Reservoir is subject to daily fluctuations in water level of as much as 10 feet (NRC 1981, pg. 2-10), but the daily average is approximately 4 feet (Dames & Moore 1985). These water level fluctuations can expose and then reinundate up to 2,550 acres of Parr Reservoir with each cycle of pumpback and generation (release of water). The amount of water pumped from and returned to Parr Reservoir daily represents as much as 88 percent of its total volume (NRC 1981, pg. 2-18).

Temperatures and dissolved oxygen (DO) levels in water leaving Parr Reservoir are monitored at a USGS water quality monitoring station just downstream of the Parr Hydro powerhouse. Temperature and DO levels vary seasonally, and show an inverse relationship, with high temperatures associated with relatively low DO levels and low temperatures associated with relatively high DO levels. Temperatures in water year 1999-2000 (Oct. 1, 1999 through Sept. 30, 2000) ranged from 38.3°F in February to 87.8°F in August, with corresponding DO concentrations of 13.1 milligrams per liter and 4.9 milligrams per liter (Cooney et al. 2001, pp. 221-224).

Currently, Parr Reservoir maintains an intermediate trophic state among reservoirs in South Carolina; its river-like flows and short retention time (approximately four days) produce high DO levels (in most months) and high turbidity in the reservoir. Aquatic life and recreational uses are "fully supported" in Parr Reservoir, according to SCDHEC (1998, pg. 114), meaning that water quality is adequate to support a balanced indigenous community of organisms, with no restrictions on recreational users.

Monticello Reservoir Hydrology and Water Quality

VCSNS lies on the south shore of Monticello Reservoir (Figure 2-2), which serves as its cooling water source and heat sink. Monticello Reservoir was formed by damming Frees Creek, a small tributary of the Broad River that flowed into Parr Reservoir about 1.2 miles upstream of the Parr Shoals dam. As previously discussed, Monticello Reservoir was designed to serve both as a cooling pond for VCSNS and the upper pool for the FPSF, with an enlarged Parr Reservoir serving as the lower pool. Water flow from the Frees Creek watershed into the newly created Monticello Reservoir was negligible, and FPSF's pumps were used initially to fill the reservoir with water from Parr Reservoir (NRC 1981). Monticello Reservoir's small watershed drains an area of only 11,000 acres, including the reservoir and its subimpoundment (discussed later in this section).

Monticello Reservoir is approximately six miles long with a surface area of 6,500 acres. The average depth is 59 feet and the maximum depth is approximately 126 feet (SCDHEC 1998, pg. 114). FPSF operations can cause water levels in Monticello Reservoir to fluctuate as much as 4.5 feet daily, from 420.5 feet above mean sea level to 425.0 feet above mean sea level. Daily elevation changes vary, depending on system needs.

The most complete source of information on the water quality and biotic resources of Monticello Reservoir is a series of reports prepared in support of a Clean Water Act (CWA) Section 316(a) Demonstration for VCSNS and summarized in a final report (Dames & Moore 1985) submitted to SCDHEC and the U.S. Nuclear Regulatory Commission (NRC) in April 1985. A station-to-station comparison of pre-operational (1978-1982) and operational (1983-1984) water chemistry in Monticello Reservoir showed significant differences in 13 of 27 chemical parameters analyzed (Dames & Moore 1985, pg. 2.2-18). In 10 cases, concentrations of chemicals or measurements were higher in the pre-operational phase and in three cases concentrations were higher in the operational phase. None of these differences were related to operations of VCSNS.

The highest temperature observed in Monticello Reservoir over the 1983-1984 operational phase was 93.6°F at a depth of one foot at Station 14 (the sampling point closest to the discharge canal) in August 1983 (Dames & Moore 1985, pg. 2.2-10). A discernible thermal plume was present on 12 of 24 monthly field surveys at this same location, but survey results were confounded by plant operations (the plant was off-line during four surveys and at 50 percent power or less during three surveys). When plumes were detected, they were observed to a depth of 1 to 3 feet. Below this depth, the influence of the thermal plume was not evident. In more recent years (1995-2000), maximum temperatures at a sampling station just outside the mouth of the discharge canal ranged from 95.2°F to 103.7°F (see Section 4.12 for additional discussion).

Long-term eutrophication studies indicate that Monticello Reservoir's trophic condition is improving (SCDHEC 1998, pg. 114). It is currently rated as one of the least eutrophic reservoirs in South Carolina, and is characterized by low nutrient (total phosphorus and total nitrogen) concentrations.

Broad River/Parr Reservoir Aquatic Communities

The Broad River in the area of VCSNS was characterized (prior to the operation of FPSF and VCSNS) by a high silt load, high DO levels, high suspended solids levels, and low buffering capacity (NRC 1981). Parr Reservoir, a narrow, shallow, run-of-the-river reservoir, had lotic rather than lentic characteristics. Turbidity and flows appeared to limit the production of phytoplankton, and as a consequence they appeared to contribute only marginally to productivity. Zooplankton were also of limited importance. Benthic macroinvertebrates showed very little diversity, but relatively high measures of biomass due to the presence of high densities of the Asiatic clam, *Corbicula*. Fish collections prior to operation of FPSF were dominated by sunfish (bluegill, in particular) and gizzard shad, a forage species. Largemouth bass and white catfish also made up a significant proportion of biomass in collections (NRC 1981).

South Carolina Electric & Gas Company (SCE&G) monitored water quality and aquatic communities in the Broad River, Parr Reservoir, and Monticello Reservoir from mid-1978 through 1984 to assess the impacts of FPSF and VCSNS operations. This represented more than three years of pre-operational data and two years of operational data. These studies, summarized in a final report submitted to SCDHEC in April 1985 as part of a CWA Section 316(a) Demonstration (Dames & Moore 1985), represent the most comprehensive information on the biotic communities of the Broad River in the vicinity of VCSNS.

Parr Reservoir fish collections were dominated numerically in 1983 and 1984 by common warm water species. Approximately 44 percent of fish collected were centrarchids (e.g., bluegill, pumpkinseed, redear sunfish, largemouth bass), while 43 percent were clupeids (gizzard shad and threadfin shad). Gizzard shad and bluegill accounted for the greatest biomass, with 20.9 and 3.4 kilograms/hectare, respectively (Dames & Moore 1985, pp. 2.8-3–2.8-21). Species composition was essentially the same in preoperational (1978-1982) and operational (1983-1984) periods, with collections dominated by centrarchids (sunfish), clupeids (shad), and ictalurids (catfish and bullheads). The species composition was typical of warm, shallow southeastern reservoirs. The fish community of Parr Reservoir appeared to be largely unaffected by operations of VCSNS.

No comprehensive surveys or studies of Parr Reservoir's fish community have been conducted since 1984. The South Carolina Department of Natural Resources (SCDNR) assessed the largemouth bass fishery in the early 1990s and determined that there were fewer largemouth bass per acre in Parr Reservoir than other reservoirs in Fisheries Region III (Hayes 1999). Mean lengths and weights of Parr Reservoir largemouth bass were also lower. Parr Reservoir largemouth bass grew slowly, with fish reaching a minimum harvestable size of 12 inches at age three (Hayes 1999, pg. 19).

No creel survey has ever been conducted on Parr Reservoir to quantify angler effort, harvest, or success. (Hayes 1999, pg. 15). Anecdotal reports and casual interviews of fishermen suggest that catfish, crappie, and largemouth bass are the most targeted species. The extreme water level fluctuations on the reservoir make navigation difficult at times (water levels can be extremely low after pump-back operations) and appear to limit fishing pressure (Hayes 1999, pg. 15).

SCDNR is currently inventorying the aquatic resources of the Broad River and creating a Geographic Information System (GIS) database for natural resource managers in the region. Work began in the fall of 2000 and is scheduled for completion in the fall of 2002 (Bettinger 2001). This work is being supported by SCE&G, Duke Power, and Lockhart Power Company under the auspices of the Broad River Mitigation Trust Fund, whose Trustees are SCE&G, Duke Power, SCDNR, and the U.S. Fish and Wildlife Service (FWS).

In the fall of 2000 and the spring of 2001, 43 species of fish representing 9 families were collected from 9 sampling stations ranging over approximately 75 miles of the Broad River, from Gaston Shoals (near the North Carolina state line) to Bookman Island (15 miles below the Parr Shoals dam). Overall, the most common fish collected were redbreast sunfish, whitefin shiner, and silver redhorse (Bettinger et al. 2001). No exotic species or nuisance species were collected, and no federally listed species were collected. Live native mussels were extremely rare, found only at a single station in the Bookman Island area (Bettinger et al. 2001). All native mussels found were of the genus *Elliptio*. Fish collections at a station 14 miles upstream of Parr Shoals dam (just upstream of the confluence of the Broad River and the Enoree River) were dominated by common centrarchids (e.g., redbreast sunfish and bluegill), notropids (e.g., whitefin shiner and spottail shiner), and ictalurids (e.g., snail bullhead and margined madtom). Because the surveys were intended to provide baseline information on unimpounded sections of the river (tailwaters of dams and reaches of river between dams), Parr Reservoir was not included in the surveys.

Monticello Reservoir Aquatic Communities

Contract biologists using gill nets and electrofishing gear collected 32 species of fish representing 8 families from Monticello Reservoir in 1983 and 1984 (Dames & Moore 1985, Table 2.8.10), the last two years that sampling was conducted in support of the station's CWA Section 316(a) Demonstration. The Monticello Reservoir fish community in 1983-1984 was dominated by centrarchids (55 percent of fish captured) and clupeids (28 percent of fish captured) (Dames & Moore 1985, p. 2.8-10). Smaller numbers of ictalurids (7 percent), catastomids (5 percent), and percids (3 percent) were also captured. The species composition and relative abundance of Monticello Reservoir fish changed very little from 1978 through 1984. In all preoperational and operational years, centrarchids ranked first in abundance and clupeids ranked second. There was no indication that VCSNS operations had an effect on fish populations in Monticello Reservoir.

Based on cove rotenone studies conducted by SCDNR in 1987, 1988, 1995, and 1996, the fish community of Monticello Reservoir remains reasonably balanced and diverse, comprised of warmwater species common to the southeastern U.S. (Nash, Christie, and Stroud 1990; Christie and Stroud 1996, 1997). Three catfish species (blue catfish, channel catfish, and white catfish) made up a substantial proportion (56 percent, by weight) of the reservoir's standing stock in 1996 and provided an important recreational fishery, particularly in summer months. Other species more traditionally regarded as gamefish (largemouth bass, black crappie, white bass) contribute less to the reservoir's standing stocks, but considerable angler effort is directed toward these species in winter, spring, and fall.

In addition to the fish species that are normally sought and harvested by anglers, Monticello Reservoir contains a variety of game and non-game species including clupeids (threadfin shad and gizzard shad, which provide important forage for predators), cyprinids (e.g., common carp, golden shiner, whitefin shiner), catastomids (e.g., silver redhorse, shorthead redhorse, river carpsucker), ictalurids (brown bullhead, flat bullhead, and snail bullhead), centrarchids (e.g., bluegill, redear sunfish, redbreast), and percids (yellow perch and tesselated darter) (Nash, Christie, and Stroud 1990; Christie and Stroud 1996, 1997). All of these species are common to ubiquitous in South Carolina streams, ponds, and reservoirs (Loyacano 1975; Lee et al. 1980; Bennett and McFarlane 1983; SCDNR 1995).

There have been a number of changes in the Monticello Reservoir fish community since VCSNS began operating in 1982, none attributable to station operations. Two species (blue catfish and white perch) that now make up a major portion of the recreational catch first appeared in SCDNR samples in 1995. These species may have been introduced by fisherman or transferred into Monticello Reservoir from Parr Reservoir by pump-back operations. The blue catfish in particular "exploded" in numbers and importance in the reservoir between 1995 and 1996 (Christie and Stroud 1997, pg. 25). In an annual report on the status of fisheries in SCDNR Region IV, Christie and Stroud (1997, pg. 28) voiced concern about the booming population of blue catfish in Monticello Reservoir, noting that Monticello Reservoir has a "...relatively low prey base..." and "the unfortunate introduction of blue catfish may lead to competition for forage between catfish and game species."

The white perch, a semi-anadromous species native to the southeastern coast, is regarded as a "pest" by many inland fisheries managers (SC Bass Federation 2000). It is a species known for its high reproductive potential (high fecundity rate and high hatching rate), slow rate of growth, and long lifespan (up to 17 years), characteristics that tend to create crowded populations of stunted white perch in reservoirs (Wisconsin Sea Grant 1999; SAREP 2000). White perch are known to depress populations of other, more desirable gamefish species, such as walleye and white bass, by competing for limited forage and by feeding heavily on walleye and white bass eggs (Wisconsin Sea Grant 1999).

A number of other fish species (brook silverside, swallowtail shiner, and green sunfish) appeared for the first time in SCDNR's Monticello Reservoir cove rotenone samples in 1995 (Christie and Stroud 1996, pg. 19). These species were known to occur in other waterbodies in the Santee-Cooper drainage basin (which includes the Broad River), but had not been collected previously in Monticello Reservoir by SCDNR. None of these species is expected to have a noticeable effect on the reservoir's fisheries, beyond some minor contribution to the forage base.

Although somewhat less productive than other, older reservoirs in the region, Monticello Reservoir continues to provide fishermen in the South Carolina Midlands and Upstate with a variety of fishing opportunities. Roving creel surveys in 1997-1998 and 1998-1999 that included interviews of selected anglers revealed that roughly half (51 percent in 1997-98; 42 percent in 1998-99) of all fishing effort in Monticello Reservoir was directed at catfish (Christie and Stroud 1999, pp. 20-28). Less effort was expended fishing for black crappie (15 percent in 1997-98; 5 percent in 1998-99), largemouth bass (12 percent in 1997-98; 10 percent in 1998-99), and other species (bluegill, carp, white bass, white perch). The creel surveys indicated that fishing effort (number of hours fished per annum) had increased substantially since the late 1980s. They also showed that fishing pressure (hours fished per acre) was lower on Monticello Reservoir than on other reservoirs in the region (Christie and Stroud 1999, Table 17).

Excluding blue catfish and white perch, both apparently introduced by fishermen, no undesirable non-native fish species appeared in Monticello Reservoir after it was created and no nuisance species appeared to be favored by its operational thermal regimes. There have been no outbreaks of disease, beyond the occasional appearance of *Aeromonas* (*Aeromonas hydrophila*; a bacterium) infections in spawning largemouth bass in the spring. These fish, already stressed by spawning, appeared to have been caught and released by anglers. Handling further stressed these fish and removed protective slime/mucous coating, which resulted in *Aeromonas* infection.

In the late 1980s, a number of limited fish kills (generally involving small catfish) occurred in the VCSNS discharge bay in late summer and early fall. SCE&G set up a monitoring program to help identify the cause of the fish kills. Investigations revealed that the fish kills were associated with relatively high discharge temperatures and Monticello Reservoir drawdowns (through the operation of FPSF). It was determined that reservoir drawdown reduced the inflow of cooler water (from the main body of the reservoir) along the bottom of the discharge canal and into the discharge bay. Reduction or loss of this inflow allowed water temperatures to rise rapidly and kill fish inhabiting the discharge bay. Since the reservoir level was subject to daily fluctuation with the operation of FPSF, fish kills recurred as high reservoir levels (following pumpback operations) allowed more cool water inflow and recolonization of the discharge canal and bay.

SCE&G took several actions over the 1991–1993 period to reduce the frequency and severity of fish kills (SCE&G Environmental Services 1994, pg. 2). In 1991, an elevated area (an old roadbed) was removed from the discharge canal by dredging. This initially appeared to have ameliorated the fish kills, but a major fish kill in August 1992 indicated that removal of the roadbed had not completely solved the problem. In September 1992, Monticello Reservoir drawdown was limited to 422.5 feet mean sea level to prevent further fish kills.

SCE&G dredged the entire length of the discharge canal in July and August of 1993 to allow more cool water inflow at low reservoir levels. The dredging of the discharge canal altered circulation patterns and increased cool water inflow such that temperature at the bottom of the discharge bay in summer remained significantly (10 to 15 degrees) cooler than "end-of-pipe" discharge temperatures (SCE&G Environmental Services 1996, Figure 2). Fish kills ceased once the dredging of the discharge canal was completed. The discharge bay and canal were monitored intensively over the summers of 1994 and 1995, and no fish kills were observed (SCE&G Environmental Services 1996, pg. 3). None have been observed since that time.

The *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS) (NRC 1996, pg. 4-57) briefly discusses the fish kills in the VCSNS discharge bay and mentions SCE&G's investigations on the specific causes of the kills. It concludes that "these fish kills were localized; they do not appear to have had any adverse effect on the cooling pond (fish) population."

Monticello Subimpoundment Aquatic Communities

Monticello Reservoir is a 6,500-acre impoundment. However, it is hydrologically connected (by a conduit that passes under the Highway 99 causeway) to a smaller 300-acre body of water known as the Monticello Subimpoundment (Figure 2-2). This smaller subimpoundment is managed for recreational boating and fishing by SCE&G and SCDNR. SCE&G maintains the property, which includes boat launch, swimming, and picnic facilities; SCDNR manages the subimpoundment's fisheries by setting creel and size limits on fish. Fishing is permitted on Wednesdays and Saturdays only.

Surveys of the subimpoundment's fishery were last conducted in 1984 (Dames & Moore 1985). At that time, the fish community of the subimpoundment was characterized by relatively low species richness (12 species collected in 1983 and 1984), with collections dominated by gizzard shad and centrarchids (e.g., bluegill, redear sunfish, black crappie, and largemouth bass) (Dames & Moore 1985, pg. 2.8-8 and Figure 2.8-24). The Monticello Subimpoundment continues to be a popular fishing spot for local fishermen.

Sec 2.4 Ref 41

SCEG-038

Threatened and Endangered Species Field Survey

V.C. Summer Nuclear Station

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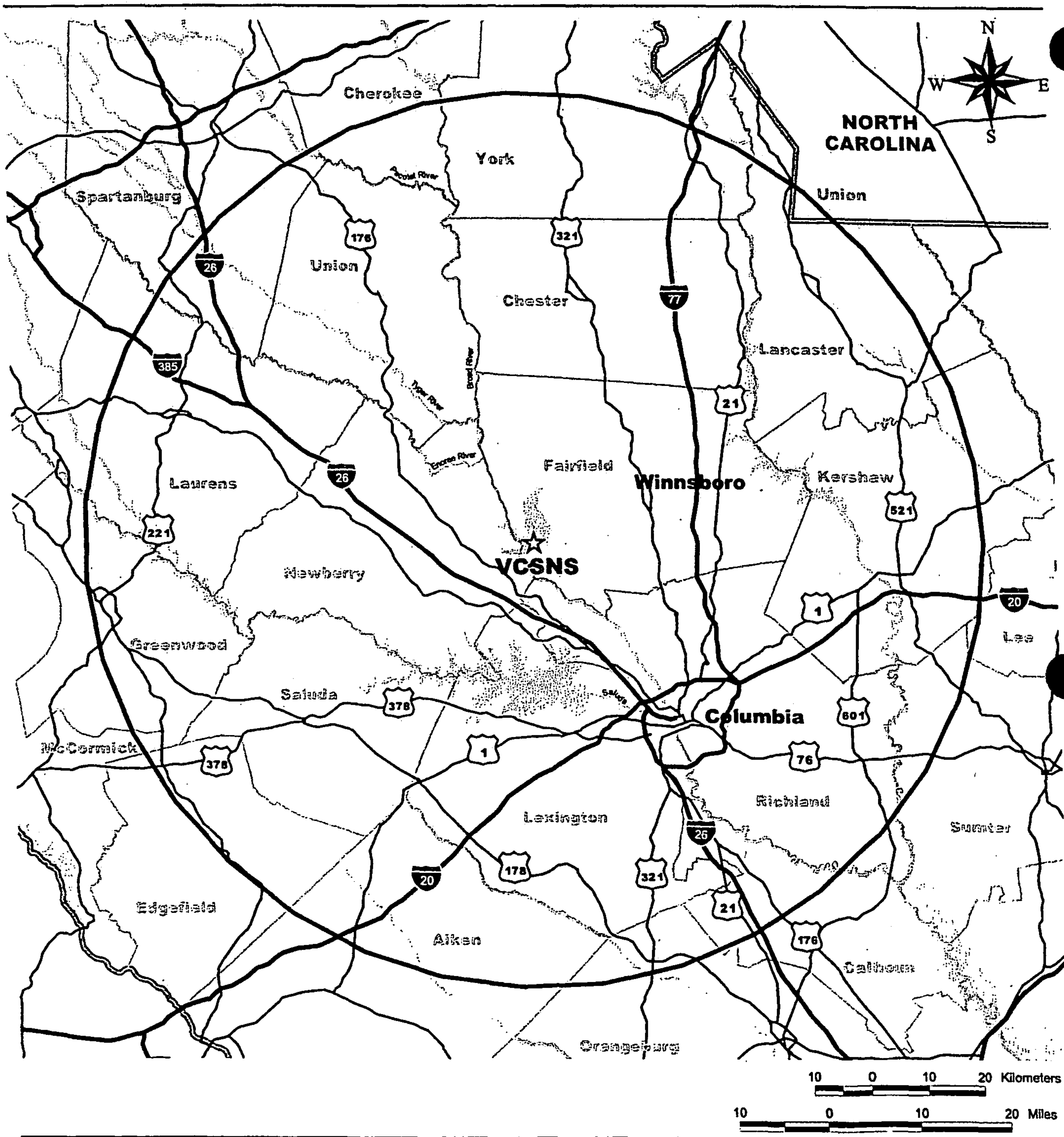
1.0 INTRODUCTION

In preparing for renewal of its operating license, V.C. Summer Nuclear Station (VCSNS) assessed a wide variety of potential impacts, including those to ecological resources, in an Environmental Report that was submitted to the U.S. Nuclear Regulatory Commission (NRC) on August 6, 2002 as part of a License Renewal Application. This *Threatened and Endangered Species Field Survey* presents the results of field surveys of the VCSNS site and associated transmission corridors conducted in late-spring (May) and summer (June, July, and August) 2002 to update information in the Environmental Report on ecological resources, emphasizing threatened and endangered species. Information obtained during the surveys will be used by the NRC in its assessment of the potential impact of VCSNS operation over the license renewal term on threatened and endangered species.

VCSNS is located in Fairfield County, South Carolina, approximately 15 miles west of the county seat of Winnsboro and 26 miles northwest of Columbia (Figure 1-1). The site is in a sparsely-populated, largely rural area, with forests and small farms comprising the dominant land use. The Broad River flows in a northwest-to-southeast direction approximately one mile west of the site and serves as the boundary between Fairfield County (to the east) and Newberry County (to the west).

VCSNS lies on the south shore of Monticello Reservoir (Figure 1-2), a 6,500-acre impoundment that serves as its cooling water source and heat sink. Monticello Reservoir was formed by damming Frees Creek, a small tributary of the Broad River that flowed into Parr Reservoir about 1.2 miles upstream of the Parr Shoals dam. Monticello Reservoir was designed to serve both as a cooling pond for VCSNS and the upper pool for the Fairfield Pumped Storage Facility, with Parr Reservoir serving as the lower pool.

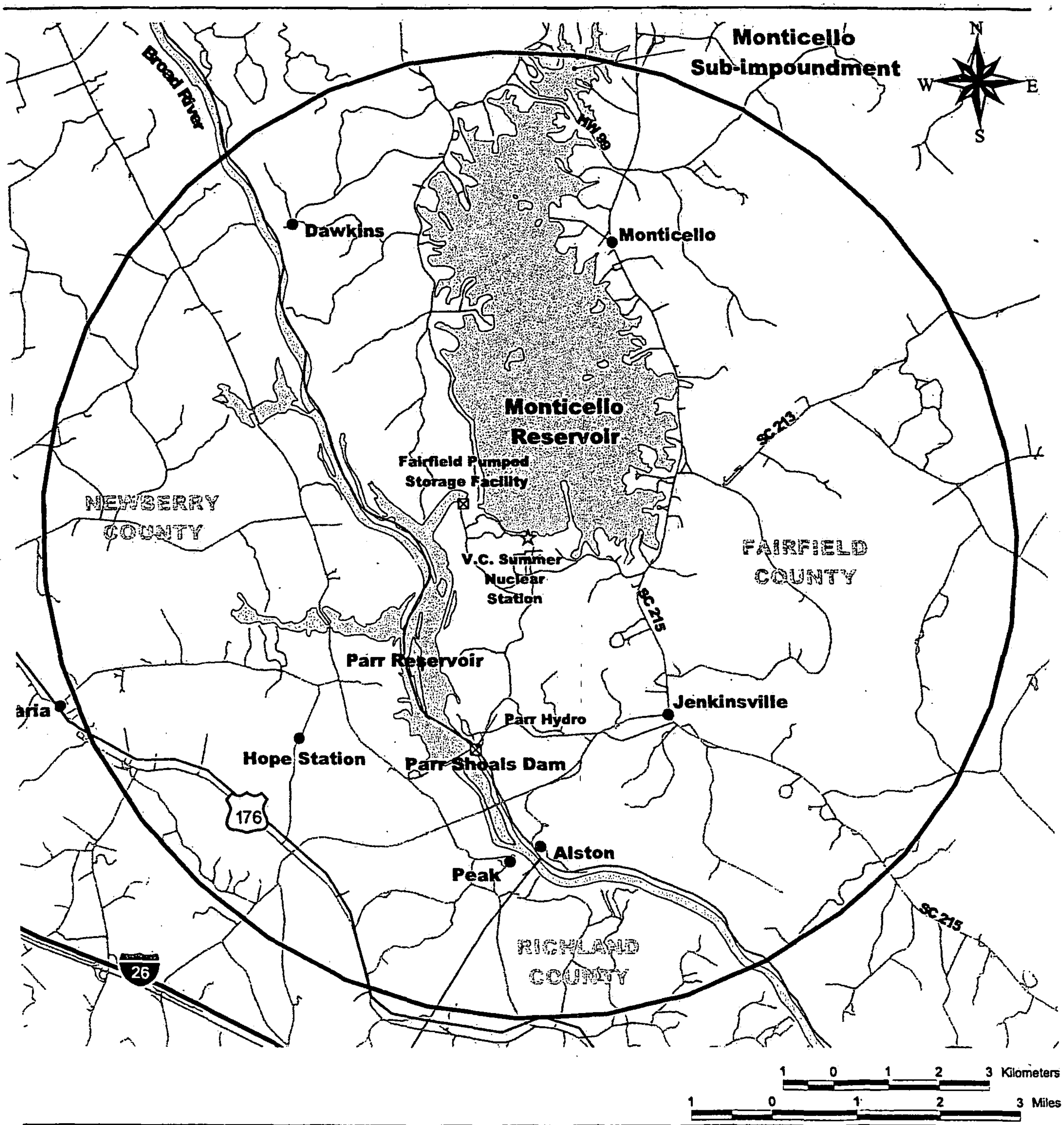
VCSNS is a single-unit pressurized water reactor plant with a once-through heat dissipation system. SCE&G operates VCSNS in accordance with NRC Operating License NPF-12, which expires August 6, 2022. VCSNS is a joint project between SCE&G, operator and two-thirds owner of the plant, and the South Carolina Public Service Authority (commonly referred to as "Santee Cooper"), owner of the remaining third.



LEGEND

- V.C. Summer Nuclear Station
- 50 mile radius of V.C. Summer
- Interstates
- Major roads
- County Boundaries
- State Boundary
- Lakes and Rivers

FIGURE 1-1
V.C. Summer Nuclear Station,
50-Mile Locational Vicinity Map



LEGEND

- Six mile radius of V.C. Summer
- Interstates
- Major roads
- Minor roads
- County Boundaries
- Lakes and Rivers

FIGURE 1-2
V.C. Summer Nuclear Station,
6-Mile Vicinity Map

Data from this survey will support the environmental documentation required by NRC (10 CFR 51.53) that was submitted with the license renewal application. The purpose of the survey is broader, however, than the satisfaction of NRC requirements, which require applicants to assess potential impacts of the proposed action {license renewal} on only federally-listed species. As explained in Section 4.0 of this document, state-listed species are also included in accordance with SCE&G's corporate commitment to environmental stewardship. The following sections describe the survey area, present a "target list" of species of interest, describe survey techniques, discuss the results of the surveys, and suggest some factors that may influence the distribution and abundance (or absence) of special-status species in the survey area. The "survey area" is defined as the VCSNS site and associated transmission corridors leading to each corridor's first substation.

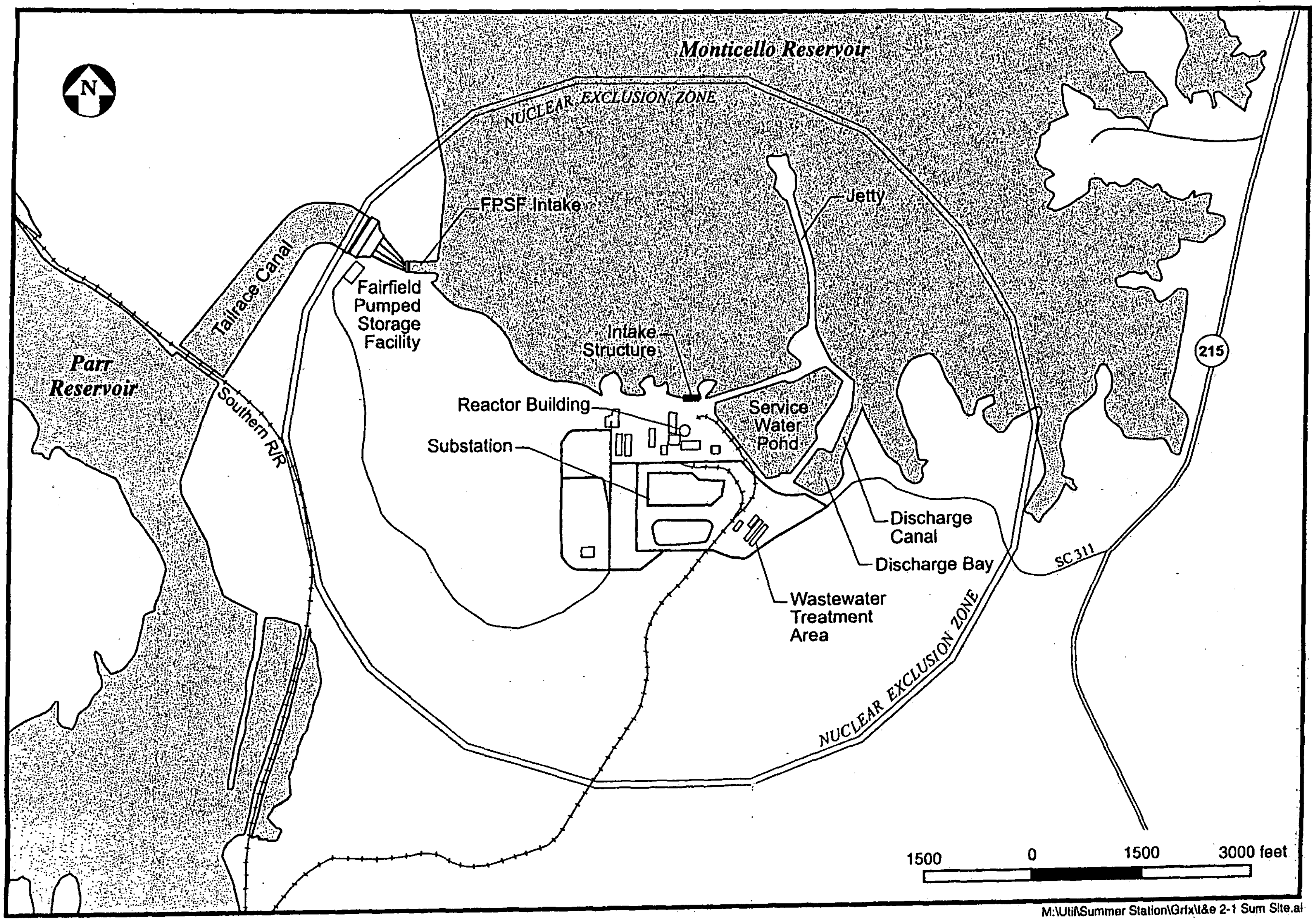
2.0 SITE DESCRIPTION

The VCSNS site covers approximately 2,200 acres, an area that includes portions of Monticello Reservoir and Fairfield Pumped Storage Facility (FPSF) (see Figure 2-1). Based on an examination of aerial photographs, approximately 860 of the 2,200 acres are covered by the waters of Monticello Reservoir. Approximately 370 acres consists of generation and maintenance facilities, warehouses, laydown areas, parking lots, roads, and mowed grass. Some 125 acres are dedicated to transmission line rights-of-way. However, much of the VCSNS property consists of forested areas (approximately 890 acres). The primary terrestrial habitats at VCSNS are pine forest, deciduous forest, and mixed pine-hardwood forest. The pine forests at VCSNS include planted pines and naturally vegetated pines. Most of the deciduous forests at the site are located along stream bottoms and on surrounding slopes. Streamside management zones at the site are protected in accordance with Best Management Practices established by the South Carolina Forestry Commission.

Forested areas within the 2,200-acre VCSNS site are managed by SCANA Services' Forestry Operations group, but timber is not routinely harvested. Timber has been harvested in the past to remove diseased trees and trees damaged by tornadoes and windstorms. Once timber is removed, these areas are replanted with tree species appropriate to the terrain, soils, and drainage characteristics of a site. Dry upland areas are normally replanted in improved loblolly pine.

Parr Reservoir, just west of the VCSNS site, provides some limited freshwater marsh habitat in shallow backwaters, around low-lying islands, and in an area east of the FPSF tailrace that was used in the 1970s for the disposal of dredge spoil (Figure 2-1). These marshes and adjacent shallows are used by migrating dabbling ducks, including mallard, black duck, and teal. Monticello Reservoir and its subimpoundment also provide resting areas for wintering waterfowl and provide year-round habitat for non-migratory Canada geese. SCE&G has been recognized by the South Carolina Wildlife Federation for its efforts in establishing a self-sustaining, non-migratory population of Canada geese on Parr and Monticello Reservoirs.

Terrestrial wildlife species found in the forested portions of the VCSNS property are those typically found in the Piedmont forests of South Carolina. Wildlife characteristically found in the pine forests and mixed pine-hardwoods of the Piedmont include toads (e.g., Fowler's toad), lizards (e.g., Carolina anole, fence lizard, various skinks), snakes (e.g., black racer, rat snake, ringneck snake), songbirds (e.g., cardinal, bluejay, towhee, various warblers), birds of prey (e.g., red-tailed hawk, red-shouldered hawk), and a number of mammal species (e.g., gray squirrel, eastern cottontail, raccoon, white-tailed deer).



M:\Util\Summer Station\Grfx\t&e 2-1 Sum Site.ai

Figure 2-1. South Carolina Electric & Gas Company, Virgil C. Summer Nuclear Station Site Area Map.

3.0 TRANSMISSION CORRIDORS

SCE&G built eight transmission lines for the specific purpose of connecting Summer Station to the regional transmission system. Two additional transmission lines were built by Santee Cooper, one-third owner of VCSNS, to connect the station to the regional grid. A pre-existing Duke Power Company line crosses the VCSNS site, but does not connect to the VCSNS switchyard or the SCE&G transmission system.

Beginning at VCSNS, the SCE&G transmission lines generally run in a southerly direction, with five terminations very near Summer Station, one near Aiken, South Carolina, and two near Columbia, South Carolina (see Figure 3-1). The Santee Cooper lines run approximately east and west to substations near Blythewood and Newberry, South Carolina, respectively. Originating in Fairfield County, the SCE&G and Santee Cooper transmission lines run through five other South Carolina counties: Aiken, Edgefield, Newberry, Saluda, and Richland.

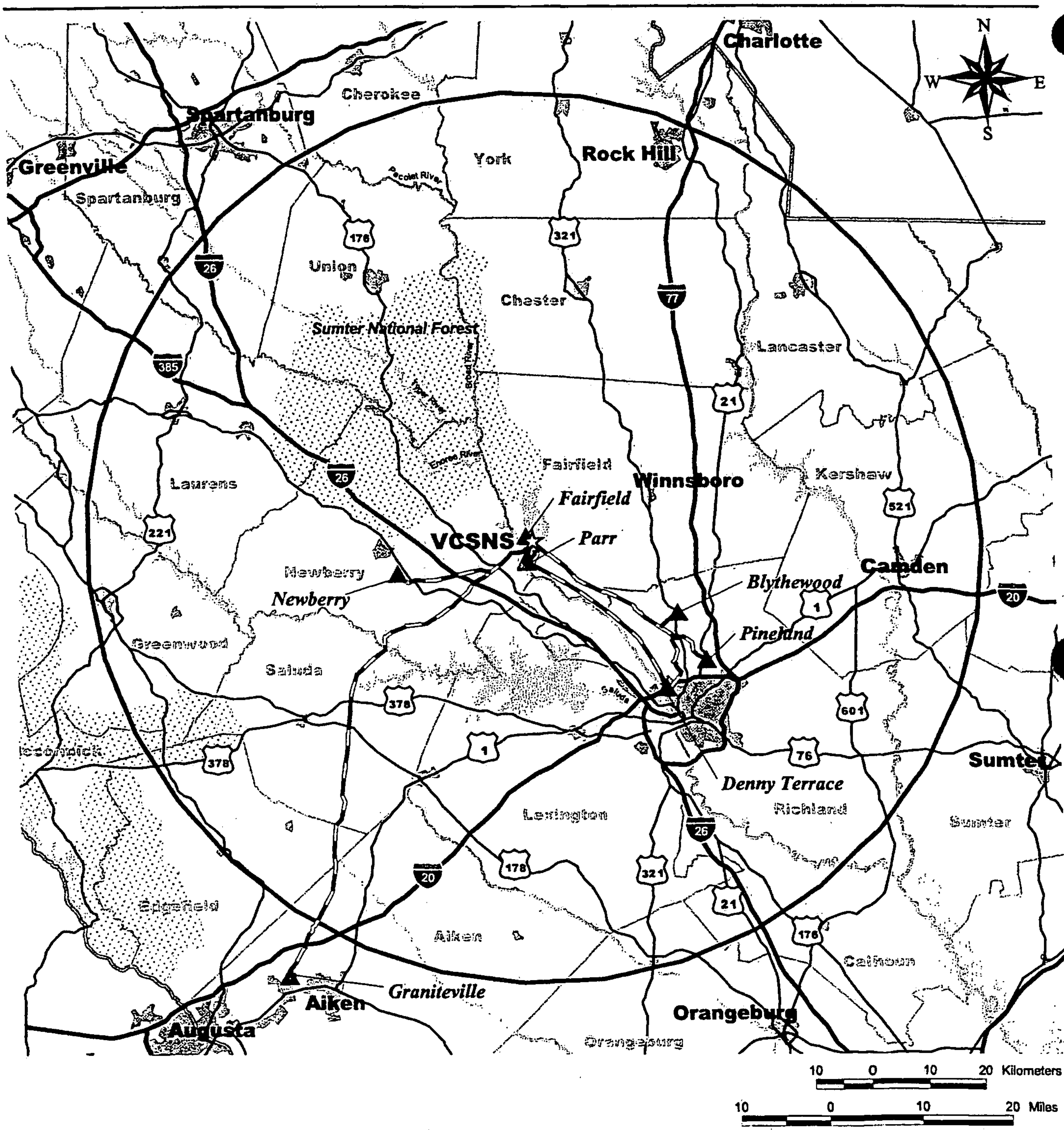
The list below identifies the transmission lines by the name of the substation (or other structure) at which each line connects to the overall electric grid. The accompanying paragraphs provide other features of the transmission lines, including voltage, right-of-way width and length, and presence of other lines in the right-of-way.

- Summer-Parr No. 1 and No. 2 – These two SCE&G lines, which occupy the same 240-foot right-of-way to the Parr Substation, operate at 230 kilovolts (kV). The lines' lengths are each 2.3 miles. For approximately 0.5 mile, these lines share the corridor with the Graniteville line and Santee Cooper's Newberry line.

- Summer-Fairfield No. 1 and No. 2 – These two 230-kV lines provide power to and from SCE&G's Fairfield Pumped Storage Facility. The lines are only 1 mile long and occupy a 170-foot, wholly-owned corridor.

- Summer-Denny Terrace No. 1 – This 2.5 mile, 230-kV tie line connects Summer Station to the Denny Terrace No. 1 line near Parr, South Carolina, well north of the Denny Terrace substation. The line was built by SCE&G and occupies a 100-foot right-of-way.

- Summer-Pineland No. 1 – This SCE&G line provides power at 230-kV to the Pineland Substation six miles northeast of Columbia. The right-of-way width is 240 feet for the approximately 18 miles that the line shares the corridor with the Denny Terrace No. 2 line and then 100 feet for



LEGEND

- V.C. Summer Nuclear Station
- Substations
- Transmission Lines
- 50 mile radius of V.C. Summer
- Interstates
- Major roads
- County Boundaries
- State Boundary
- Lakes and Rivers
- National Forests
- Major Urban Areas

FIGURE 3-1
V.C. Summer Nuclear Station, 50-Mile Transmission Line Map

the remaining 5.5 miles. Santee Cooper's Blythewood line parallels this line for approximately 17 miles.

- Summer-Denny Terrace No. 2 – This 230-kV SCE&G line to the Denny Terrace substation two miles north of Columbia follows the Pineland corridor for approximately 18 miles and then continues for approximately 7 miles in a 100-foot right-of-way. Santee Cooper's Blythewood line parallels this line for 17 miles.

- Summer-Graniteville – This SCE&G line provides 230 kV of power to the Graniteville Substation. The line is 62.5 miles long. For the first 0.5 mile, it runs with the Newberry and Summer-Parr No. 1 and No. 2 line. Then for 2.5 miles it parallels the Newberry line. For the remaining 59.5 miles, it is the sole occupant of the corridor. The right-of-way width is 170 feet as far as the Broad River and then 100 feet to Graniteville.

- Summer-Blythewood – The Blythewood line is owned by Santee Cooper. It is a 230-kV line that runs for approximately 20 miles, sharing the corridor with the Summer-Pineland and the Denny Terrace No. 2 lines for the first 17 miles. For the remaining 3 miles, the right-of-way is 100 feet.

- Summer-Newberry – This Santee Cooper line, which is approximately 18 miles long, operates at 230 kV and provides power to the Newberry Substation. For the first 0.5 mile, it shares the corridor with the Summer-Parr No. 1 and No. 2 and the Graniteville lines. For the next 2.5 miles it shares the corridor with the Summer-Graniteville line. For the remaining 15 miles, it occupies the 100-foot right-of-way alone.

In total, for the specific purpose of connecting VCSNS to the transmission system, SCE&G and Santee Cooper have constructed approximately 160 miles of transmission lines (120 miles of corridor) that occupy approximately 2,000 acres of corridor. The areas are mostly remote, with low population densities. The longer lines cross numerous state and U.S. highways, including I-26 and I-20. SCE&G and Santee Cooper plan to maintain these transmission lines, which are integral to the larger transmission system, indefinitely. These transmission lines are expected to remain a permanent part of the regional transmission system after Summer Station is decommissioned.

Most of the transmission corridors are situated within the Piedmont Physiographic Region, but the southernmost portions of the Summer-Graniteville, Summer-Denny Terrace No. 2, and Summer-Pineland corridors are situated within the Sandhills Physiographic Region. Most of the areas crossed by the transmission corridors are forestlands or agricultural lands (in pasture or row crops). Forest habitats along transmission corridors consist primarily of pine forest, pine-hardwood forest, and bottomland hardwood forest. Transmission corridors that run west from VCSNS cross more agricultural lands (mostly pasture) than corridors that run to the east. Conversely, corridors that run to the east cross more forested lands and residential areas (northern suburbs of Columbia) than corridors that run to the west.

No areas designated by the U.S. Fish and Wildlife Service (FWS) as "critical habitat" for endangered species occur at VCSNS or adjacent to associated transmission lines. In addition, the transmission corridors do not cross any state or federal parks, wildlife refuges, or wildlife management areas.

The transmission corridors are maintained by mowing, trimming of undesirable vegetation from the sides of the corridors, and by use of approved herbicides. Under normal circumstances, the mowing and herbicide schedule follows a three-year cycle. Trees are "side-trimmed" every 10 years by helicopters carrying hydraulically operated saws. Aerial patrols of transmission corridors are conducted four times a year by SCE&G and twice a year by Santee Cooper. Dead and diseased trees at the edges of corridors are removed if it appears that they could fall and strike the transmission lines or support structures.

Periodic mowing in dry, upland portions of transmission corridors creates sunny, open conditions favorable for plants and animals normally found in fire-maintained ecosystems, such as successional grasslands and longleaf pine-wiregrass communities. Rare species found in these fire-maintained ecosystems in the southeastern U.S. include the smooth coneflower (*Echinacea laevigata*) and the gopher tortoise (*Gopherus polyphemus*). Permanent and seasonal wetlands along transmission corridors hold potential for harboring a number of other plant species currently listed by the FWS and South Carolina Department of Natural Resources (SCDNR), including the rough-leaved loosestrife (*Lysimachia asperufolia*) and Canby's dropwort (*Oxypolis canbyi*). Wetlands also provide habitat for several listed animal species, and some species (e.g., the wood stork) are found only in wetlands. Many animal species, however, are highly mobile and utilize more than one habitat type. The transmission corridors provide an open canopy and offer an abundance of herbaceous ground cover. Thus, they can be natural avenues for movement and foraging by some animals.

SCE&G and Santee Cooper participate with the U.S. Department of Agriculture–Natural Resources Conservation Service, SCDNR, and other organizations in a wildlife management program for transmission line corridors. The "Power for Wildlife" program is designed to help landowners whose property is crossed by transmission lines convert transmission corridors into productive habitat for wildlife. The program offers grant money and wildlife management expertise to landowners who commit to participating in the program for five years.

4.0 METHODOLOGY

4.1 Species of Interest

For actions such as issuing permits and licenses, NRC has responsibility under the Endangered Species Act (50 CFR 17.11 and 17.12) to review such actions to determine whether they may jeopardize the continued existence of federally listed species or their habitats. The term "listed species" as used in this report includes the following:

- Species that the U.S. Fish and Wildlife Service (FWS) has listed as threatened or endangered in accordance with the Endangered Species Act. The U.S. Fish and Wildlife Service maintains (and frequently updates) lists of threatened and endangered species on the Endangered Species Program web (internet) site at http://endangered.fws.gov/wildlife.html.

- Species that the FWS has proposed for listing or made a candidate for listing under the Endangered Species Act. Lists of proposed and candidate species are also on the Endangered Species Program web (internet) site at http://endangered.fws.gov/wildlife.html.

- Species that the South Carolina Department of Natural Resources (SCDNR) Heritage Trust Program has listed as threatened or endangered. SCDNR maintains the "South Carolina Rare, Threatened & Endangered Species Inventory" (including county lists) on its website at http://www.dnr.state.sc.us/etc/conservation.html.

4.2 Target Species

Before going into the field, project biologists conducted a literature review to identify species known to occur in the counties crossed by VCSNS transmission lines. Previous research for the VCSNS Environmental Report (submitted to the NRC in August 2002) had shown that only one listed species, the bald eagle, was known to occur on the VCSNS site and there were no records of threatened and endangered species occurring along the station's transmission corridors. The state and federally listed species known to occur in the counties crossed by VCSNS-associated transmission corridors are shown in Table 4-1. This list was based largely on information received from the FWS (see list, Appendix A, sent to SCE&G), the SCDNR Heritage Trust Program (see letter and list, Appendix A, sent to SCE&G), and the Heritage Trust Program's protected database.

Although this species list was based primarily on information obtained from the FWS and SCDNR, a number of other sources and authorities were consulted, including *Manual of the Vascular Flora of the*

Carolinas (Radford et al. 1973), *Endangered, Threatened, and Rare Vascular Flora of the Savannah River Site* (Knox and Sharitz 1990), *Amphibians and Reptiles of the Carolinas and Virginia* (Martof et al. 1980), *Guide to the Reptiles and Amphibians of the Savannah River Site* (Gibbons and Semlitsch 1991), *South Carolina Bird Life* (Sprunt and Chamberlain 1970), and *Mammals of the Savannah River Site* (Cothran et al. 1991).

Table 4-1 was intended to serve as a "target list," focusing the efforts of the field personnel. It was not, however, intended to restrict the survey's scope to only these species. Any rare or unusual species encountered in the field was identified and characterized (its rarity and regulatory status determined), ensuring that previously unrecorded species were not overlooked.

Two state- and federally-listed aquatic species have been recorded in counties crossed by VCSNS transmission lines, but could not be affected by Station operations or transmission line maintenance over the license renewal term. The shortnose sturgeon (*Acipenser brevirostrum*), which SCDNR lists as occurring in Aiken County, is found in the Savannah River, which is not crossed by VCSNS transmission lines. Small numbers of shortnose sturgeon may also ascend the Congaree River from Lake Marion, but are blocked from entering the Broad River by a hydroelectric facility (Columbia Hydro) in Columbia. The Carolina heelsplitter (*Lasmigona decorata*), a freshwater mussel, is found in Turkey Creek and two of its tributaries in the Sumter National Forest in western Edgefield County. The Summer-Graniteville transmission line crosses a very small portion of eastern Edgefield County (see Figure 3-1), more than 15 miles from Turkey Creek and its tributaries. As a consequence, these and other aquatic species were not a part of the survey.

Table 4-1. Federal- and State-Listed Terrestrial Species Identified in S.C. Counties Crossed by VCSNS-associated Transmission Corridors.

Species		Federal status	State status	Habitat	County
Common name	Scientific name				
Mammals					
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	---	Endangered	Found in forested areas, especially pine flatwoods and pine-oak woodlands. Roosts in hollow trees, under bark, in old cabins and barns, and in wells and culverts.	Aiken, Richland
Birds					
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Endangered	Commonly observed foraging around large Piedmont and Coastal Plain rivers and reservoirs. More than one hundred nesting pairs in South Carolina.	Aiken, Edgefield, Fairfield, Newberry, Saluda
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered	Nest in mature pine with low understory vegetation (<1.5m); forage in pine and pine hardwood stands > 30 years of age, preferably > 10" diameter at breast height	Aiken, Edgefield, Richland, Saluda.
Wood stork	*Mycteria americana*	Endangered	Endangered	Wood storks from the Birdsville Colony (near Millen, Georgia) feed in shallow wetlands on the Savannah River Site and at foraging ponds constructed at the National Audubon Society's Silver Bluff Sanctuary.	Aiken
Reptiles					
Gopher tortoise	*Gopherus polyphemus*	---	Endangered	Well-drained, sandy soils in forest and grassy areas; often associated with pine overstory, open understory with grass and forb groundcover, and sunny areas for nesting.	Aiken
Spotted turtle	*Clemmys guttata*	---	Threatened	Swamps, small streams, shallow ponds.	Aiken
American alligator	*Alligator mississippiensis*	Threatened (similarity of appearance)	Threatened	Swamps, ponds, lakes, slow moving streams and rivers.	Aiken, Richland
Amphibians					
Pine barrens treefrog	*Hyla andersonii*	---	Threatened	Swamps, streams, and acid bog areas	Richland

Table 4-1. Federal- and State-Listed Terrestrial Species Identified in S.C. Counties Crossed by VCSNS-associated Transmission Corridors (continued).

Species		Federal	State		
Common name	Scientific name	status	status	Habitat	County
Webster's salamander	*Plethodon websterii*	---	Endangered	North-facing slopes of moist, shaded hardwood forests in Piedmont with rock outcrops.	Edgefield, Saluda
Carolina gopher frog	*Rana capito capito*	---	Endangered	Upland, xeric areas used as shelter; seasonally flooded shallow ponds used as breeding habitat.	Aiken
Mollusk					
Carolina heelsplitter	*Lasmigona decorata*	Endangered	Endangered	Small-to-large streams in Piedmont with stable, shaded banks and clean sand or gravel bottoms.	Edgefield
Fish					
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered	Endangered	Large, sluggish coastal rivers and estuaries, but moving upstream in early spring to spawn in faster-flowing freshwater reaches.	Aiken
Plants					
Pool sprite	*Amphianthus pusillus*	Threatened	Threatened	Shallow vernal depressions and pools (less than 1 foot deep) assoc. with granite outcrops where water collects after rains. Piedmont.	Saluda
Georgia aster	*Aster georgianus*	Candidate	---	Open woodland borders, roadsides, in utility rights-of-way. Conspicuous, closely related to the common *Aster patens*, known to occur in study area.	Edgefield, Fairfield, Richland
Smooth coneflower	*Echinacea laevigata*	Endangered	Endangered	Meadows, open woodlands, roadsides. Most often found on circumneutral soils throughout its range (and in S.C. upstate), but may occur on sandy, acidic soils in Richland County (Fort Jackson).	Aiken, Richland

Table 4-1. Federal- and State-Listed Terrestrial Species Identified in S.C. Counties Crossed by VCSNS-associated Transmission Corridors (continued).

Species		Federal	State		
Common name	Scientific name	status	status	Habitat	County
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	Endangered	Endangered	Sandhills seepage bogs in S.C. midlands; one known population at Fort Jackson. Appears to be dependent on periodic fires.	Richland
Canby's dropwort	*Oxypolis canbyi*	Endangered	Endangered	Carolina bays. Rarely (in S.C.) elsewhere.	Richland
Harperella	*Ptilimnium nodosum*	Endangered	Endangered	Variable. In the northern part of its range, occurs on rocky river shoals. In the southern part of its range, including S.C., more likely to be found in Carolina bays.	Saluda
Relict trillium	*Trillium reliquum*	Endangered	Endangered	Mature, moist hardwood forests; in the Piedmont, found in either in rich ravines or adjacent alluvial terraces over mafic rock and/or circumneutral soils. In S.C., found only in certain stream bottoms along the Savannah River.	Aiken, Edgefield

5.0 SURVEY TECHNIQUES

The undeveloped portions of the VCSNS site were surveyed on foot. The transmission corridors, because of their size, were surveyed by concentrating efforts in areas offering the greatest potential for harboring listed species. Areas of interest were identified using USGS 7.5 minute topographic maps, county soil maps, and aerial photographs prior to conducting ground surveys. This initial "desk-top" survey allowed biologists to rapidly eliminate from consideration cropland, pastures, and other areas of poor quality habitat for listed species. Following this phase of the survey, biologists drove to areas of potential interest and conducted surveys on foot. The survey of the VCSNS site was conducted in late May 2002. Surveys of the corridors were conducted over the May-August 2002 period.

5.1 Plants

The VCSNS site contains substantial acreage of intact forestland (exclusive of planted pines), and an attempt was made to visit all forested sites, especially those featuring steep topography and stream drainages, since these would be expected to support the highest diversity of vascular species. Similarly, portions of transmission corridors with intact forests on one or both sides were presumed most likely to harbor rare plants.

A total of 75 locations representing more than 60 miles of transmission corridor were surveyed on foot. As noted earlier, most these sites were chosen based on terrain features (from topo maps), soils (from county soil surveys), land use in the area (from aerial photographs), and existing vegetation (from aerial photographs). Other sites were added due to proximity to known populations of threatened and endangered species. Several access points were locked/gated and thus inaccessible; these sites generally feature pastureland that otherwise offer little in the way of habitat for rare species.

Enlarged topographic maps developed from United States Geological Survey (USGS) quadsheets (7.5 minute series) and a hand-held Global Positioning System (GPS) unit were used to record the locations of areas that were searched. Notes were taken at each area searched describing habitats and plant species present. Field surveys involved careful study of all vegetation in each target area. In the case of problematic genera, specimens were collected for further study and placed in a plant press. Specimens collected and preserved during this study are stored at the A.C. Moore Herbarium of the University of South Carolina.

Botanical surveys were performed by Dr. John Nelson. Dr. Nelson received his Ph. D. in Biological Sciences from Florida State University and has been on the faculty of the University of South Carolina since 1990. He is also Curator of the University of South Carolina's A.C. Moore Herbarium, and a recognized authority on the distribution and abundance of rare plants in South Carolina. He is widely known for his research on the taxonomy and ecology of the mint family (Lamiaceae). Prior to joining the University of South Carolina, Dr. Nelson worked as a Botanist with the Non-Game & Heritage Trust Section of the South Carolina Department of Natural Resources.

5.2 Animals

The surveys for birds, mammals, reptiles, and amphibians were designed to provide information on the occurrence and potential for occurrence of listed species at the VCSNS site and along the transmission corridors. Biologists conducted the survey of the VCSNS site by systematic walkover within all natural habitats, such that each habitat type was thoroughly searched. Surveys conducted along the transmission corridors were focused on areas identified, through the examination of aerial photographs and topographic maps, as providing potential habitat for listed animal species.

During each survey, wildlife species were identified through actual observations, as well as from tracks, scat, and birdcalls. Notes regarding species observed, as well as pertinent data regarding habitat quality, weather conditions, time of day, etc., were recorded in a field notebook. No trapping or other collecting activities were conducted, except where slow-moving reptiles or amphibians were captured by hand and released after identification. Because many animal species are mobile and secretive, the absence of a species during a survey is not necessarily conclusive evidence that the species does not use the area in question. Therefore, the *potential* for use of the VCSNS site and transmission corridors by listed wildlife species was also evaluated, based on the quality of habitats observed.

Wildlife surveys were conducted by Mike Whitten. Mr. Whitten has more than 12 years of experience as a wildlife biologist and ecotoxicologist. He currently serves as a Wildlife Biologist in the Aiken, South Carolina, office of Tetra Tech NUS, conducting wildlife surveys, habitat evaluations, and ecological risk assessments for government, commercial, and utility clients. He has managed or personally conducted studies in the midwest (Michigan and Indiana), middle-Atlantic (Pennsylvania, Maryland, and Delaware) and southeast (Alabama, Florida, Georgia, and South Carolina) that assessed the impacts of electric generating plants (both proposed and operational), transmission lines, gas pipelines and other development projects on threatened and endangered wildlife species. He has also advised government and utility clients on the management and protection of southeastern threatened and endangered species, including bald eagles, gopher tortoises, and red-cockaded woodpeckers.

6.0 RESULTS

6.1 VCSNS Site

As noted earlier, in Chapter 2.0, the VCSNS site is approximately 2,245 acres in area, with about 860 acres covered by the southern portion of Monticello Reservoir. Approximately 1,385 acres are high ground, but 370 acres of this total are committed to generating facilities, support facilities, warehouses, landscaped areas, parking lots, and mowed grass (Photo 1, Appendix B). Another 125 acres of the VCSNS site are maintained as power line rights-of-way. The remaining area, approximately 890 acres, is forested.

The forests at VCSNS are characteristic of Piedmont forests, with a variety of canopy types. Most of the canopies are dominated by loblolly pine, either alone (heavily manipulated, merchantable pine) or in mixed pine/hardwood stands, generally "second growth" forest. These canopy types are generally low in diversity of vegetation. The most botanically-interesting forest systems on the VCSNS site contain a mixture of hardwoods with scattered pines, loblolly pine being ubiquitous in all forested ecosystems. These hardwood forests are best developed on steep slopes, and tend to be the most mature forest systems present. Canopy size and tree age at VCSNS appear to be related to slope aspect: steep slopes were generally less used for cotton farming or cattle grazing prior to the 1960s, when much of the land was acquired. However, no forest on the VCSNS site can be considered a virgin or near-virgin stand. An overview of habitats and vegetation is herein provided from east to west within the one-mile nuclear exclusion zone, the area that defines the VCSNS site. Figure 6-1, which is adapted from an SCE&G Forest Inventory Map (Collins 2001), shows these habitats, as well as locations within the VCSNS site surveyed in May 2002.

Both sides of the main entrance road (SC Hwy 311) feature second-growth pine woods. The portion on the north side of the road (Site 1), essentially bounded by the nature trail, is a monotonous near-even age stand of loblolly pine, featuring a thick layer of straw litter, and with little diversity. Hardwoods present include red maple, winged elm, along with black cherry and sweet-gum. The reader is directed to Appendix C for scientific names of these and other plant species mentioned in the report. Few herbaceous species are present, but include burning Tragia, spotted wintergreen, and broomstraw.

The forest on the south side of the entrance road (Site 2) is somewhat more diverse, with scattered stands of American beech and American holly. Persimmon, red cedar, black gum, and sourwood are present as well. Numerous open gullies and eroded ravines are present; and the herbaceous vegetation is not diverse.

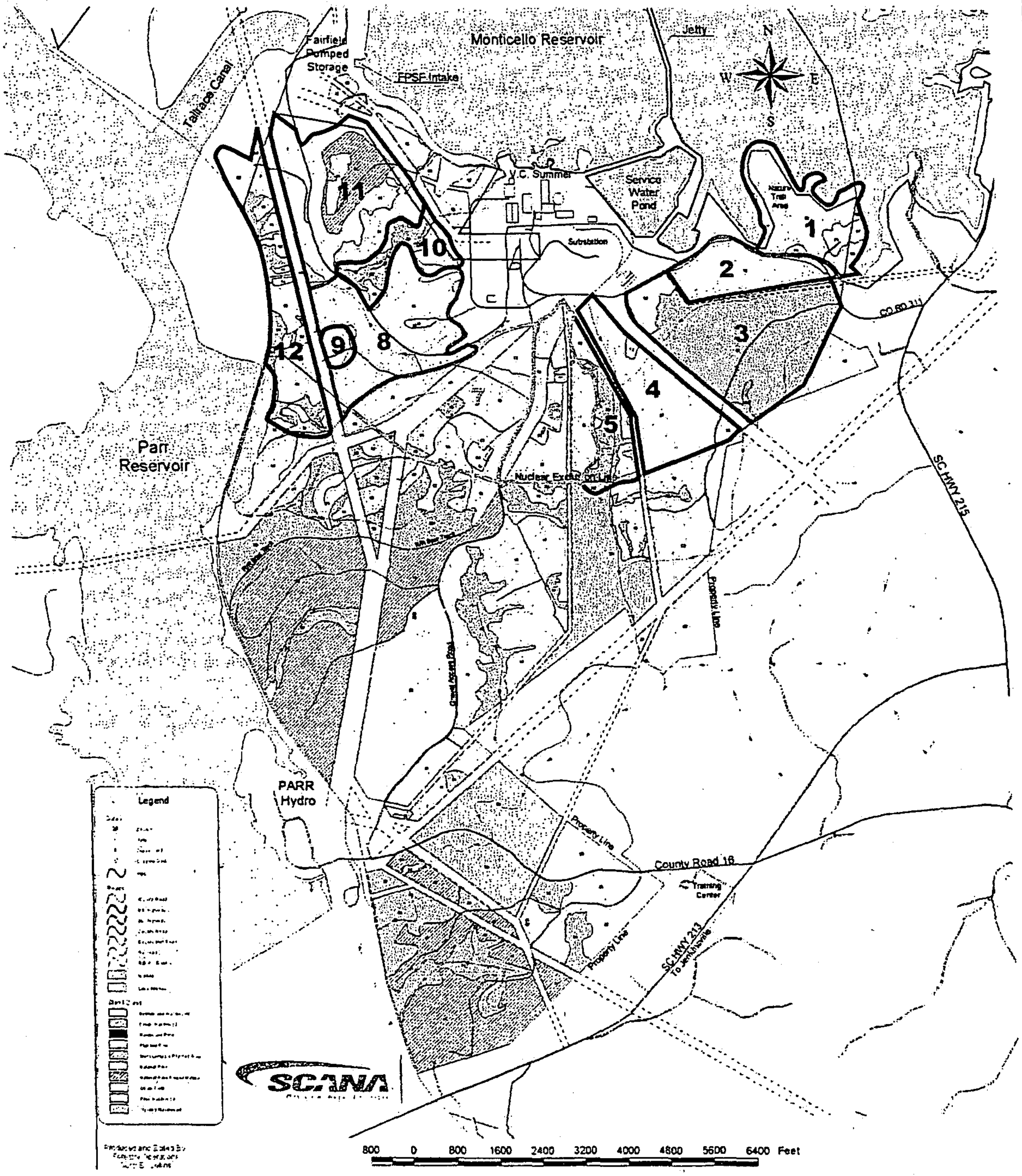


FIGURE 6-1
Timber Stands and Survey Sites, VCSNS

M:\Util\Summer Station\T&E species\6-1 TE Timber Survey.ai

The adjacent forest (Site 3) is considerably more diverse, featuring mixed-mesophytic hardwoods on a variety of aspects. Two narrow creek drainages (north and south) harbor a variety of flowering herbs, including Hepatica, golden alexander, sanicle, Christmas fern, and little nut-rush. The canopy contains white oak, southern red oak, black gum, with flowering dogwood an important component of the understory. Portions of the forest include a substantial amount of beech.

Sites 3 and 4 are separated by the Summer-Pineland transmission corridor. Site 4 is similar to Sites 1 and 2, featuring a canopy of loblolly pine with a mixture of red maple and sweet-gum. Sites 4 and 5 are separated by the Summer-Denny Terrace transmission corridor.

Site 5 occurs along a narrow north-south creek drainage, a portion of Mayo Creek. This site is diverse and relatively interesting botanically, and features a steep east-facing rocky slope dominated by hardwoods with a mixture of pines. Several spring-blooming species are present here, including wild geranium, windflower, and Hepatica. The bottom along the creek is characteristic of well-developed Piedmont stream systems (an active beaver dam is present), featuring mayapple, as well as a fairly large population of painted buckeye and beech. The fairly uncommon sedge, *Carex superata*, present here in some abundance, is sometimes an indicator of high-quality Piedmont forests.

Site 6 includes a manipulated pine stand and exhibits little botanical diversity.

Site 7 consists mostly of planted pine, with little diversity.

Site 8, which features a considerable mixture of hardwoods and pines, is bisected by an access road. American beech, yellow poplar, sweet-gum, and hop hornbeam are common canopy and midstory elements here. The most interesting portion of this site is along a central flank, featuring a steep northeast-facing slope, its relief about 100 feet, overlooking a narrow creek drainage (the creek flows northwest). The slope itself is visually quite impressive, featuring large trees in the canopy. Beech, red maple, white oak, southern red oak, and sourwood occur in the canopy, along with hornbeam, Florida maple, and redbud in the subcanopy. The herbaceous layer is relatively rich, including woods iris, black cohosh, sicklepod, windflower, snakeroot, cinnamon vine, spotted wintergreen, fragrant sumac, wood grass, wild ginger, sanicle, and desmodium. In addition, boggy ground along the creek bed supports Vietnam grass and *Carex crinita*, a distinctive sedge.

Site 9 is a high-ground (approximately 400 foot elevation) pine forest shown on the SCE&G Forest Inventory Map (Collins 2001) as "pine plantation." It merited attention because of its well-developed canopy and tall trees. The forest is clearly dominated by loblolly pine, with a reasonably diverse subcanopy of white oak, American holly, hop hornbeam, American ash, flowering dogwood, southern red oak, nanny-berry, persimmon, sparkleberry, and winged elm. Muscadine is common. The herb layer features a variety of species, including tickseed, golden alexander, and licorice goldenrod.

Site 10 occurs immediately west of the powerblock area. SCE&G's Forest Inventory Map (Collins 2001) indicates that this area is "Upland Hardwood," but most of it is dominated by a wetland. The steep slopes on the south side of the creek feature white oak and mockernut hickory along with loblolly pine. Florida maple is scattered throughout the area. Of some interest is a population of wild savory, the only one seen during the study. The wetland occurs along a narrow drainage flowing to the west-southwest. A large portion of this stream has been dammed by beavers. The beaver pond area is quite diverse, featuring smartweed, climbing hemp, sensitive fern, black willow, cattails, monkeyflower, swamp skullcap, bishop's weed, false nettle, and rushes. An old dam with a culvert is present downstream from the dam. Here the canopy is more closed, and the bottomland forest present is relatively shady.

Site 11, immediately south of the FPSF, features mostly pine plantation and regenerating secondary woods with little diversity. A lawn on the east side of the powerline at this site features a population of *Hedeoma hispida*, a member of the mint family, which has been found in South Carolina prior to this survey in only two other locations. An attractive mesophytic woodland occurs in the northwest portion of Site 11, and features steep woods with Indian cherry, bell-wort, Christmas fern, Walter's violet, blue skullcap, yellow maypop and bee-mint, below a varied canopy of white oak, beech, hickory, and loblolly pine. Additionally, a north-facing bluff and woodland occur in this area adjacent to Weir 14. The canopy here contains white oak, black oak, and American beech, with pawpaw, witch hazel, and granddaddy greybeard below. Herbs present include sedges, black cohosh, Hepatica, snakeroot, and Christmas fern.

Sites 11 and 12 are separated by a transmission line that extends north from Parr Hydro. This transmission line was in service before VCSNS was built and does not connect to the VCSNS switchyard.

Site 12 is a north-south trending stretch of ground along the east side of the Parr Reservoir. Numerous hardwood "stringers" occur alternately with regenerating pine.

Transmission corridors inside the boundary of the VCSNS site were also inventoried. These rights-of-way feature a wide variety of topographic aspects and relief. All are heavily manipulated, and contain less woody vegetation than the off-site rights-of-way surveyed. Some of the rights-of-way are heavily gullied in places (Photo 2), with erosion revealing extensive areas of bare red clay. However, grassy slopes are often present as well, containing a surprising diversity of herbs. These include oat-grass, fescue, and sneezeweed, three ubiquitous components of the flora of the VCSNS rights-of-ways. Mall grass, fleabane, wing stem, sticky catchfly, venus' looking glass, nut-rushes, pussy toes, wild carrot, wild radish, Johnson grass, plantain, cheat, and cutleaf primrose are common and regularly encountered. Blackberries commonly occur on these rights-of-ways, frequently in dense patches. Woody plants within transmission corridors are generally representative of the surrounding forest. Commonly observed woody species include nanny berry, sweet-gum, Russian olive, winged sumac, and hackberry, most frequently at the edges of the rights-of-ways.

6.2 Transmission Line Corridors

Before fieldwork began, the transmission corridors were evaluated using USGS topographic maps, aerial photographs, soil maps, and other resources. Lengths of corridor that appeared have potential for supporting a high level of biological diversity or harboring one or more rare species were identified and assigned unique survey location numbers (Figure 6-2). Each of these survey locations is described in the section that follows.

SUMMER-BLYTHEWOOD

B1

Location and access: West of Sec Hwy 422; Little Horse Branch, 2.4 miles southwest of US 321. Richland County.
Surrounding Land Use: Secondary forest, pine plantation.
Transmission line aspect: Dissected/gullied, with very large amount of tall shrubbery; this site has not been cleared for several years. Considerable standing dead woody vegetation is present from the last herbicide treatment. Much of the sprouting woody vegetation is attaining small tree stature presently, including white oak, post oak, persimmon, black gum, and red cedar. Large patches of turkey foot grass are also present.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

B2

Location and access: 2500 feet due west of US 321 along Will Douglass Road, about 4000 feet southwest of Blythewood Substation. Richland County.
Surrounding Land Use: Secondary forest, pine plantation, housing.
Transmission line aspect: Much as above (B1). Variably dissected and gullied with considerable amounts of dead and living woody vegetation.
Additional observations: A new housing development is being constructed on the north and west sides of this site. A wetland zone is present on the south, featuring a number of grasses and sedges, just south of the transmission line.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

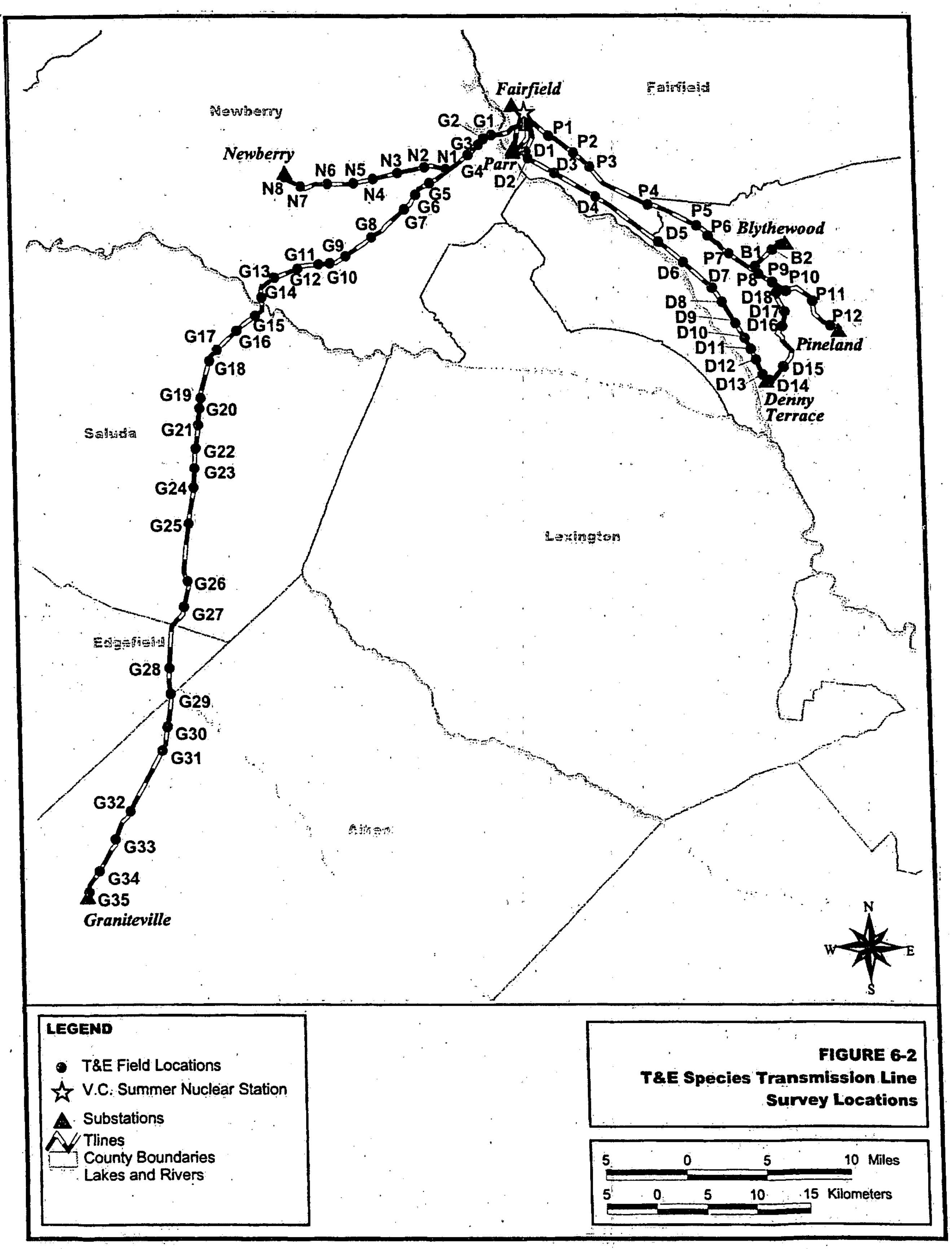


FIGURE 6-2
T&E Species Transmission Line Survey Locations

SUMMER-DENNY TERRACE

D1

Location and access: 4000 feet east of Parr Substation on both sides of Sec. Hwy 16. Fairfield County.
Surrounding Land Use: Dissected hill/swales. Both sides of the transmission line are in forest. To the north side of Sec. Hwy 16, this forest is diverse, featuring shortleaf pine, loblolly pine, red cedar, and with American beech, white oak, blackjack oak, Florida maple, and red maple. Sparkleberry is a common shrub. The canopy tends to be relatively dense, and there is considerable pine straw litter on the floor.
Transmission line aspect: Mowed/cleared with practically no shrubs. A number of gullies are present, these exhibiting bare soil. Commonly observed herbs include pussy-toes, sunflower, black-eyed susan, burning Tragia, and licorice goldenrod.
Additional observations: The northern terminus of this site contains a wildlife food plot (corn). A steep north-facing slope occurs on the south side of Sec. Hwy 16; the upper portion (and summit) are largely scraped over, and highly disturbed, featuring abundant weeds (including field Croton). The north side of the highway is near a local population of American columbo, but the corridor itself contains no habitat for it. The forest on the immediate south side of the highway contains an impressive stand of American beech and mixed hardwoods.
Potential elements of occurrence: American columbo is known with certainty from the adjacent drainage of Mayo Creek.
Significant elements of occurrence: None.

D2

Location and access: 6000 feet southeast of Parr Substation on both sides of SC 213. Fairfield County.
Surrounding Land Use: Gently rolling topography. Both sides of the transmission line are in forest. To the north side of SC 213, this forest is fairly diverse, especially toward a narrow draw. Winged elm, American beautyberry, red maple, chestnut oak, water oak, and white oak are abundant. A reasonably large population of Cucumber tree occurs in one place along the east side of the corridor, the only site for this species within the study.
Transmission line aspect: Mowed/cleared with practically no shrubs. To the north of SC 213, a small boulder field is present, these mostly buried, and occurring as small outcrops. Commonly observed herbs include very abundant oat-grass.
Additional observations: A portion of this site contains a well-defined wildlife food plot (oats/rye).
Potential elements of occurrence: Pool sprite would be expected on granitic outcrops; the outcrops present here are not flat enough to support the development of vernal pools.
Significant elements of occurrence: None.

D3

Location and access: 7500 feet south of SC 215 along Pinner Road (unnumbered); about 1 mile south of Jenkinsville. Fairfield County.
Surrounding Land Use: Forestland, a canopy of loblolly pine and mixed hardwoods. The canopy is generally thin, especially on ridges. Portions of this forest appear to be managed loblolly pine, with very little diversity.
Transmission line aspect: Mowed/cleared throughout most of its length, with considerable lengths in blackberry as well as remnant shrub stands (dead or dying, having been treated with herbicide). Steep aspects are afforded by gullies near Pinner Road. Commonly observed herbs include very abundant oat-grass, pink Sabatia, burning Tragia, and considerable nut-rush. The dry woods margin provides habitat for narrow-leaf milkweed, a reasonably uncommon species.

Additional observations: A dirt road traverses a portion of this site. Recent off-road vehicle activity is obvious. A well-defined wildlife food plot is present. A large patch of Himalaya-berry was seen here, the only location of this introduced bramble during this study.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D4

Location and access: 5000 feet south of SC 215 along Wallaceville Road (= Sec. Hwy 232); 3 miles southeast of Jenkinsville. Fairfield County.
Surrounding Land Use: Forestland, a canopy of loblolly pine and mixed hardwoods. The canopy is thin, appearing somewhat "battered." A large portion of the land on the south side of the corridor, east of Wallaceville Road, has been clearcut.
Transmission line aspect: Mowed/cleared throughout most of its length, with scattered patches of dead/dying shrubs, as well as extensive blackberry thickets. The topography is mostly flat, although gullies are present toward the southeast and northwest. Of some interest is a fairly large draw/swale near the drainage of Freshley Branch, with an abundance of aquatic plants (cattails, scirpus, etc.). Commonly observed herbs include very abundant oat-grass, field onion, sand thistle (Photo 3), and nut-rush.
Additional observations: Climbing milkweed, rattlebox, and Rhynchosia occur on the west side of Wallaceville Road.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D5

Location and access: Along both sides of Little River, approximately 5500 feet downstream from SC 215 (Ashley Bridge), about 6 miles southeast of Jenkinsville. Access is provided by Littleton Road (unnumbered) from SC 215. The border between Fairfield and Richland Counties is Little River (Photo 4).
Surrounding Land Use: Forestland, a canopy of loblolly pine and mixed hardwoods. The south side of Little River exhibits a typical Piedmont floodplain forest, with associated steep north-facing slopes, especially downstream from the transmission line. Florida maple, ash, granddaddy greybeard and box elder are common along the transmission line within this flood plain.
Transmission line aspect: Mowed/cleared throughout its length, with the lawn presenting a disked look. Two deer stands present.
Additional observations: The Fairfield County side of this site is not readily accessible, being gated and locked. The forest here is essentially the same as the Richland County portion.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D6

Location and access: Approximately 2 miles southwest of SC 215 on the loop formed by Sec. Hwy 41. The "loop" is in the vicinity of the old town of Bookman (and Bookman Shoals). Richland County.
Surrounding Land Use: Cut-over forestland, a canopy of loblolly pine and mixed hardwoods.
Transmission line aspect: Brushy and/or grassy for its entire length. The site is mostly high ground, in part severely eroded, with two narrow swales present. Oat-grass dominates the herbaceous cover here.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D7

Location and access: Approximately 8000 feet southwest of SC 215, immediately north of Nipper Creek, on both sides of Sec. Hwy 38 (road to old town of Montgomery). Richland County.
Surrounding Land Use: Cut-over forestland, a canopy of loblolly pine and mixed hardwoods.
Transmission line aspect: Both sides of Sec. Hwy 38 at the transmission line are gated and locked: the corridor is dominated by a grassy lawn with considerable dead brush present.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D8

Location and access: Along both sides of Sec. Hwy 2374 (leading to Richland County Construction and Demolition Landfill on west side of transmission line), about 5000 feet southwest of SC 215; south side of Nipper Creek. Richland County.
Surrounding Land Use: Cut-over pine woods, with a mixture of hardwoods. Portions on the west side of the corridor are clearcut. The north side of Sec. Hwy 2374 exhibits steep north-facing bluffs, dominated by hardwoods.
Transmission line aspect: Mowed and open for its entire length. The topography on the south side of the access road is gently rolling to flat, and features a wetland (cut-over and brushy). Herbs present include thin-leafed mountain mint (Photo 5) in some abundance. Otherwise, the corridor is dominated by blackberries, fescue, and oat-grass.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D9

Location and access: SC 215 where crossed by the transmission line, in vicinity of Slatestone Creek. Richland County.
Surrounding Land Use: Manipulated pine woods, housing, urbanized.
Transmission line aspect: Mowed and open, with an intensive manicured look.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D10

Location and access: Along east edge of SC 215 at junction with Sec. Hwy 1281, immediately north of Burgess Creek; 7500 feet north of Columbia International University. Richland County.
Surrounding Land Use: Housing, urbanized.
Transmission line aspect: Mowed and open, in part fenced with horses.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D11

Location and access: Burgess Creek and Brice Hill, immediately north of Columbia International University; SC 215 crosses the corridor obliquely here. Richland County.
Surrounding Land Use: Mostly in secondary forest, otherwise highway corridor, urbanized. Surrounding forests on both sides of the corridor at this point are fairly well-developed, with a heterogeneous canopy of hardwoods, including American beech, southern red oak, white oak, blackjack oak, and redbud.

Transmission line aspect: Grassy and open. The south portion of this site is on high ground, a steep north-facing slope of Brice Hill. The ground is in part eroded, and very rocky. Herbs present include chalky sunflower, tickseed, burning Tragia, joe-pye weed, windflower, and groundcherry. On the north side of SC 215, the corridor is flat and open, in part of the flood plain of Burgess Creek. The corridor here is very brushy, with blackberries in great abundance.
Additional observations: This is one of the more diverse sites of the Denny Terrace transmission line. Additional species present are phlox and climbing milkweed (Photo 6). Frost Mill Road (=Sec. Hwy 1785) provides access to the southern portion of this site, but access to the transmission line is prohibited.
Potential elements of occurrence: *Echinacea laevigata.*
Significant elements of occurrence: None.

D12

Location and access: South side of Columbia International University, 1800 feet southwest of SC 215. Richland County.
Surrounding Land Use: Pine woods; urbanized.
Transmission line aspect: A steep south-facing hillside, affording a good view of Columbia (Photo 7), occurs here. The corridor is heavily manipulated, featuring elderberry and considerable dead brush and an abundance of dead and living blackberries. Nevertheless, this corridor is remarkably diverse, especially on its edges and at the base of the hill, where a narrow stream flows. Oat-grass dominates the high ground, giving way in part to phlox, queen's delight, Euphorbia, wild rye, violet, cinnamon vine, and meadow-beauty (both pink and white forms), swamp day-flower, duck-potato, white-topped aster, cow-itch vine (Photo 8), and various sedges (*Cyperus* and *Rhynchospora*).
Additional observations: The north side of this site (north of the entry road) is mowed and brushy, of low diversity and little interest.
Potential elements of occurrence: *Echinacea laevigata.*
Significant elements of occurrence: None.

D13

Location and access: West side of Denny Terrace neighborhood, from Frost Avenue south to the substation. Richland County.
Surrounding Land Use: Housing, urbanized.
Transmission line aspect: Dissected and gullied, with significant erosion in places. The south side of Frost Avenue presents a mowed corridor with a steep south-facing aspect, featuring considerable herbaceous diversity (tickseed, oat-grass, man-root morning glory (Photo 9), field onion, frostflower, etc.). Portions of the corridor to the south maintain narrow, flowing wetlands, featuring boggy ground and seepage from the adjacent woods.
Additional observations: South of Denny Road, cultivated gardens occur on the corridor
Potential elements of occurrence: *Echinacea laevigata.*
Significant elements of occurrence: None.

D14

Location and access: Denny Terrace Substation, east to SC 215. Richland County.
Surrounding Land Use: Housing, urbanized.
Transmission line aspect: Flat, featuring the channel and floodplain of Crane Creek (Photo 10). The wetlands here are fairly extensive, featuring bishop's weed (Photo 11), duck-potato, various sedges (*Carex* and *Rhynchospora*), and lizard's tail.

Additional observations: This portion of Crane Creek is apparently ecologically sound, although under considerable threat from runoff from nearby streets and factories. This site, if managed properly, would make an outstanding urban wetland for community involvement. It would provide habitat for a number of wildlife species, especially birds.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D15

Location and access: Industrial park on east side of SC 215, north side of I-20. Richland County.
Surrounding Land Use: Secondary forest, urbanized.
Transmission line aspect: Flat, featuring the channel and floodplain of Crane Creek. Site is very weedy, otherwise dominated by a brushy lawn.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D16

Location and access: Both sides of Sec. Hwy 423, about 1-mile northwest of its junction with US 321. Richland County.
Surrounding Land Use: Secondary forest.
Transmission line aspect: Mostly flat and open, variably grassy and brushy.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D17

Location and access: Both sides of Sec. Hwy 947, about 4000 feet west of junction with US 321. Richland County.
Surrounding Land Use: Pine plantation, secondary forest.
Transmission line aspect: Gently sloping, with a south aspect; grassy and weedy.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

D18

Location and access: Terminus of unnumbered road and about 3000 feet south of Campground Road (= Sec. Hwy 38), 3000 feet west of US 321. Richland County.
Surrounding Land Use: Pine plantation, secondary forest.
Transmission line aspect: Brushy, mowed; mostly southwestern slope.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

SUMMER-GRANITEVILLE

G1

Location and access: East side of Sec. Hwy 28, on west side of Parr Reservoir. Newberry County (Photo 12).
Surrounding Land Use: Pine plantation.
Transmission line aspect: Heavily disturbed, featuring logging roads; many patches of dead woody shrubs are present, and many weeds, including blackberries, Russian olive, Wahlenbergia, Indian chickweed, fescue, highway lespedeza, sneezeweed, thistle, yard plantain, purple vervain, wing-stem, venus' looking glass, and hairy brome.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G2

Location and access: West side of Sec. Hwy 28, immediately north of St. Pauls Church, 5000 feet west of Parr Reservoir. Newberry County.
Surrounding Land Use: Pine plantation, housing.
Transmission line aspect: Weedy, grassy ground, featuring abundant blackberries, cudweed, sneezeweed (Photo 13), and hairy brome. The east side of this site is bounded by clear-cut forest.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G3

Location and access: Between Sec. Hwy 33 and railroad near Hope Station, 4000 feet southwest of Sec. Hwy 28. Newberry County.
Surrounding Land Use: Pine plantation.
Transmission line aspect: Very brushy/grassy, featuring a gentle slope with a narrow central swale. Many weeds are present, including rabbit tobacco, thistle, oat-grass, fescue, and purple heliotrope.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G4

Location and access: East side of US 176, 2.4 miles southeast of Pomaria. Newberry County.
Surrounding Land Use: Pine plantation.
Transmission line aspect: Very brushy, alternately with weedy, grassy stretches; reasonably low herbaceous diversity. Herbs present include wingstem, cudweed, dogbane, poison hemlock, cattails, wild carrot, hairgrass, and orange milkweed (Photo 14).
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G5

Location and access: Between Meadowbrook Road (frontage road on east side of I-26), immediately west of exit 85, and SC 202, 3 miles south-southwest of Pomaria. Newberry County.
Surrounding Land Use: Pine plantation, housing, urbanized.

Transmission line aspect: Heavily disturbed, featuring gardens and planted lawns. Grasses dominate this weedy corridor, including fescue, Vulpia, hair-grass, along with field onion, cudweed, sneezeweed, and blackberries. One small swale (a tributary of Crims Creek) features a number of wetland plants.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G6

Location and access: Southwest side of I-26 along Dr. Bowers Road (unnumbered), immediately southeast of Kibler. Newberry County.
Surrounding Land Use: Pine plantation, housing.
Transmission line aspect: Heavily disturbed, featuring planted/manipulated lawns, and a large corn patch.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G7

Location and access: Berley Doland Road (unnumbered), 2 miles west of Little Mountain. Newberry County.
Surrounding Land Use: Pine plantation, housing.
Transmission line aspect: Dissected corridor features very brushy vegetation with little diversity.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G8

Location and access: Between Dreher State Park Road (= Sec. Hwy 26) and Camping Creek, about 1.5 miles southeast of Prosperity. Newberry County.
Surrounding Land Use: Pine plantation.
Transmission line aspect: Heterogeneous, brushy corridor featuring typical herbaceous flora.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G9

Location and access: Between SC 391 and Sec. Hwy 319, 1.5 south of Prosperity. Newberry County.
Surrounding Land Use: Pine plantation, agriculture, housing.
Transmission line aspect: Highly dissected ground featuring two ridges and three swales; most of the transmission line corridor is dominated by brushy vegetation, other parts of it are apparently pastureland.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G10

Location and access: West side of SC 391, along south side of Mother Goose Road (unnumbered road); two miles south of Prosperity. Newberry County.
Surrounding Land Use: Pine plantation, agriculture, housing.
Transmission line aspect: Most of this site is devoted to goats and cattle (Photo 15).
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G11

Location and access: Both sides of Sec. Hwy 231, 2 miles south-southeast of Prosperity. Newberry County.
Surrounding Land Use: Pine plantation, agriculture.
Transmission line aspect: The west side of this site is heavily brushy, with dead and living shrubby vegetation. The eastern portion is essentially a lawn of grasses, probably for livestock.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G12

Location and access: Between Sec. Hwys 360 and 407; south side of Stoney Hill, 4.8 miles southwest of Prosperity. Newberry County.
Surrounding Land Use: Pine plantation, agriculture.
Transmission line aspect: This is a heavily manipulated site on dissected topography. Most of the corridor is in pastureland, although considerable portions of it are brushy.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G13

Location and access: Between Sec. Hwys 541 and 237, 6 miles southwest of Prosperity. Newberry County.
Surrounding Land Use: Pine plantation, agriculture.
Transmission line aspect: This is a dissected site with most of the length of the transmission line in heavy brush. The ground is rocky, and there is considerable gullying. The eastern portion of the corridor is dominated by a pasture.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G14

Location and access: Near terminus of Sec. Hwy 774, at which point this is a private road; old Kempsons Bridge Road, 8 miles southwest of Prosperity. Newberry County.
Surrounding Land Use: Pine plantation, pasture.
Transmission line aspect: The transmission corridor is dominated by a low lawn, part of an extensive pasture.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G15

Location and access: Southwest edge of Lake Murray, 8.4 miles southwest of Prosperity. Saluda County.
Surrounding Land Use: Pine plantation.
Transmission line aspect: The transmission line traverses high ground bounded on both sides by reasonably dense pine forests; this site is of very little likelihood for significant species.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G16

Location and access: Both sides of SC 194, 10 miles northeast of Saluda. Saluda County.
Surrounding Land Use: Pine plantation, agriculture, pasture.
Transmission line aspect: The corridor is alternately dominated by heavy brush and mowed pasture ground.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G17

Location and access: Both sides of Sec. Hwy 44, about 8 miles northeast of Saluda. Saluda County.
Surrounding Land Use: Agriculture, pasture.
Transmission line aspect: The corridor is dominated by a planted garden and a mowed lawn.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G18

Location and access: Both sides of Sec. Hwy 121 on north side of Big Creek, about 6.3 miles northeast of Saluda. Saluda County.
Surrounding Land Use: Agriculture, pasture.
Transmission line aspect: The transmission line corridor on the north side of Sec. Hwy 121 is dominated by a hayfield. On the south side, most of the corridor consists of high ground sloping gradually toward the floodplain of Big Creek. The corridor is very brushy with woody as well as herbaceous plants, and has not been mowed recently.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G19

Location and access: Both sides of Sec. Hwy 164, just south of Little Saluda River, about 5 miles northeast of Saluda. Saluda County.
Surrounding Land Use: Agriculture, pasture.
Transmission line aspect: The corridor at this site is represented by a hayfield/mowed lawn/pasture.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G20

Location and access: South side of US 378, about 4 miles east-northeast of Saluda. Saluda County.
Surrounding Land Use: Agriculture, pasture.
Transmission line aspect: The corridor at this site is represented almost completely by a mowed lawn/pasture.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G21

Location and access: Sec. Hwy 21, 6000 feet south of US 378, about 4 miles east-northeast of Saluda. Saluda County.
Surrounding Land Use: Agriculture, pasture.
Transmission line aspect: The corridor at this site is represented almost completely by an active pasture.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G22

Location and access: US 178, 4 miles east of Saluda. Saluda County.
Surrounding Land Use: Agriculture, pasture.
Transmission line aspect: The corridor at this site is represented almost completely by an active pasture.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G23

Location and access: Sec. Hwy 432 between Poplar Branch and Corley Creek, 4 miles east of Saluda. Saluda County.
Surrounding Land Use: Pine plantation, agriculture.
Transmission line aspect: Very dense brushy vegetation, otherwise weedy; with low potential for significant species. A well-developed wildlife food plot (bean/buckwheat patch) lies on north side of Sec. Hwy 432, along with deer hunters' stands.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G24

Location and access: Sec. Hwy 29 at Richland, about 4 miles east-southeast of Saluda. Saluda County.
Surrounding Land Use: Agriculture, livestock grazing.
Transmission line aspect: Very low potential for significant species; heavily manipulated with livestock within the corridor, second growth pine plantations.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G25

Location and access: North side of Good Hope School Road (= Sec. Hwy 548) and north to Artem Road (= Sec. Hwy 340), about 5.2 miles southwest of Saluda. Saluda County.
Surrounding Land Use: Agriculture, livestock, pastureland.
Transmission line aspect: Very low potential for significant species; heavily manipulated with livestock within the corridor, second growth pine plantations.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G26

Location and access: North side of Murphy Farm Road (unnumbered) and north to Neighbors Road (= Sec. Hwy 149), 1.5 miles northwest of Ridge Spring. Saluda County.
Surrounding Land Use: Agriculture (especially peach orchards), pine plantation.
Transmission line aspect: Very low potential for significant species; flat topography at a bend in the transmission line. Abundant grasses, goldenrod, and fetid Pluchea occur at a small depression within the corridor North of this site, the corridor is used for pasture.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G27

Location and access: Junction of SC 23 and Sec. Hwy 238, west side of Ridge Spring. Saluda County.
Surrounding Land Use: Agriculture, forest remnant.
Transmission line aspect: This site was examined due to its near proximity to known locations for Harperella, high-pond Hypericum, spoon-leaf seedbox, and rosy tickseed. However, no habitat is present along the transmission line for any of these wetland species.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G28

Location and access: South side of McCreight Road (= Sec. Hwy 17), about 5 miles southeast of Johnston. Edgefield County.
Surrounding Land Use: Pine plantation.
Transmission line aspect: The site on the north side of Sec. Hwy 17 is largely unimpressive. The south side however, is particularly interesting in its association with the south fork of the Edisto River and the flood plain of Beeck Creek, a tributary of the Edisto.
Additional observations: Reasonably intact forestland occurs on the upper portion of the site (at least on the west side), and a gently sloping flat stretches here toward the south. The corridor is relatively diverse, featuring numerous grasses and sedges, sunflowers, ironweed, and Angelica. Of highest interest here is the presence of bog-mint (*Macbridea caroliniana*), which was not expected at this site (Photo 16). This is essentially a Coastal Plain species, and its presence here indicates some affinity with the soils of this area and the outer Coastal Plain.
Potential elements of occurrence: None.
Significant elements of occurrence: Bog-mint, *Macbridea caroliniana*, GPS reading as 34°17.584, 81° 18.355. This plant is a Federal species of concern. It has recently been the subject of a status review study.

G29

Location and access: North side of Sec. Hwy 270, up to South Fork of Edisto River. Aiken and Edgefield Counties.
Surrounding Land Use: Pine plantation.
Transmission line aspect: This site consists of about half high/dry ground (on the south portion), which also features a couple of reasonably well-developed sandhill bogs in swales, and a gently sloping hillside toward the South Fork of the Edisto River.
Additional observations: The surrounding forests on the Aiken County side are fairly heavily manipulated, with an even crown and little diversity. The sandhill bogs are considerably more interesting, and substantial inventory time was spent here. Orange milkwort, beakrush, shining panic grass, dwarf

meadow beauty, pink meadow beauty (Photo 17), and abundant mats of *Sphagnum* moss were observed. This sort of bog is highly reminiscent of Coastal Plain ecosystems, and suggests agreement with soils as mapped in this area ("The Ridge") as being related more to those of the Coastal Plain than either the Piedmont or fall-line sandhills.
Potential elements of occurrence: sandbog beakrush, narrow-leaf beakrush, rough-leafed loosestrife.
Significant elements of occurrence: None.

G30

Location and access: Sec. Hwy 208, 3 miles northeast of Eureka. Aiken County.
Surrounding Land Use: Pine plantation, agriculture, housing, pasture.
Transmission line aspect: Heavily manipulated, featuring a junkyard and variously scraped sand. This is high and dry ground that supports abundant prickly pear cactus, sandhill morning-glory, and false indigo.
Additional observations: The area would seem to be suitable for *Stylisma pickeringii*.
Potential elements of occurrence: *Stylisma pickeringii*.
Significant elements of occurrence: None.

G31

Location and access: Mason Branch Road (unnumbered) at Sec. Hwy 155 (both sides); 2 miles northeast of Eureka. Aiken County.
Surrounding Land Use: Pine plantation, agriculture, pastureland.
Transmission line aspect: Heavily manipulated, disturbed, and weedy (ragweed, fleabane, rosin-plant, Wahlenbergia, sand spur, poke salad, etc.)
Additional observations: Of little interest botanically, other than some jointweed that occurs on the north side of Sec. Hwy 155 on high/dry ground.
Potential elements of occurrence: *Stylisma pickeringii*.
Significant elements of occurrence: None.

G32

Location and access: SC 19SC 191 near I-20, north side of Vaucluse. Aiken County.
Surrounding Land Use: Pine plantation, agriculture, pasture.
Transmission line aspect: Pastureland in part. Highly manipulated by surrounding land use.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G33

Location and access: SC 191 near I-20, north side of Vaucluse.
Surrounding Land Use: Pine plantation, agriculture, pasture.
Transmission line aspect: Mowed in considerable part, and much of it now pasture ground. The corridor tends to be weedy, and of little interest botanically due to heavy manipulation, especially on the north side of I-20. On the south side of the interstate, a steep south-facing slope complex (not associated with the transmission line) may provide habitat for significant plants; this site is on private land, inaccessible during the study. Several gullies present.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G34

Location and access: Between Sec. Hwys 105 and 503, east side of Vaucluse.
Surrounding Land Use: Pine plantation, housing.
Transmission line aspect: Variably grassy/brushy with abundant patches of dead woody vegetation. Open gullies present.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

G35

Location and access: Graniteville Substation and approximately 4000 feet north, east side of SC 191.
Surrounding Land Use: Longleaf pine forest, a portion of which (southeast) has been clearcut.
Transmission line aspect: Gently ascending slope toward north.
Additional observations: Both sides of the transmission line corridor border longleaf pine forest. This is probably the most arresting site, visually, that was surveyed. The corridor is dominated by herbs, with very little woody vegetation above low shrub level. Few weeds are present, and the vegetation is largely characteristic of healthy, xeric to near-xeric sandhills of central South Carolina. The corridor supports a large population of the sandhill endemic "jointweed" (Photo 18). Additional species include maypop, sandhill thistle, Lloyd's hypericum (Photo 19), sandhill morning-glory (Photo 20), prickly pear cactus, yellow Baptisia, devils' shoestring, silky-scale, sticky foxglove (Photo 21), narrowleaf ironweed (Photo 22), sensitive briar, and tread-softly (Photo 23). Deep sands dominate the site.

The surrounding forests are without question the highest quality stands of longleaf seen during this study. Many of the trees on both sides of the line are of considerable size. Four woodpecker species (red-headed, downy, hairy, yellow shafted flicker) were observed in the forests adjacent to the corridor, but the habitat appears to be only marginally suitable for red-cockaded woodpeckers. The forest on the west side of the corridor appears to have been thinned recently; that on the east side has an obviously denser canopy. On the east side of the corridor, sandhill rosemary, an additional sandhill endemic, occurs in some abundance. The presence of any dripping or seeping wetlands in association with this site would be grounds for serious additional investigation. However, no such wetlands have been seen along the corridor
Potential elements of occurrence: *Stylisma pickeringii, Nolina georgiana, Sporobolus teretifolius.*
Significant elements of occurrence: None.

SUMMER-NEWBERRY

N1

Location and access: South side of Sec. Hwy 202, 4000 feet southwest of junction with US 176. Newberry County.
Surrounding Land Use: Secondary forest, pasture, hay fields.
Transmission line aspect: Relatively flat and open, featuring a localized wet spot. The corridor is dominated by grasses and has apparently been recently mowed.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

N2

Location and access: Unnumbered road just north of Sec. Hwy 521 on west side of abandoned railroad line, about 2 miles southwest of Pomaria. Newberry County.
Surrounding Land Use: Clear-cut, secondary forest, housing, pasture. The east end of the site is bordered by an abandoned railroad line, present now only as a berm.
Transmission line aspect: Dissected landscape with several draws with active streams.
Additional observations: This is one of the most diverse sites visited during this project, in part because of the case taken to develop it as wildlife habitat (a sign to this effect exists on the east edge of the site). A wide variety of shrubs and herbs is present within the corridor, and considerable care was taken to inventory species present. typical Piedmont corridor vegetation includes oat-grass, blackberries, burning Tragia, thistle, heal-all, wild petunia, sun-drops, false dandelion (Photo 24), helenium (Photo 25), and fescue, and in the draws along streams, buttonbush and bear's paw (Photo 26), and various grasses and sedges. One of the largest populations of Indian pink (Photo 27) observed during this study was seen here. Three different species of milkweeds.
Potential elements of occurrence: *Echinacea laevigata.*
Significant elements of occurrence: None.

N3

Location and access: Exit 82 on I-26, where crossed by SC 773. Wicker Road (= Sec. Hwy 358) provides access to the central portion of the site. Newberry County.
Surrounding Land Use: Clear-cut, secondary forest, highway corridor, housing, pasture.
Transmission line aspect: This is a highly disturbed site. Portions of it are in gardens and pasture; the most "natural" portion is near I-26 in the vicinity of Mt. Hebron Church.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

N4

Location and access: Jollystreet Substation, along Old Jollystreet Road (= Sec. Hwy 99), about 3.2 miles northeast of Prosperity. Newberry County.
Surrounding Land Use: Forest, pastureland.
Transmission line aspect: Fairly steep slopes are associated with gullying; vegetation very dense and brushy, with considerable dead vegetation still standing.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

N5

Location and access: Along Sec. Hwy 436, just south of Kerr Creek, 2.4 miles northeast of Prosperity. Newberry County.
Surrounding Land Use: Forest, clearcut, pastureland, housing.
Transmission line aspect: Very brushy terrain offers difficult access and maneuvering. Little open ground present.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

N6

Location and access: Along Sec. Hwy 82, about 2 miles northwest of Prosperity. Newberry County.
Surrounding Land Use: Forest, pastureland, housing.
Transmission line aspect: Very brushy terrain.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

N7

Location and access: Along Sec. Hwy 281, about 2.5 miles northwest of Prosperity at Colony Church along US 176. Newberry County.
Surrounding Land Use: Forest, highway corridor, housing.
Transmission line aspect: Open terrain, mowed. Very little diversity. This site is fairly heavily disturbed due to its proximity to buildings and a major highway.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

N8

Location and access: Newberry Substation, and south and southeast for about 6000 feet.
Surrounding Land Use: Secondary pine/hardwoods, housing.
Transmission line aspect: Open terrain, mowed. The portion of the corridor immediately south of the substation is quite wide, due to the presence of additional transmission lines converging here.
Additional observations: The corridor itself gently slopes toward the southeast, ultimately crossed by a narrow swale that has been dammed by beavers (Photo 28). Aquatic plants are abundant. The corridor is relatively weedy, featuring, in addition to the ubiquitous oat-grass, burning Tragia, and field onion, considerable amounts of poison ivy, sprouting black cherry, highway lespedeza, rabbit's foot clover, winged sumac, horse nettle, purple vetch, cudweed, and sleepy catchfly.
Potential elements of occurrence: None. The area around the beaver pond is of some interest, however, no significant species are present.
Significant elements of occurrence: None.

SUMMER-PINELAND

P1

Location and access: Both sides of SC 215 immediately north of Sec. Hwy 247; Jenkinsville. Fairfield County.
Surrounding Land Use: Mixed pine/hardwoods, pine plantation, housing.
Transmission line aspect: Variously dissected to level; features deep gullies on west side of SC 215. Terrain is rather rough, with dense patches of low shrubs and blackberries.
Additional observations: Considerable numbers of Indian cherry occur along the west part of this site. This is a reasonably common Piedmont species but one that is commonly overlooked unless in fruit. Turkey foot grass, Carolina rose, blue skullcap (Photo 29).
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P2

Location and access: Both sides of Sleepy Hollow Road (= Sec. Hwy 514), just east of SC 215 on southeast side of Jenkinsville. Fairfield County.
Surrounding Land Use: Mixed pine/hardwoods, pine plantation.
Transmission line aspect: Variously dissected to level; grassy/brushy high-ground corridor
Additional observations: Turkey foot grass, Carolina rose, blue skullcap, sneezeweed.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P3

Location and access: East of SC 215 on south side of Sec. Hwy 60 at Rock Hill. Fairfield County.
Surrounding Land Use: Mixed pine/hardwoods, pine plantation, housing.
Transmission line aspect: Highly dissected, featuring difficult terrain: extremely brushy with dead woody plants as well as extensive groves of blackberry and dog fennel, etc. Some very deep, bare gullies occur. A house site occurs on the east side of the corridor, and signs of regular ATV use are present. A narrow creek bottom occurs nearby, and features typical corridor wetland species.
Additional observations: *Lespedeza cuneata* is especially abundant along the roadside, with fescue. A large patch of Himalaya berry occurs here as well.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P4

Location and access: Both sides of Brown's Bridge Road (= Sec. Hwy 420 extension), west side of Little River. Fairfield County.
Surrounding Land Use: Pine plantation, pastureland.
Transmission line aspect: Fairly flat ground. The ground is eroded, and red clay gullies are well-developed. From Sec. Hwy 420 toward Little River, the transmission line is devoted to a large cattle pasture. Northwest of the road, the corridor is very brushy.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P5

Location and access: Both sides of SC 269, about 5000 feet north of SC 215. Richland County.
Surrounding Land Use: Pine plantation, pastureland.
Transmission line aspect: Fairly flat ground, largely disturbed with a new housing development putting put in. The site is very brushy and not diverse.
Additional observations: Dry ground species include tickseed, big-leaf compass plant.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P6

Location and access: Both sides of Sec. Hwy 682 (at Cedar Creek Church) immediately east of junction of SC 215 and SC 269. Richland County.
Surrounding Land Use: Pine plantation, pastureland.
Transmission line aspect: Highly dissected and disturbed. A wood chipping operation occurs here; most of the corridor is very brushy and open.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P7

Location and access: Sec. Hwy 59, about 1 mile south of Oak Grove Church, 4 miles west of Lin Rick golf course. Richland County.
Surrounding Land Use: Pine plantation, pastureland.
Transmission line aspect: Dissected and gullied. Most of the site is dominated by grassy/brushy lawns; the east portion contains a junkyard within the corridor
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P8

Location and access: Junction of Friendly Wood (= Sec. Hwy 422) and Pineway (=Sec. Hwy 1436) Roads, 1.5 miles east of Lin Rick golf course. Richland County.
Surrounding Land Use: Pine plantation, housing, pastureland.
Transmission line aspect: Mostly flat. The northwest portion of this site has not been mowed for some time, and the herbaceous layer (mostly grasses) is quite dense. Included with the grasses are blackberries, maypop, verbena, fleabane, and horse nettle. Many dead woody shrubs are scattered throughout. The southeast portion, which is gated, has been recently mowed, and exhibits a low lawn.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

P9

Location and access: Both sides of Campground Road (=Sec. Hwy 38), 3000 feet west of US 321 and about 6 miles north-northwest of I-20. Richland County.
Surrounding Land Use: Pine plantation, housing, pastureland.
Transmission line aspect: Mostly flat. Site is dominated by a low lawn of various grasses, also prickly-pear cactus.
Potential elements of occurrence: *Stylisma pickeringii.*
Significant elements of occurrence: None.

P10

Location and access: West side of US 321 along south side of Faunus Road, 5.3 miles north of I-20. Richland County.
Surrounding Land Use: Pine plantation, housing, pastureland.
Transmission line aspect: Generally flat.
Additional observations: The only interesting part of this site is an open bog immediately west of US 321 which features many Coastal Plain species. This bog would otherwise resemble well-developed

sandhill seepages known from elsewhere in Richland County (most notably Fort Jackson) except for the fact that this corridor is apparently never burned. Conspicuous members of the bog include pink sundew, orange milkwort, sweetbay magnolia, and a number of sedges. Sphagnum moss is abundant and widespread, probably consisting of several species. The bog here potentially represents habitat for a number of rare species, but because it is not burned, it is very unlikely that these plants will occur here. Nevertheless, considerable effort was made to locate rare species, as this is an anomalous site relative to the rest of the study. A management program on a community level, involving limited on-site burning, would no doubt increase the diversity of this bog, and probably encourage additional species, currently not apparent, to bloom.
Potential elements of occurrence: Rough-leafed loosestrife, red treasure lily, sandbog beakrush, narrow-leaf beakrush.
Significant elements of occurrence: None.

P11

Location and access: North side of Sec. Hwy 61, 6000 feet east of US 321, 3.6 miles north of I-20. Richland County.
Surrounding Land Use: Floodplain forest, oak-hickory pine woods.
Transmission line aspect: Flat portion along floodplain of Dry Fork Creek on north side of Sec. Hwy 61. Farther to the north, the transmission line climbs steep, rocky ground, thus affording a southern exposure.
Additional observations: Most of the corridor is dominated by grasses and brush, in a very heterogeneous assemblage. The wetland portion contains numerous permanent "puddles," these featuring wetland and aquatic species (especially sedges). In addition, a portion of the floodplain forest here has been cut-over. Moderate erosion and gullying takes place on the high ground portion of this site. This site is relatively diverse. Among the herbaceous plants seen are tickseed, white-topped aster, fescue, poison hemlock, and small-flowered milkwort.
Potential elements of occurrence: *Echinacea laevigata*.
Significant elements of occurrence: None.

P12

Location and access: 3500 feet west of US 21 along Alta Vista Road (unnumbered); also at US 21 and intervening distance; Pineland Substation. Richland County.
Surrounding Land Use: Second-growth pine woods, housing, urbanized
Transmission line aspect: Variable mowed and/or brushy, the topography is mostly gently sloping, including a portion of the Crane Creek flood plain. The corridor features pastures and active gardens.
Potential elements of occurrence: None.
Significant elements of occurrence: None.

7.0 DISCUSSION

The discussion that follows elaborates on possible reasons for the absence of the target species listed in Table 4-1, species that were thought to have some chance of occurring in the study area based on historical records and the habitats present.

7.1 Plants

Pool sprite (*Amphianthus pusillus*) is an extremely rare annual species in South Carolina. The largest and most consistently reappearing populations are in Lancaster County at Flat Creek Natural Area. This is a plant absolutely endemic to open flat granite rocks, with enough surface area to allow the development of shallow pools which fill with water during spring rainy periods, when the seeds germinate, followed by rapid growth, flowering, and fruit set. Transmission corridors featuring granitic rock anywhere within this project were examined for the slightest possibility of occurrence; the best developed "flatrocks" are just south of VCSNS (see Denny Terrace Site D2). Some boulders were seen elsewhere along powerlines in Fairfield County, but none was adequate for supporting this species. It is highly unlikely that Pool sprite ever occurred anywhere within the study area, and there is little likelihood of its ever appearing within it.

Smooth coneflower (*Echinacea laevigata*) is very rare in South Carolina. The best developed populations are on marble or similar rock in Oconee County. Aiken and Richland Counties have small populations that have been argued as non-natural. Additionally, some evidence suggests that smooth coneflower depends in part on occasional fires. Considering the absence of truly circumneutral soils on the transmission corridors studied, the absence of apparent habitat on neighboring land, and the fact that fires are practically non-existent in the transmission corridors, it is highly unlikely that smooth coneflower ever has been a resident of these areas. Nevertheless, it was sought on open corridors featuring steep, rocky terrain, throughout this project.

Rough-leafed loosestrife (*Lysimachia asperulaefolia*) is known from a highly specialized, fire-maintained sandhill ecosystem in Richland County (Fort Jackson). It is absolutely dependent on recurring fires, and is historically known only east of Columbia (i.e., Florence County). Some possibility exists that this species could survive on boggy places under powerlines studied in this survey, but there are only two sites (see Graniteville G29 and Pineland P10) that could reasonably be considered, and neither of them is burned. Portions of the Graniteville transmission corridor would be thought to potentially support loosestrife, but no sandhill seepage bogs were discovered. It is highly unlikely that rough-leafed loosestrife has ever grown anywhere within the project area.

Harperella (*Ptilimnium nodosum*) is a conspicuous (when flowering) herb that is known from a few "high ponds" in South Carolina. It is of potential occurrence, therefore, in suitable habitat along portions of the Summer-Graniteville line, particularly around Ridge Spring. High ponds occur around SC Hwy 23 in the vicinity of the Graniteville line, but these bays are highly altered, and little resident native vegetation remains. On the other hand, the Graniteville line does not appear to specifically cross any Carolina bays in the region. It is conceivable, nevertheless, that Harperella may have grown in wet places prior to the development of the Graniteville line, but it is rather certain that no suitable habitat exists for it now.

Relict trillium (*Trillium reliquum*) in South Carolina is known from Aiken and McCormick Counties, along tributaries of the Savannah River. The plants are apparently restricted to sites over mafic rock, within old-growth, intact forest systems. They do respond somewhat positively to disturbance, and may be expected to survive in opening under powerlines if present in adjacent forests. No trilliums were seen during this survey. The Aiken County locations for this species are much unlike anything else seen in Aiken County under the Graniteville transmission line; it is extremely unlikely that this species ever occurred in the project area.

Canby's dropwort (*Oxypolis canbyi*) is a perennial member of the carrot family, which in South Carolina is nearly restricted to mostly canopy-free Carolina bays. The nearest populations to the powerlines studied are in lower Richland County. Suitable habitats are not present at all under the Denny Terrace and Pineville lines. It is conceivable that this plant could occur in the vicinity of the wetlands previously supporting Harperella (Aiken-Edgefield County), but that would involve a fairly significant range extension in South Carolina. It is unlikely that Canby's dropwort ever grew in association with transmission corridors of this project.

Georgia aster (*Aster georgianus*) is a perennial member of the sunflower family, maintained by some taxonomists as a variant of the widespread *A. patens*. It is reasonably difficult to separate these taxa even with flowering material. Habitat preferences are not clear, although there is some suggestion that Georgia aster, as an entity, may be associated with smooth coneflower. Plants referable to *A. patens* were occasionally observed on the Graniteville and Denny Terrace transmission corridors.

Bog-mint (*Macbridea caroliniana*) occurs as one population on the Graniteville corridor (see Graniteville Site G28). This is a highly conspicuous (when in bloom) perennial member of the mint family, and it has recently been the object of a status review for possible consideration as a candidate for federal listing. Elsewhere in South Carolina this species is a resident generally of old-growth swamp ecosystems, a good example being a large colony along the boardwalk system at Congaree Swamp National Monument

(Richland County). The plants at Site G28 are on opposite sides of the corridor, and represented by only a few clumps on each side. Presumably, the adjacent forest on both sides is suitable habitat. It is not clear whether the population below the powerlines has been there indefinitely, or if it has recently been able to move into the corridor. The plants' location suggests the former. The plants seem to be secure; however, the site is manipulated for deer hunting (a stand located nearby overlooks the site) and the central portion of the corridor appears to be plowed at least occasionally.

The most important botanical element in the vicinity of VCSNS is American columbo (*Frasera caroliniensis*), which occurs on SCE&G land approximately one mile south of the site boundary. This plant occurs at one place along the west bank of Mayo Creek, and the population appears to be expanding. While not listed as an endangered species, this plant is very rare in South Carolina, and the Mayo Creek population is the state's largest. Although technically out of scope, because it occurs off-site and the species is not listed, this population seems worthy of mention.

7.2 Animals

The bald eagle (*Haliaeetus leucocephalus*) was the only listed animal species observed during the surveys. Four juvenile bald eagles were observed on May 30, 2002 perched in trees near the FPSF at the VCSNS site, and two adult eagles were seen just offsite, on the (north) bank of the FPSF tailrace canal. An adult and three juvenile bald eagles were seen later on the same day approximately one-half mile south of the railroad trestle that crosses the FPSF tailrace. Bald eagles are commonly observed foraging around Monticello Reservoir, the FPSF tailrace canal, Parr Reservoir, and on the Broad River downstream of Parr Shoals dam. There are no recorded eagle nests at the VCSNS site, but there are six nests within five miles of VCSNS, the nearest being approximately two miles from VCSNS (Holling 2001). Four of these six nests are believed to be active nesting sites, while the status of two nests is unknown (SCDNR 2002).

There are two recorded bald eagle nests in the vicinity of the Summer transmission lines. The nearest is an active nest in Saluda County, approximately 0.5 mile west of the Summer-Graniteville transmission line. One nest in Richland County is approximately 0.9 mile south of the Summer-Denny Terrace transmission line; the current status of the Richland County nest is unknown, but the nest was "viable" as recently as 1995 (SCDNR 2002).

Red-cockaded woodpeckers (*Picoides borealis*) are known to occur in Aiken, Edgefield, Richland, and Saluda counties. Active nest cavities of this cooperative breeder occur in open, mature pine stands with sparse midstory vegetation. When the hardwood midstory grows above 15 feet, cavity abandonment usually occurs (Hooper et al. 1980). Preferred habitat for this species is not found at the VCSNS site, nor is it found along the transmission corridors. Site G35 on the Summer-Graniteville corridor was the only location where the Summer transmission corridors passed through mature, marginally open pine forests. At this location, however, numerous oaks of considerable height are scattered among the pines, significantly decreasing the probability that red-cockaded woodpeckers would occur here. Nevertheless, the forest adjacent to Site G35 was thoroughly searched, and no active or abandoned nest cavities were observed.

Wood storks (*Mycteria americana*) from the Birdsville Colony (near Millen, Georgia) forage in shallow wetlands on the Department of Energy's Savannah River Site and in specially constructed ponds on the National Audubon Society's Silver Bluff Sanctuary, near Jackson, South Carolina (DOE 1997; NAS undated). There are no known nesting colonies in Aiken County. No transmission corridors associated with VCSNS cross or approach the Savannah River Site or the Silver Bluff Sanctuary, and wood storks have not been recorded near VCSNS or the Summer transmission line corridors.

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) has been recorded in Aiken and Richland counties (SCDNR 2002). This bat is found in forested areas, especially in pine flatwoods and pine-oak woodlands. It roosts in hollow trees, under bark, in old cabins and barns, and in wells and culverts, and its geographic range includes the entire southeastern United States (Brown 1997). Thus, Rafinesque's big-eared bat could occur in forested portions of the VCSNS site or in forested areas adjacent to the transmission corridors.

The gopher tortoise (*Gopherus polyphemus*) inhabits sandy, well-drained areas where adequate vegetation for foraging exists. Gopher tortoise burrows, which are readily visible, have not been observed at VCSNS. In addition, no burrows have been recorded in or adjacent to the transmission line corridors associated with VCSNS (SCDNR 2002). Gopher tortoises have not been recorded north of Aiken County (SCDNR 2002), and the Aiken Gopher Tortoise State Preserve is the northernmost extent of the species range. The Graniteville substation, which is the southern terminus of the Summer-Graniteville transmission corridor, is 18 miles west-northwest of the Aiken Gopher Tortoise State Preserve, and thus, is slightly north of the known species range. Gopher tortoises are generally not found in areas of Piedmont soils, which characterize most of the transmission corridors associated with VCSNS. Soil types suitable for this species exist only in the southern portion of the Summer-Graniteville corridor, corresponding roughly to Sites G28 through G35 of Figure 6-2. No tortoise burrows were observed at these or any other sites surveyed during the surveys of the Summer transmission lines. It is highly unlikely that gopher tortoises exist in the study area.

American alligator (*Alligator mississippiensis*) habitat consists of swamps, marshes, ponds, lakes, and slow-moving streams and rivers. Alligators are known to occur in Aiken and Richland counties and could occur in wetlands crossed by transmission corridors in these counties.

The spotted turtle (*Clemmys guttata*) inhabits shallow bodies of water such as swamps and small streams. It has been recorded in and around Carolina bays and bogs on the Savannah River Site in Aiken County (Gibbons and Semlitsch 1991). The spotted turtle could occur in suitable habitats crossed by the southern (Aiken County) portion of the Summer-Graniteville transmission corridor, but this is believed to be unlikely. The VCSNS site is near the northern extent of the geographic range of this species.

The pine barrens treefrog (*Hyla andersonii*) is known to occur in Richland County (SCDNR 2002). This species inhabits trees in swamps adjacent to sandhill habitats (Martoff et al, 1980). There are no recorded occurrences of this species in or adjacent to the transmission line corridors associated with VCSNS (SCDNR 2002). Due to the general absence of suitable habitat at VCSNS and along the transmission lines, it is unlikely that pine barrens treefrogs exist in the study area.

Webster's salamander (*Plethodon websteri*) has been recorded in Saluda and Edgefield counties (SCDNR 2002), which represent the eastern extent of its range. Webster's salamander inhabits moist, mixed hardwood forests on steep north-facing slopes with rock outcrops (Martoff et al. 1980). There are no recorded occurrences of this species in or adjacent to the transmission line corridors associated with VCSNS (SCDNR 2002). Because its geographic range is west of VCSNS and the lack of suitable habitat along the transmission lines, it is unlikely that Webster's salamanders exist in the study area.

The Carolina gopher frog (*Rana capito capito*) inhabits upland, xeric areas, especially longleaf pine/turkey oak sandhills. It takes shelter during the day in active and abandoned gopher tortoise burrows, crayfish burrows, and stump holes, but lays its eggs in seasonally flooded, grassy ponds and cypress ponds that lack fish populations. It has been recorded in and around Carolina bays on the Savannah River Site in Aiken County (Gibbons and Semlitsch 1991). The likelihood of this species occurring at VCSNS is low, due to lack of suitable habitat. Likewise, the probability of this species breeding within the transmission corridors is low, due to lack of appropriate breeding habitat. It is conceivable that Carolina gopher frogs could find shelter in some wetlands along the southern (Aiken County) portion of the Summer-Graniteville transmission corridor.

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APPENDIX A

Agency Consultations

From: Lori_Duncan@fws.gov [mailto:Lori_Duncan@fws.gov]
Sent: Thursday, March 15, 2001 12:45 PM
To: ssummer@scana.com
Cc: Steve_Gilbert@fws.gov; Jason_Ayers@fws.gov
Subject: Virgil C. Summer Nuclear Station License Renewal

Please find attached a Word Perfect document with the Federally listed and candidate species and species of concern for South Carolina. Please use this list to aid you in analyzing potential impacts your project may have on these species. Thank you.

(See attached file: listetcsc.wpd)

Lori A.W. Duncan
U.S. Fish and Wildlife Service
176 Croghan Spur Road, Suite 200
Charleston, South Carolina 29407
(843) 727-4707 ext. 21
(843) 727-4218 fax
lori_duncan@fws.gov

South Carolina Distribution Records of
Endangered, Threatened, Candidate and Species of Concern
March 8, 2001

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
Abbeville				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Georgia aster	*Aster georgianus*	C	Known
Aiken				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Relict trillium	*Trillium reliquum*	E	Known
	Piedmont bishop-weed	*Ptilimnium nodosum*	E	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Dwarf burhead	*Echinodorus parvulus*	SC	Known
	Bog spicebush	*Lindera subcoriacea*	SC	Known
	Carolina bogmint	*Macbridea caroliniana*	SC	Known
	Gopher frog	*Rana capito*	SC	Known
	Pickering's morning-glory	*Stylisma pickeringii var. pickeringii*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known

County	Common Name	Scientific Name	Status	Occurrences
Allendale				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Possible
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
	False coco	*Pteroglossaspis ecristata*	SC	Known
	Yellow lampmussel	*Lampsilis cariosa*	SC	Known
	Savannah lilliput	*Toxolasma pullus*	SC	Known
Anderson				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Carolina darter	*Etheostoma collis*	SC	Known
Bamberg				
	Wood stork	*Mycteria americana*	E	Possible
	Red-cockaded woodpecker	*Picoides borealis*	E	Possible
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Dwarf burhead	*Echinodorus parvulus*	SC	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
	Chapman's sedge	*Carex chapmanii*	SC	Known
Barnwell				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Possible
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Pondberry	*Lindera melissifolia*	E	Possible

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County	Common Name	Scientific Name	Status	Occurrences
Barnwell (cont.)	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Piedmont bishop-weed	*Ptilimnium nodosum*	E	Known
	American chaffseed	*Schwalbea americana*	E	Possible
	Dwarf burhead	*Echinodorus parvulus*	SC	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Bog spicebush	*Lindera subcoriacea*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
	Carolina bogmint	*Macbridea caroliniana*	SC	Known
	Creeping St. John's wort	*Hypericum adpressum*	SC	Known
	Gopher frog	*Rana capito*	SC	Known
	Sandhills milk-vetch	*Astragalus michauxii*	SC	Known
	Yellow lampmussel	*Lampsilis cariosa*	SC	Known
Beaufort				
	West Indian manatee	*Trichechus manatus*	E	Known
	Finback whale	*Balaenoptera physalus**	E	Known
	Humpback whale	*Megaptera novaeanqliae**	E	Known
	Northern right whale	*Eubaleana glacialis**	E	Known
	Sei whale	*Balaenoptera borealis**	E	Known
	Sperm whale	*Physeter catodon**	E	Known
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Piping plover	*Charadrius melodus*	T/PCH	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
	Flatwoods salamander	*Ambystoma cingulatum*	T	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Pondberry	*Lindera melissifolia*	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Possible
	Chaff-seed	*Schwalbea americana*	E	Known
	Dusky shark	*Carcharhinus obscurus**	C	Possible

County Common Name Scientific Name Status Occurrences

County	Common Name	Scientific Name	Status	Occurrences
Beaufort (cont.)				
	Sand tiger shark	*Odontaspis taurus**	C	Possible
	Night shark	*Carcharinus signatus**	C	Possible
	Speckled hind	*Epinephelus drummondhayi**	C	Possible
	Jewfish	*E. itijara**	C	Possible
	Warsaw grouper	*E. nigritus**	C	Possible
	Nassau grouper	*E. striatus**	C	Possible
	Cupgrass	*Eriochloa michauxii*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
	Southeastern myotis	*Myotis austroriparius*	SC	Known
Berkeley				
	West Indian manatee	*Trichechus manatus*	E	Possible
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Loggerhead sea turtle	*Caretta caretta*	T	Known
	Flatwoods salamander	*Ambystoma cingulatum*	T	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Pondberry	*Lindera melissifolia*	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Chaff-seed	*Schwalbea americana*	E	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
	Chapman's sedge	*Carex chapmanii*	SC	Known
	False coco	*Pteroglossaspis ecristata*	SC	Known
	Gopher frog	*Rana capito*	SC	Known
	Incised groovebur	*Agrimonia incisa*	SC	Known
	Least trillium	*Trillium pusillum var. pusillum*	SC	Known
	Pineland plantain	*Plantago sparsiflora*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Sun-facing coneflower	*Rudbeckia heliopsidis*	SC	Known
County	**Common Name**	**Scientific Name**	**Status**	**Occurrences**
Calhoun				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Possible
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Least trillium	*Trillium pusillum var. pusillum*	SC	Known

County	Common Name	Scientific Name	Status	Occurrences
Charleston				
	West Indian manatee	*Trichechus manatus*	E	Known
	Finback whale	*Balaenoptera physalus**	E	Known
	Humpback whale	*Megaptera novaeanqliae**	E	Known
	Northern right whale	*Eubaleana glacialis**	E	Known
	Sei whale	*Balaenoptera borealis**	E	Known
	Sperm whale	*Physeter catodon**	E	Known
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Bachman's warbler	*Vermivora bachmanii*	E	Known
	Wood stork	*Mycteria americana*	E	Known
	Red-cockaded woodpecker	*Picoides borealis*	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
	Flatwoods salamander	*Ambystoma cingulatum*	T	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Sea-beach amaranth	*Amaranthus pumilus*	T	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Possible
	Pondberry	*Lindera melissifolia*	E	Possible
	Chaff-seed	*Schwalbea americana*	E	Known
	Dusky shark	*Carcharhinus obscurus**	C	Possible
	Sand tiger shark	*Odontaspis taurus**	C	Possible
	Night shark	*Carcharinus signatus**	C	Possible
	Speckled hind	*Epinephelus drummondhayi**	C	Possible
	Jewfish	*E. itijara**	C	Possible
	Warsaw grouper	*E. nigritus**	C	Possible
	Nassau grouper	*E. striatus**	C	Possible
	Bachman's sparrow	*Aimophila aestivalis*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
	Gopher frog	*Rana capito*	SC	Known

County	Common Name	Scientific Name	Status	Occurrences
Charleston (cont.)	Island glass lizard	*Ophisaurus compressus*	SC	Known
	Incised groovebur	*Agrimonia incisa*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Southeastern myotis	*Myotis austroriparius*	SC	Known
	Sweet pinesap	*Monotropsis odorata*	SC	Known

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County	Common Name	Scientific Name	Status	Occurrences
	Venus' fly-trap	*Dionaea muscipula*	SC	Known
Cherokee				
	Dwarf-flowered heartleaf	*Hexastylis naniflora*	T	Known
	Georgia aster	*Aster georgianus*	C	Known
	Southeastern myotis	*Myotis austroriparius*	SC	Known
Chester				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Possible
	Georgia aster	*Aster georgianus*	C	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known
Chesterfield				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Possible
	Carolina heelsplitter	*Lasmigona decorata*	E	Known
	Carolina dropseed	*Sporobolus sp1*	SC	Known
	Pine or Gopher snake	*Pituophis melanoleucus*	SC	Known
	Spring-flowering goldenrod	*Solidago verna*	SC	Known
	Well's pixie-moss	*Pyxidanthera brevifolia*	SC	Known
	Wire-leaved dropseed	*Sporobolus teretifolius*	SC	Known

County	Common Name	Scientific Name	Status	Occurrences
Clarendon				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Chaff-seed	*Schwalbea americana*	E	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
	Creeping St. John's wort	*Hypericum adpressum*	SC	Known
	Dwarf burhead	*Echinodorus parvulus*	SC	Known
	False coco	*Pteroglossaspis ecristata*	SC	Known
Colleton				

	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Piping plover	*Charadrius melodus*	T/PCH	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
	Pondberry	*Lindera melissifolia*	E	Possible
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Dusky shark	*Carcharhinus obscurus**	C	Possible
	Sand tiger shark	*Odontaspis taurus**	C	Possible
	Night shark	*Carcharinus signatus**	C	Possible
	Speckled hind	*Epinephelus drummondhayi**	C	Possible
	Jewfish	*E. itijara**	C	Possible
	Warsaw grouper	*E. nigritus**	C	Possible
	Nassau grouper	*E. striatus**	C	Possible
	Carolina bird-in-a-nest	*Macbridea caroliniana*	SC	Known
	Crested fringed orchid	*Pteroglossaspis ecristata*	SC	Known
	Island glass lizard	*Ophisaurus compressus*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
Darlington				
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Possible
	Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E	Known
County	**Common Name**	**Scientific Name**	**Status**	**Occurrences**
Darlington (cont.)				
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Carolina bogmint	*Macbridea caroliniana*	SC	Known
	Georgia lead-plant	*Amorpha georgiana var. georgiana*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Sandhills milkvetch	*Astragalus michauxii*	SC	Known
	Spring-flowering goldenrod	*Solidago verna*	SC	Known
	Well's pixie-moss	*Pyxidanthera brevifolia*	SC	Known
	White false-asphodel	*Tofieldia glabra*	SC	Known
Dillon				

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County	Common Name	Scientific Name	Status	Occurrences
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Possible
	Carolina bogmint	*Macbridea caroliniana*	SC	Known
	Falso coco	*Pteroglossaspis ecristata*	SC	Known
	Pine barrens bonneset	*Eupatorium resinosum*	SC	Known
Dorchester				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Possible
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Possible
	Pondberry	*Lindera melissifolia*	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Possible
	Bog asphodel	*Narthecium americanum*	C	Known
	False coco	*Pteroglossaspis ecristata*	SC	Known
	Gopher frog	*Rana capito*	SC	Known
	Least trillium	*Trillium pusillum var. pusillum*	SC	Known
	Pineland plantain	*Plantago sparsiflora*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Southeastern myotis	*Myotis austroriparius*	SC	Known

County	Common Name	Scientific Name	Status	Occurrences
Edgefield				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Carolina heelsplitter	*Lasmigona decorata*	E	Known
	Miccosukee gooseberry	*Ribes echinellum*	T	Possible
	Relict trillium	*Trillium reliquum*	E	Known
	Georgia aster	*Aster georgianus*	C	Known
	Brook floater	*Alasmidonta varicosa*	SC	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known
	Yellow lampmussel	*Lampsilis cariosa*	SC	Known
Fairfield				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Georgia aster	*Aster georgianus*	C	Known
	Carolina darter	*Etheostoma collis*	SC	Known
Florence				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known

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	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Chaffseed	*Schwalbea americana*	E	Known
	Carolina bogmint	*Macbridea caroliniana*	SC	Known
	Georgia lead-plant	*Amorpha georgiana var. georgiana*	SC	Known
	Ovate catchfly	*Silene ovata*	SC	Known
Georgetown				
	West Indian manatee	*Trichechus manutus*	E	Known
	Finback whale	*Balaenoptera physalus**	E	Known
	Humpback whale	*Megaptera novaeanqliae**	E	Known
	Northern right whale	*Eubaleana glacialis**	E	Known
	Sei whale	*Balaenoptera borealis**	E	Known
	Sperm whale	*Physeter catodon**	E	Known
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Wood stork	*Mycteria americana*	E	Known

<u>County</u>	<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>	<u>Occurrences</u>
Georgetown (cont.)				
	Piping plover	*Charadrius melodus*	T/PCH	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
	Dusky shark	*Carcharhinus obscurus**	C	Possible
	Sand tiger shark	*Odontaspis taurus**	C	Possible
	Night shark	*Carcharinus signatus**	C	Possible
	Speckled hind	*Epinephelus drummondhayi**	C	Possible
	Jewfish	*E. itijara**	C	Possible
	Warsaw grouper	*E. nigritus**	C	Possible
	Nassau grouper	*E. striatus**	C	Possible
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Bachman's sparrow	*Aimophia aestivalis*	SC	Known
	Carolina pygmy sunfish	*Elassoma boehlkei*	SC	Known

	Carolina grass-of-parnassus	*Parnassia caroliniana*	SC	Known
	Dune bluecurls	*Trichostema sp 1*	SC	Known
	One-flower balduina	*Balduina uniflora*	SC	Known
	Pineland plantain	*Plantago sparsiflora*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
	Reclined meadow-rue	*Thalictrum subrotundum*	SC	Known
	Wire-leaved dropseed	*Sporobolus teretifolius*	SC	Known
	Venus' fly-trap	*Dionaea muscipula*	SC	Known
Greenville				
	Bog turtle	*Clemmys muhlenbergii*	T S/A	Known
	Swamp-pink	*Helonias bullata*	T	Known
	Dwarf-flowered heartleaf	*Hexastylis naniflora*	T	Known
	Small whorled pogonia	*Isotria medeoloides*	T	Known
	Bunched arrowhead	*Sagittaria fasciculata*	E	Known
	Mountain sweet pitcher-plant	*Sarracenia rubra ssp. jonesii*	E	Known
	White irisette	*Sisyrinchium dichotomum*	E	Known
	Rock gnome lichen	*Gymnoderma lineare*	E	Known
	White fringeless orchid	*Platanthera integrilabia*	C	Known
	Green salamander	*Aneides aeneus*	SC	Known

County	**Common Name**	**Scientific Name**	**Status**	**Occurrences**
Greenville (cont.)				
	Oconee-bells	*Shortia galacifolia*	SC	Known
	Piedmont ragwort	*Senecio millefolium*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Southeastern myotis	*Myotis austroriparius*	SC	Known
	Southern Appalachian woodrat	*Neotoma floridana haematoreia*	SC	Known
	Sweet pinesap	*Monotropsis odorata*	SC	Known
Greenwood				
	Carolina heelsplitter	*Lasmigona decorata*	E	Known
Hampton				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Wood stork	*Mycteria americana*	E	Known
	Eastern indigo snake	*Drymarchon corais couperi*	T	Possible
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known

	Boykin's lobella	*Lobelia boykinii*	SC	Known
	Carolina bogmint	*Macbridea caroliniana*	SC	Known
	Chapman's sedge	*Carex chapmanii*	SC	Known
	False coco	*Pteroglossaspis ecristata*	SC	Known
	Gopher frog	*Rana capito*	SC	Known
	Pine or Gopher snake	*Pituophis melanoleucus*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
Horry				
	West Indian manatee	*Trichechus manutus*	E	Known
	Finback whale	*Balaenoptera physalus**	E	Known
	Humpback whale	*Megaptera novaeanqliae**	E	Known
	Northern right whale	*Eubaleana glacialis**	E	Known
	Sei whale	*Balaenoptera borealis**	E	Known
	Sperm whale	*Physeter catodon**	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/PCH	Known

County	Common Name	Scientific Name	Status	Occurrences
Horry (cont.)				
	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
	Dusky shark	*Carcharhinus obscurus**	C	Possible
	Sand tiger shark	*Odontaspis taurus**	C	Possible
	Night shark	*Carcharinus signatus**	C	Possible
	Speckled hind	*Epinephelus drummondhayi**	C	Possible
	Jewfish	*E. itijara**	C	Possible
	Warsaw grouper	*E. nigritus**	C	Possible
	Nassau grouper	*E. striatus**	C	Possible
	Dwarf burhead	*Echinodorus parvalus*	SC	Known
	Carolina grass-of parnassus	*Parnassia caroliniana*	SC	Known

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Crested fringed orchid	*Pteroglossaspis ecristata*	SC	Known
Dwarf burhead	*Echinodorus parvulus*	SC	Known
Harper's fimbristylis	*Fimbristylis perpusilla*	SC	Known
One-flower balduina	*Balduina uniflora*	SC	Known
Pickering's morning-glory	*Stylisma pickerngii var. pickeringii*	SC	Known
Piedmont cowbane	*Oxypolis ternata*	SC	Known
Pine or Gopher snake	*Pituophis melanoleucus*	SC	Known
Pineland plantain	*Plantago sparsiflora*	SC	Known
Pondspice	*Litsea astivalis*	SC	Known
Venus' fly-trap	*Dionaea muscipula*	SC	Known
Well's Pyxie Moss	*Pyxidanthera barbulata var. barbulata*	SC	Known
White false-asphodel	*Tofieldia glabra*	SC	Known
Wire-leaved dropseed	*Sporobolus teretifolius*	SC	Known

County	Common Name	Scientific Name	Status	Occurrences
Jasper				
	West Indian manatee	*Trichechus manutus*	E	Known
	Finback whale	*Balaenoptera physalus*	E	Known
	Humpback whale	*Megaptera novaeanqliae*	E	Known
	Right whale	*Eubaleana glacialis*	E	Known
	Sei whale	*Balaenoptera borealis*	E	Known
	Sperm whale	*Physeter catodon*	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	Possible
	Eastern indigo snake	*Drymarchon corais couperi*	T	Possible
	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
	Flatwoods salamander	*Ambystoma cingulatum*	T	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Pondberry	*Lindera melissifolia*	E	Possible
	Canby's dropwort	*Oxypolis canbyi*	E	Possible
	Chaff-seed	*Schwalbea americana*	E	Known
	Dusky shark	*Carcharhinus obscurus**	C	Possible
	Sand tiger shark	*Odontaspis taurus**	C	Possible

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	Night shark	*Carcharinus signatus**	C	Possible
	Speckled hind	*Epinephelus drummondhayi**	C	Possible
	Jewfish	*E. itijara**	C	Possible
	Warsaw grouper	*E. nigritus**	C	Possible
	Nassau grouper	*E. striatus**	C	Possible
	Bachman's sparrow	*Aimophila aestivalis*	SC	Known
	Creeping St. Johns-wort	*Hypericum adpressum*	SC	Known
	Crested fringed orchid	*Pteroglossaspis ecristata*	SC	Known
	Florida pine snake	*Pituophis melanoleucus*	SC	Known
	Mimic glass lizard	*Ophisaurus mimicus*	SC	Known
	Pine or Gopher snake	*Pituophis melanoleucus*	SC	Known
	Pineland plantain	*Plantago sparsiflora*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
	Yellow lampmussel	*Lampsilis cariosa*	SC	Known

County	Common Name	Scientific Name	Status	Occurrences
Kershaw				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Carolina heelsplitter	*Lasmigona decorata*	E	Known
	Michaux's sumac	*Rhus michauxii*	E	Known
	Georgia aster	*Aster georgianus*	C	Known
	Carolina pygmy sunfish	*Elassoma boehlkei*	SC	Known
	One-flower stitchwort	*inuartia uniflora*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
	Southeastern myotis	*Myotis austroriparius*	SC	Known
	White-false-asphodel	*Tofieldia glabra*	SC	Known
	White-wicky	*Kalmia cuneata*	SC	Known
	Wire-leaved dropseed	*Sporobolus teretifolius*	SC	Known
Lancaster				
	Carolina heelsplitter	*Lasmigona decorata*	E	Known
	Little amphianthus	*Amphianthus pusillus*	T	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Schweinitz's sunflower	*Helianthus schweinitzii*	E	Known
	Black-spored quillwort	*Isoetes melanospora*	E	Known
	Brook floater	*Alasmidonta varicosa*	SC	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known

Laurens				
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Georgia aster	*Aster georganus*	C	Known
Lee				
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Chaffseed	*Schwalbea americana*	E	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
County	**Common Name**	**Scientific Name**	**Status**	**Occurrences**
Lexington				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Possible
	Smooth coneflower	*Echinacea laevigata*	E	Possible
	Schweinitz's sunflower	*Helianthus schweinitzii*	E	Known
	Pickering's morning-glory	*Stylisma pickeringii var. pickeringii*	SC	Known
	Piedmont cowbane	*Oxypolis ternata*	SC	Known
	Rayner's blueberry	*Vaccinium crassifolium ssp sempervirens*	SC	Known
	Shoal's spider-lily	*Hymenocallis coronaria*	SC	Known
Marion				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Wood stork	*Mycteria americana*	E	Possible
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Canby's dropwort	*Oxypolis canbyii*	E	Known
	Yellow lampmussel	*Lampsilis cariosa*	SC	Known
Marlboro				
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Possible
	Canby's dropwort	*Oxypolis canbyi*	E	Possible
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Pickering's morning-glory	*Stylisma pickeringii var.* pickeringii	SC	Known
	Spring-flowering goldenrod	*Solidago verna*	SC	Known
	Yellow lampmussel	*Lampsilis cariosa*	SC	Known

McCormick				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Carolina heelsplitter	*Lasmigona decorata*	E	Known
	Miccosukee gooseberry	*Ribes echinellum*	T	Known
	Georgia aster	*Aster georgianus*	C	Known
	Brook floater	*Alasmidonta varicosa*	SC	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known
	Yellow lampmussel	*Lampsilis cariosa*	SC	Known
County	**Common Name**	**Scientific Name**	**Status**	**Occurrences**
Newberry				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Saluda crayfish	*Distocambarus youngineri*	SC	Known
	Sweet pinesap	*Monotropsis odorata*	SC	Known
Oconee				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Small whorled pogonia	*Isotria medeoloides*	T	Known
	Persistent trillium	*Trillium persistens*	E	Known
	Georgia aster	*Aster georgianus*	C	Known
	Brook floater	*Alasmidonta varicosa*	SC	Known
	Fort mountain sedge	*Carex amplisquama*	SC	Known
	Fraser loosestrife	*Lysimachia fraseri*	SC	Known
	Green salamander	*Aneides aeneus*	SC	Known
	Hellbender	*Cryptobranchus alleganiensis*	SC	Known
	Manhart's sedge	*Carex manhartii*	SC	Known
	Oconee-bells	*Shortia galacifolia*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Southern appalachian woodrat	*Neotoma floridana haematoreia*	SC	Known
	Sun-facing coneflower	*Rudbeckia heliopsidis*	SC	Known
	Sweet pinesap	*Monotropsis odorata*	SC	Known
Orangeburg				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Flatwoods salamander	*Ambystoma cingulatum*	T	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known

County	Common Name	Scientific Name	Status	Occurrences
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
	Florida pine snake	Pituophis melanoleucus mugitus	SC	Known
	Gopher frog	*Rana capito*	SC	Known
	Incised groovebur	*Agrimonia incisa*	SC	Known
	Pondspice	*Litsea aestivalis*	SC	Known
	Southeastern myotis	*Myotis austroriparius*	SC	Known
County	**Common Name**	**Scientific Name**	**Status**	**Occurrences**
Pickens				
	Bald eagle	*Haliaeetus leucocephalus*	T	Possible
	Bog turtle	*Clemmys muhlenbergii*	T S/A	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Dwarf-flowered heartleaf	*Hexastylis naniflora*	T	Possible
	Black-spored quillwort	*Isoetes melanospora*	E	Known
	Mountain sweet pitcher-plant	*Sarracenia rubra ssp. jonesii*	E	Known
	Georgia aster	*Aster georgianus*	C	Known
	Alexander's rock aster	*Aster avitus*	SC	Known
	Fort Mountain sedge	*Carex amplisquana*	SC	Known
	Green salamander	*Aneides aeneus*	SC	Known
	Oconee-bells	*Shortia galacifolia*	SC	Known
	Biltmore greenbrier	Smilax biltmoreana	SC	
	Manhart sedge	*Carex manhartii*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Southern appalachian woodrat	*Neotoma floridana haematoreia*	SC	Known
	Sweet pinesap	*Monotropsis odorata*	SC	Known
Richland				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Smooth coneflower	*Echinacea laevigata*	E	Known
	Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Georgia aster	*Aster georgianus*	C	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Bog spicebush	*Lindera subcoriacea*	SC	Known
	Carolina bogmint	*Macbridea caroliniana*	SC	Known
	Carolina darter	*Etheostoma collis*	SC	Known

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County	Common Name	Scientific Name	Status	Occurrences
	Creeping St. John's wort	*Hypericum adpressum*	SC	Known
	False coco	*Pteroglossaspis ecristata*	SC	Known
	Purple balduina	*Balduina atropurpurea*	SC	Known
	Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known
	Rayner's blueberry	*Vaccinium crassifolium ssp. empervirens*	SC	Known
	Sandhills milk-vetch	*Astragalus michauxii*	SC	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known
	Southern hognose snake	*Heterodon simus*	SC	Known
	White false-asphodel	*Tofieldia glabra*	SC	Known
Saluda				
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Little amphianthus	*Amphianthus pusillus*	T	Known
	Piedmont bishop-weed	*Ptilimnium nodosum*	E	Known
	Creeping St. John's wort	*Hypericum adpressum*	SC	Known
	Dwarf burhead	*Echinodorus parvulus*	SC	Known
	Savannah lilliput	*Toxolasma pullus*	SC	Known
Spartanburg				
	Dwarf-flowered heartleaf	*Hexastylis naniflora*	T	Known
	Sweet pinesap	*Monotropsis odorata*	SC	Known
Sumter				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Chaff-seed	*Schwalbea americana*	E	Known
	Dwarf burhead	*Echinodorus parvulus*	SC	Known
	Awned meadowbeauty	*Rhexia aristosa*	SC	Known
	Boykin's lobelia	*Lobelia boykinii*	SC	Known
Union				
	Georgia aster	*Aster georgianus*	C	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known
	Sweet pinesap	*Monotropsis odorata*	SC	Known
Williamsburg				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Wood stork	*Mycteria americana*	E	Possible

County	Common Name	Scientific Name	Status	Occurrences
	Red-cockaded woodpecker	*Picoides borealis*	E	Known
	Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
	Canby's dropwort	*Oxypolis canbyi*	E	Known
	Chaff-seed	*Schwalbea americana*	E	Known

County	**Common Name**	**Scientific Name**	**Status**	**Occurrences**
York				
	Bald eagle	*Haliaeetus leucocephalus*	T	Known
	Little amphianthus	*Amphianthus pusillus*	T	Known
	Schweinitz' sunflower	*Helianthus schweinitzii*	E	Known
	Dwarf-flowered heartleaf	*Hexastylis naniflora*	T	Possible
	Georgia aster	*Aster georgianus*	C	Known
	Carolina darter	*Etheostoma collis*	SC	Known
	Shoals spider-lily	*Hymenocallis coronaria*	SC	Known
	Sun-facing coneflower	*Rudbeckia heliopsidis*	SC	Known

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South Carolina Department of
Natural Resources

Paul A. Sandifer, Ph.D.
Director
William S. McTeer
Deputy Director for
Wildlife and
Freshwater Fisheries

February 15, 2001

Stephen A. Byrne, Vice President, Nuclear Operations
SCE&G, Virgil C. Summer Nuclear Station
P.O. Box 88
Jenkinsville, SC 29065

RE: Virgil C. Summer Nuclear Station License Renewal
Request for Information on Listed Species and Important Habitats

Dear Mr. Byrne,

I have checked our database, and there are no occurrences of any federally or state threatened or endangered species within one mile of the project area. There are a number of known Bald Eagle nesting sites within a five mile radius. I've included a map indicating those locations for your information. Please understand that our database does not represent a comprehensive biological inventory of the state. Field work remains the responsibility of the investigator.

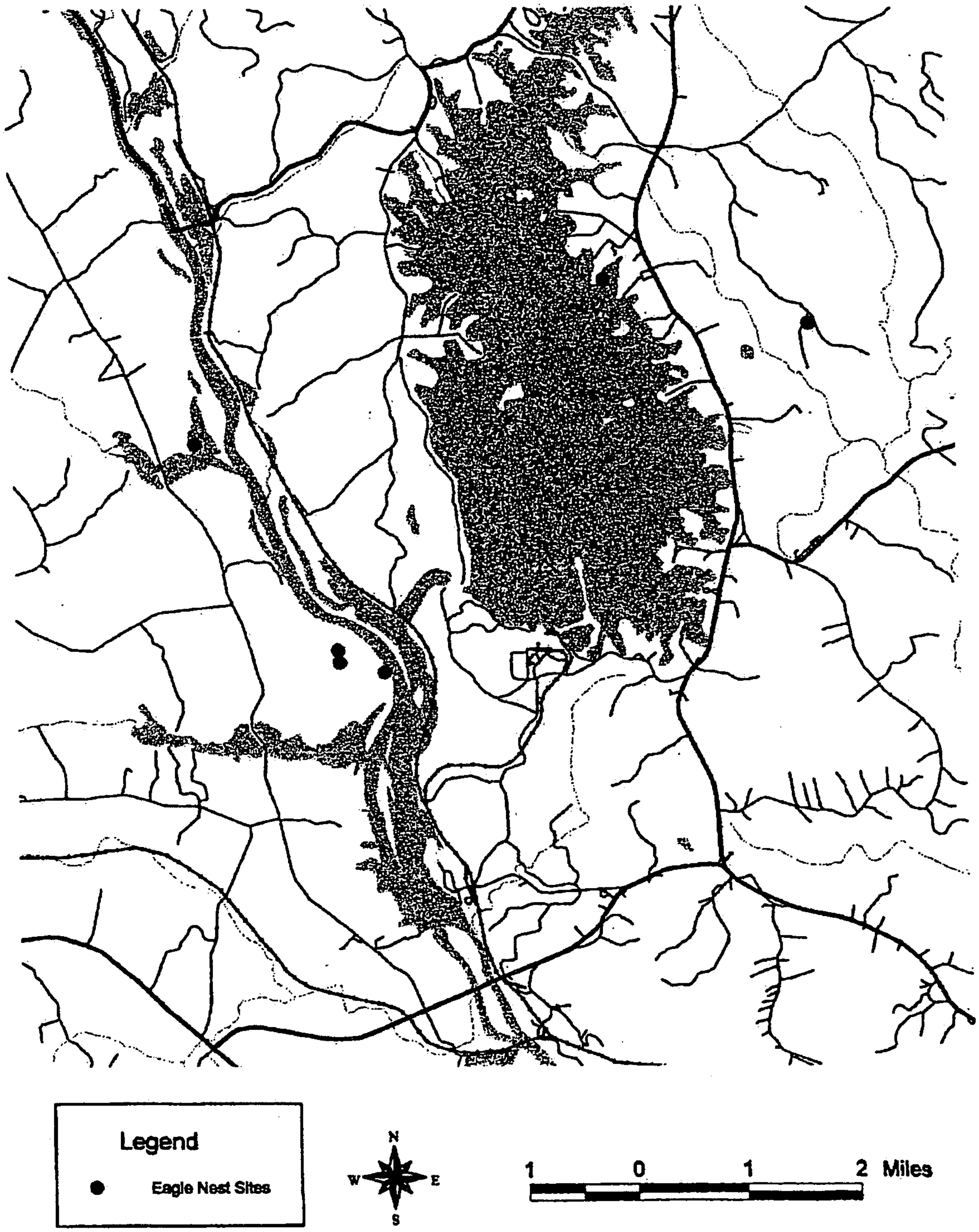
As an indication of other potential occurrences in the area, I have enclosed the lists of rare and endangered species for Fairfield, Newberry, and Richland counties. The highlighted ones are of legal significance. The remaining species on the list are of concern in the state.

If you need additional assistance, please contact me by phone at 803/734-3917 or by e-mail at JulieH@scdnr.state.sc.us.

Sincerely,

Julie Holling

Julie Holling
SC Department of Natural Resources
Heritage Trust Program


Legend
Eagle Nest Sites
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2 Miles

RARE, THREATENED, AND ENDANGERED SPECIES OF FAIRFIELD COUNTY

	STATUS...	GRANK...	SRANK...	SCIENTIFIC NAME.............	COMMON NAME................
ANIMALS:					
	SC	G3	S?	ETHEOSTOMA COLLIS	CAROLINA DARTER
	FT/SE	G4	S2	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE
	SC	G5	S?	PYGANODON CATARACTA	EASTERN FLOATER
	SC	G5	S4	SCIURUS NIGER	EASTERN FOX SQUIRREL
	SC	G4	S?	VILLOSA DELUMBIS	EASTERN CREEKSHELL
PLANTS:					
	SC	G2G3	S?	ASTER GEORGIANUS	GEORGIA ASTER
	SC	G4	S?	CAREX OLIGOCARPA	EASTERN FEW-FRUIT SEDGE
	SC	G4	S?	DIRCA PALUSTRIS	EASTERN LEATHERWOOD
	RC	G5	S1	FRASERA CAROLINIENSIS	COLUMBO
	SC	G3	S2	ISOETES PIEDMONTANA	PIEDMONT QUILLWORT
	SC	G4	S?	MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT
	SC	G5	S?	OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY
	SC	G5	S1	PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE
	SC	G4	S?	SCUTELLARIA PARVULA	SMALL SKULLCAP
	NC	G3	S2	SEDUM PUSILLUM	GRANITE ROCK STONECROP

RARE, THREATENED, AND ENDANGERED SPECIES OF LEXINGTON COUNTY

	STATUS	GRANK	SRANK	SCIENTIFIC NAME	COMMON NAME
ANIMALS:					
	FT/SE	G4	S2	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE
	SC	G2	S?	HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE
	SC	G5	S2	MICRURUS FULVIUS	EASTERN CORAL SNAKE
	FE/SE	G3	S2	PICOIDES BOREALIS	RED-COCKADED WOODPECKER
	SC	G5	S4	SCIURUS NIGER	EASTERN FOX SQUIRREL
	SC	G5	S?	SEMINATRIX PYGAEA	BLACK SWAMP SNAKE
PLANTS:					
	SC	G5T3T4	S1	ANDROPOGON PERANGUSTATUS	NARROW LEAVED BLUESTEM
	SC	G4?	S?	ARISTIDA CONDENSATA	PIEDMONT THREE-AWNED GRASS
	SC	G4	S1	ASPLENIUM PINNATIFIDUM	LOBED SPLEENWORT
	SC	G4G5	S?	BURMANNIA BIFLORA	NORTHERN BURMANNIA
	SC	G4	S1	CAREX COLLINSII	COLLINS' SEDGE
	SC	G4G5	S1S2	CHRYSOMA PAUCIFLOSCULOSA	WOODY GOLDENROD
	SC	G3G5	S?	COREOPSIS GLADIATA	SOUTHEASTERN TICKSEED
	SC	G5	S1	EUONYMUS ATROPURPUREUS	WAHOO
	SC	G4	S?	GAYLUSSACIA MOSIERI	WOOLLY-BERRY
	NC	G2Q	S2	HYMENOCALLIS CORONARIA	SHOALS SPIDER-LILY
	SC	G4	S?	HYPERICUM NITIDUM	CAROLINA ST. JOHN'S-WORT
	SC	G4	S3	ILEX AMELANCHIER	SARVIS HOLLY
	SC	G3G4	S?	LIATRIS MICROCEPHALA	SMALL-HEAD GAYFEATHER
	SC	G?	S?	LOBELIA SP 1	LOBELIA
	SC	G3	S?	LYCOPUS COKERI	CAROLINA BUGLEWEED
	SC	G5	S?	MENISPERMUM CANADENSE	CANADA MOONSEED
	RC	G3	S2	MYRIOPHYLLUM LAXUM	PIEDMONT WATER-MILFOIL
	SC	G3G5	S?	NOLINA GEORGIANA	GEORGIA BEARGRASS
	SC	G3	S?	OXYPOLIS TERNATA	PIEDMONT COWBANE
	SC	G4	S?	PITYOPSIS PINIFOLIA	PINE-LEAVED GOLDEN ASTER
	SC	G5	S1S2	POLYGALA NANA	DWARF MILKWORT
	SC	G5	S1	RHYNCHOSPORA ALBA	WHITE BEAKRUSH
	SC	G3G4	S?	RHYNCHOSPORA INUNDATA	DROWNED HORNEDRUSH
		G3	SR	RHYNCHOSPORA LEPTOCARPA	
	SC	G4	S?	RHYNCHOSPORA STENOPHYLLA	CHAPMAN BEAKRUSH
	SC	G5	S?	RORIPPA SESSILIFLORA	STALKLESS YELLOWCRESS
	SC	G3G4	S2	SAGITTARIA ISOETIFORMIS	SLENDER ARROW-HEAD
	SC	G3	S1	SARRACENIA RUBRA	SWEET PITCHER-PLANT
	SC	G4G5	S?	SCIRPUS SUBTERMINALIS	WATER BULRUSH
	NC	G1G2	S1	SPOROBOLUS TERETIFOLIUS	WIRE-LEAVED DROPSEED
	SC	G4T2T3	S1	STYLISMA PICKERINGII VAR PICKERINGII	PICKERING'S MORNING-GLORY
	SC	G3?	S?	TRIDENS CAROLINIANUS	CAROLINA FLUFF GRASS
	NC	G4G5T1	S1	VACCINIUM CRASSIFOLIUM SSP SEMPERVIRENS	RAYNER'S BLUEBERRY
	SC	G3	S?	XYRIS CHAPMANII	CHAPMAN'S YELLOW-EYED GRASS

RARE, THREATENED, AND ENDANGERED SPECIES OF NEWBERRY COUNTY

	STATUS	GRANK	SRANK	SCIENTIFIC NAME	COMMON NAME
ANIMALS:					
	SC	G1	S1	DISTOCAMBARUS YOUNGINERI	A CRAYFISH
	SC	G2G3	S?	ELLIPTIO LANCEOLATA	YELLOW LANCE
	FT/SE	G4	S2	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE
	SC	G5	S3?	URSUS AMERICANUS	BLACK BEAR
PLANTS:					
	SC	G4	S?	DIRCA PALUSTRIS	EASTERN LEATHERWOOD
	SC	G5?	S?	EUPATORIUM FISTULOSUM	HOLLOW JOE-PYE WEED
	RC	G5	S1	FRASERA CAROLINIENSIS	COLUMBO
	SC	G5	S?	HETERANTHERA RENIFORMIS	KIDNEYLEAF MUD-PLANTAIN
	SC	G5	S?	LIPARIS LILIIFOLIA	LARGE TWAYBLADE
	RC	G4	S1	MAGNOLIA PYRAMIDATA	PYRAMID MAGNOLIA
	RC	G3	S1	MONOTROPSIS ODORATA	SWEET PINESAP
	SC	G5T5	S?	VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET

APPENDIX B

Photographs

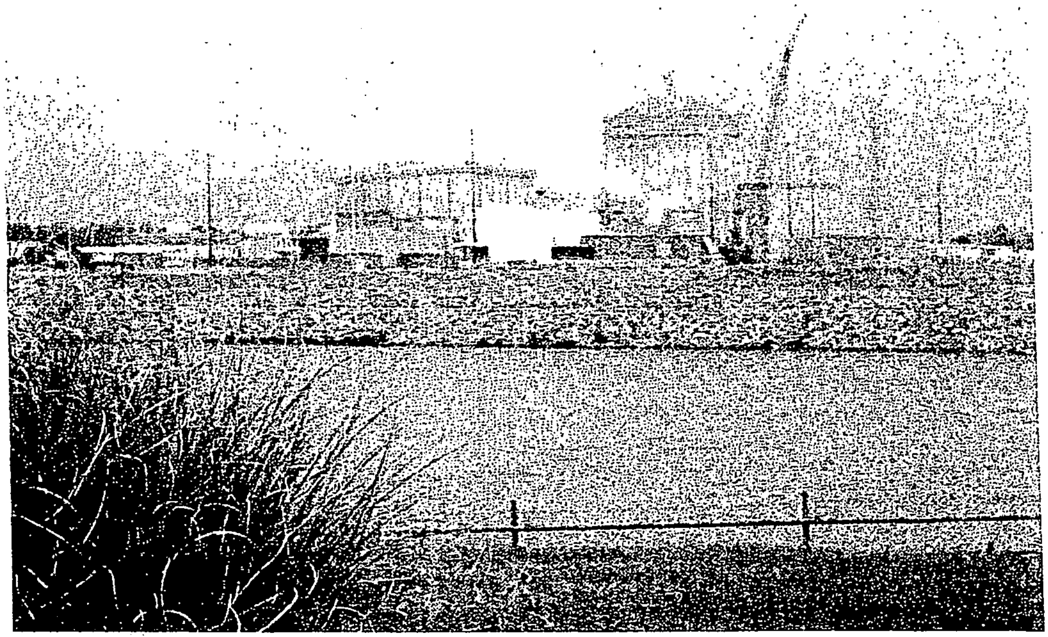

Photo 1. View of VCSNS generating facilities from the discharge canal area.

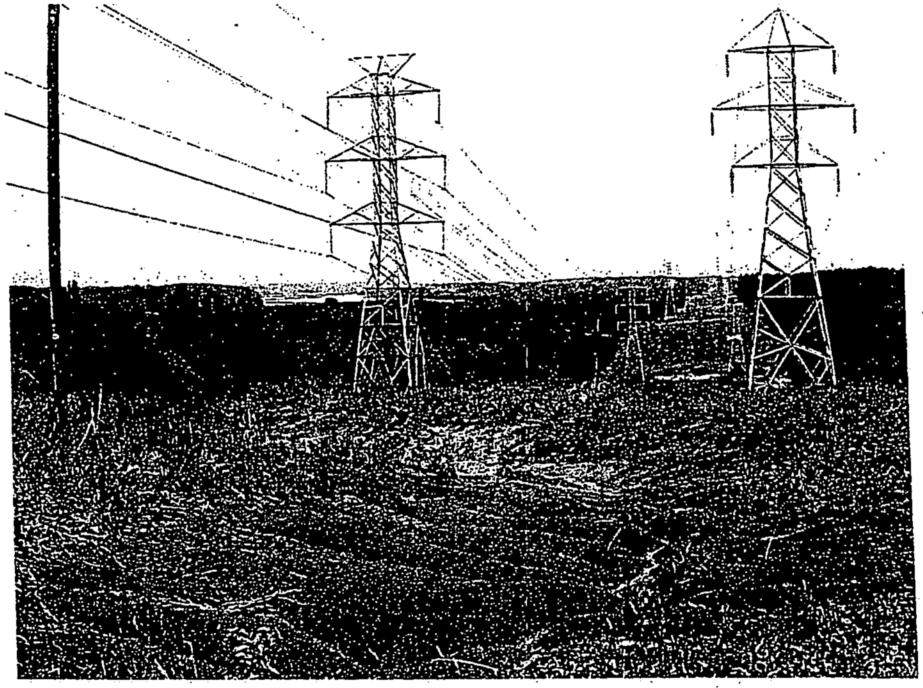

Photo 2. Gullied transmission corridor immediately east of Parr Reservoir.

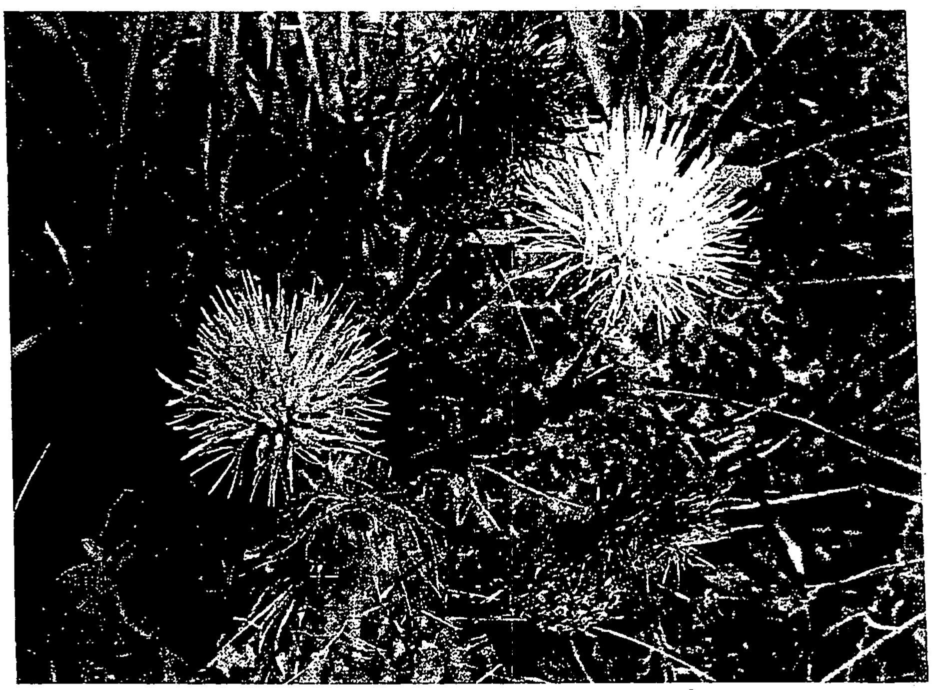

Photo 3. Sand-thistle (*Cirsium repandum*).

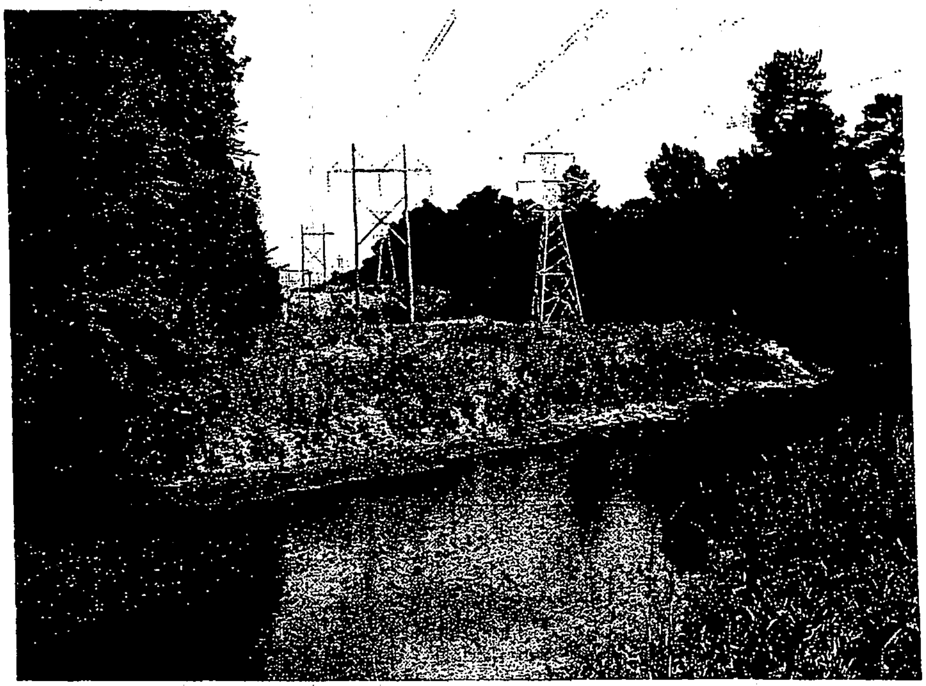

Photo 4. Little River, with Richland County (east) bank in foreground and Fairfield County (west) bank in background. (Denny Terrace Site D5)

Photo 5. Thin-leafed mountain mint (*Pycnanthemum tenuifolium*).

Photo 6. Climbing milkweed (*Gonolubus suberosus*).

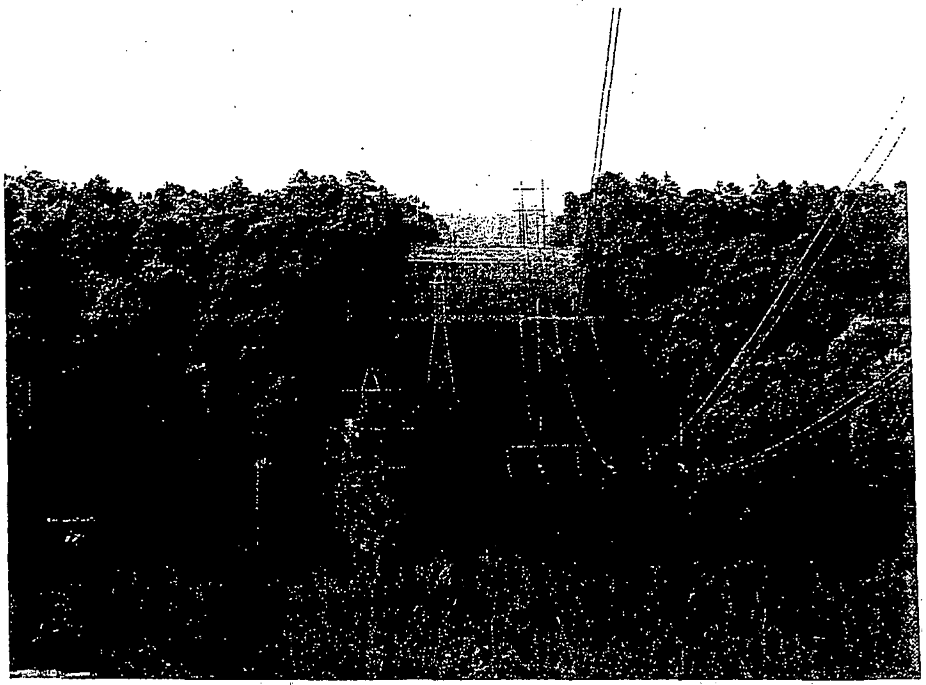

Photo 7. View of Columbia skyline from area of Columbia International University (Denny Terrace Site D11)

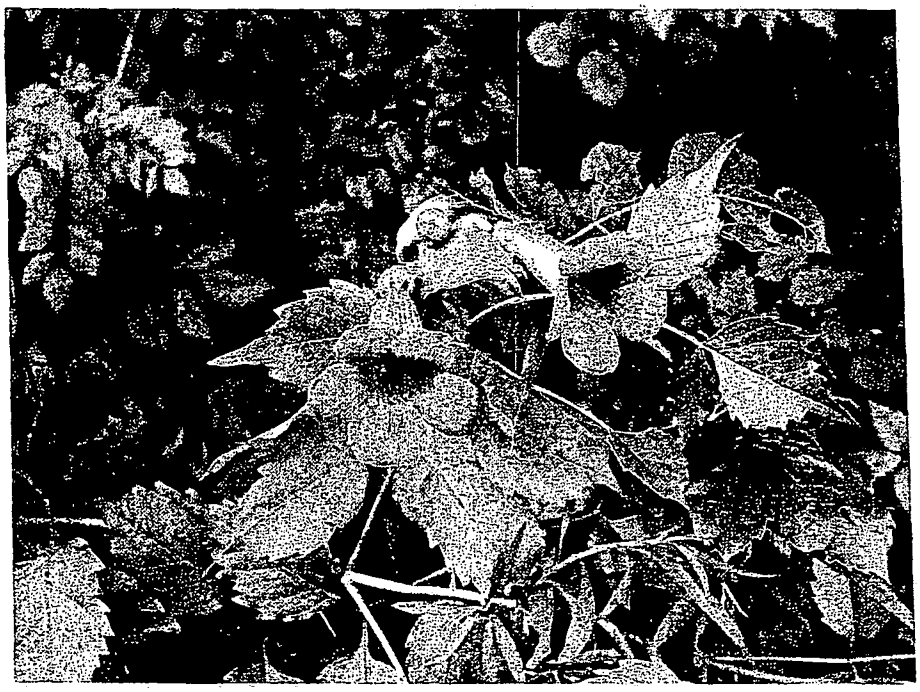

Photo 8. Cow-itch vine (*Campsis radicans*).

Photo 9. Manroot (*Ipomoea pandurata*).

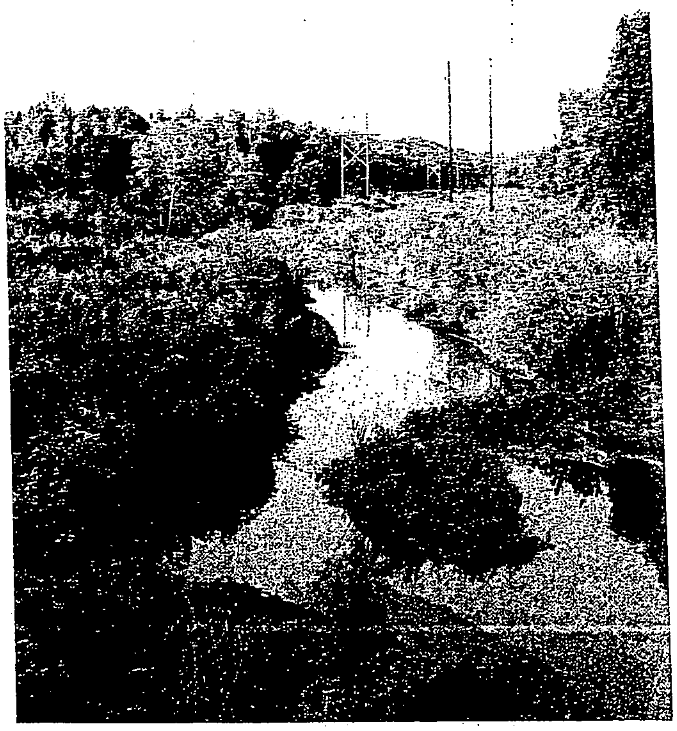

Photo 10. Crane Creek, view to west. The photo is taken from SC 215.
(Denny Terrace Site D14)

Photo 11. Bishop's weed (*Ptilimnium capillaceum*).

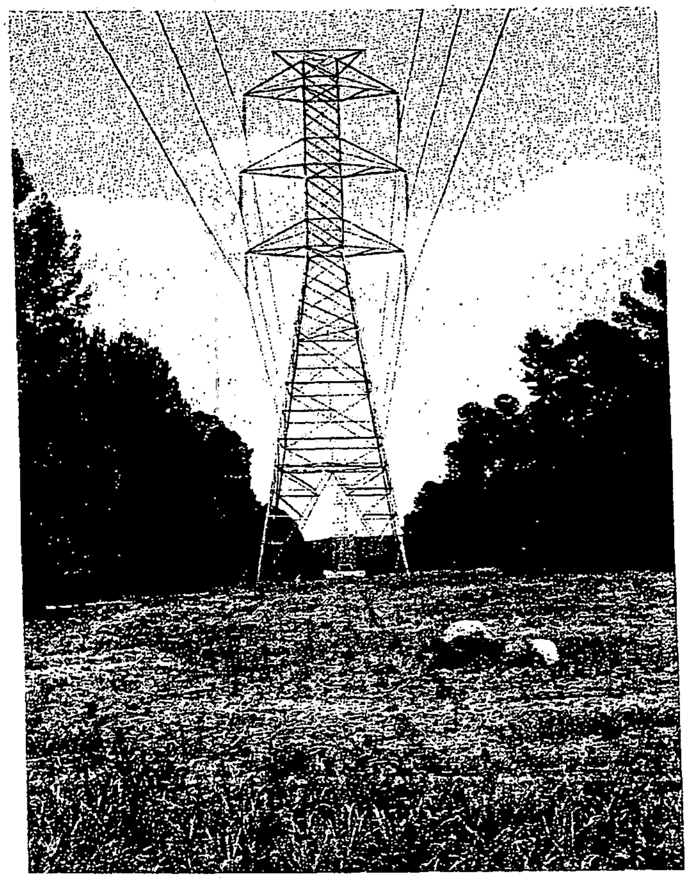

Photo 12. View toward Parr Reservoir from south (Newberry) side of Cannons Creek (Graniteville Site G1).

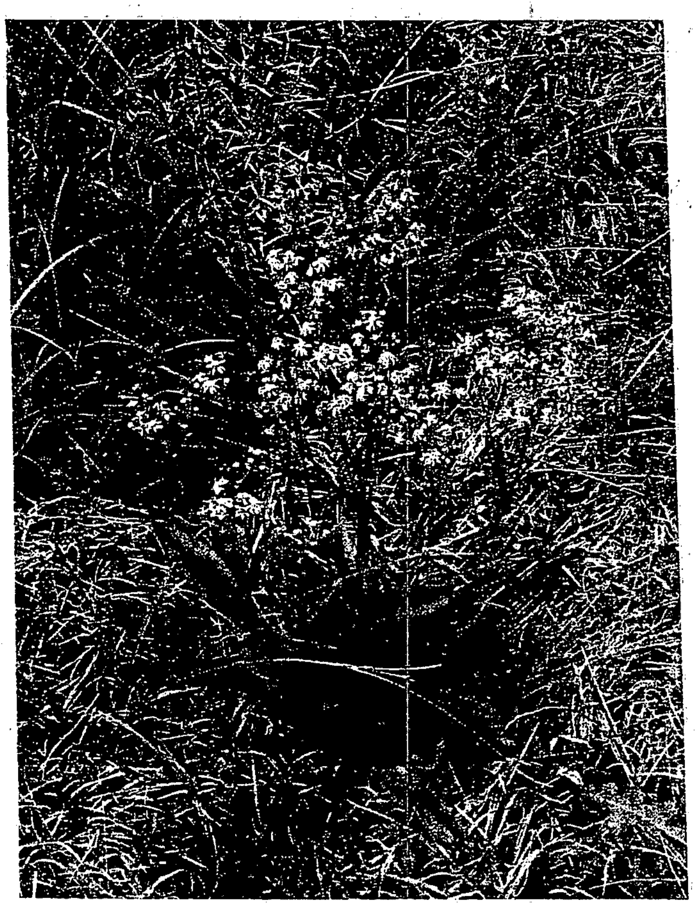

Photo 13. Sneezeweed (*Senecio anonymus*).

Photo 14. Butterfly weed (*Asclepias tuberosa*), with Indian pink (*Spigelia marilandica*) visible just left of center.

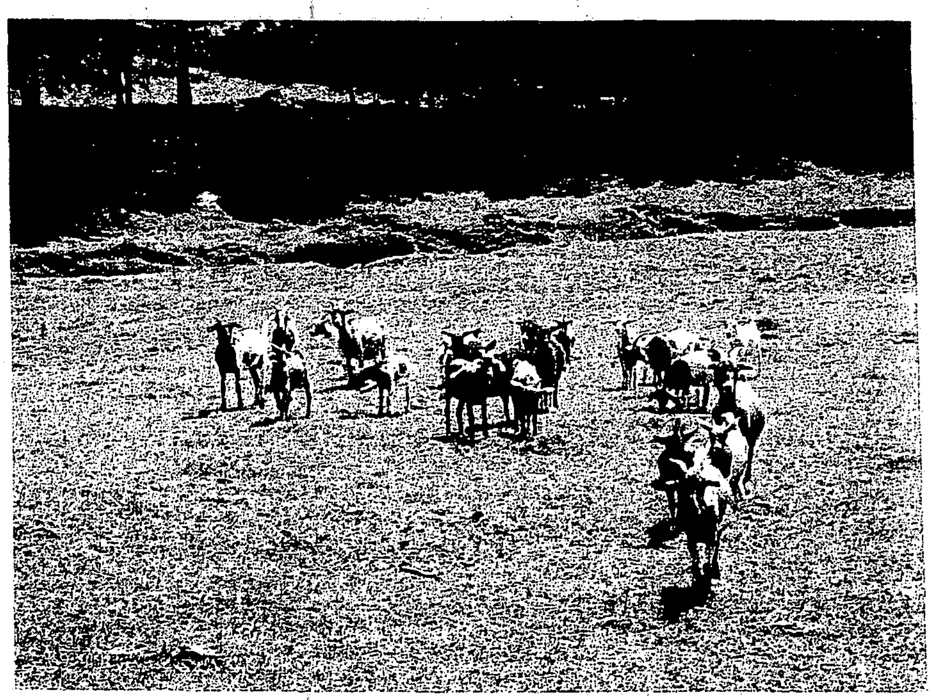

Photo 15. Goats and pastureland (Graniteville Site G10).

Photo 16. Bogmint (*Macbridea caroliniana*).

Photo 17. Pink meadow beauty (*Rhexia mariana* var. *maniana*).

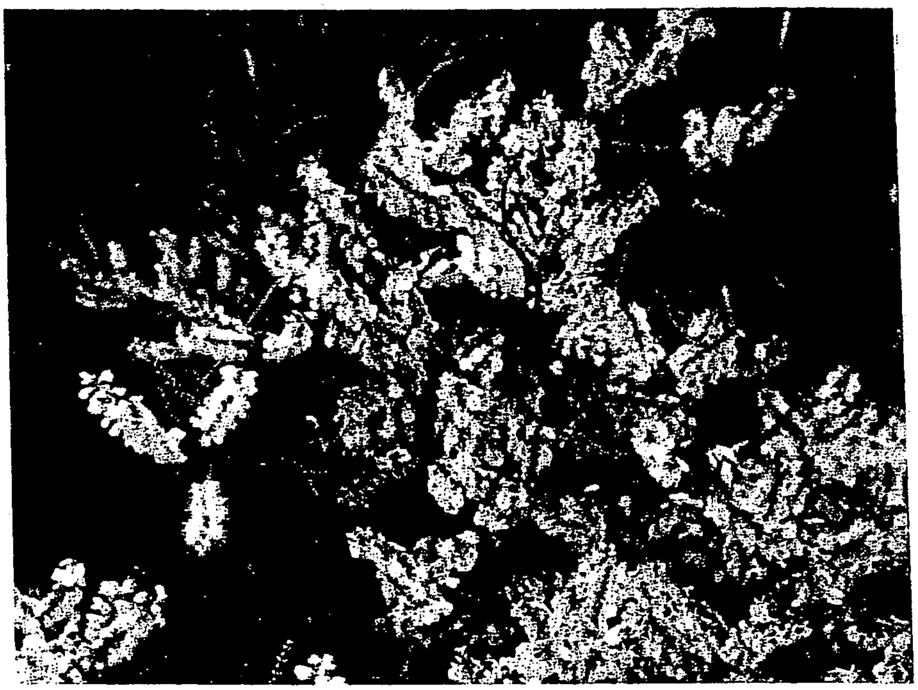

Photo 18. Jointweed (*Polygonella americana*).

Photo 19. Lloyd's hypericum (*Hypericum lloydii*).

Photo 20. Sandhill morning-glory (*Stylisma patens*).

Photo 21. Sticky foxglove (*Aureolaria pectinata*).

Photo 22. Narrow-leaf ironweed (*Vernonia angustifolia*).

Photo 23. Tread-softly (*Cnidoscolus stimulosus*).

Photo 24. False dandelion (*Pyrrhopappus carolinianus*).

Photo 25. Helenium (*Helenium flexuosum*).

Photo 26. Bear's paw (*Polymnia uvedalia*).

Photo 27. Indian pink (*Spigelia marilandica*).

Photo 28. View of active beaver pond, Newberry Site N8.

Photo 29. Blue skullcap (*Scutellaria integrifolia*).

APPENDIX C

Scientific Names of Plants Mentioned in Report

Plant species at VCSNS (bold taxa potentially present, not observed)
(alphabetized by common name)

Common Name	Scientific Name
American ash	*Fraxinus americana*
American beauty-berry	*Callicarpa americana*
American beech	*Fagus grandifolia*
American columbo	*Frasera caroliniensis*
American holly	*Ilex opaca*
Angelica	*Angelica venenosa*
Annual fescue	*Vulpia octoflora*
Bahia grass	*Paspalum notatum*
Beakrush	*Rhynchospora caduca*
Beakrush	*Rhynchospora chalarocephala*
Beard-tongue	*Penstemon australis*
Bear's paw	*Polymnia uvedalia*
Bee-mint	*Blephilia ciliata*
Bell-wort	*Uvularia sessilifolia*
Bighead lespedeza	*Lespedeza capitata*
Bishop's weed	*Ptilimnium capillaceum*
Black cherry	*Prunus serotina*
Black cohosh	*Cimicifuga racemosa*
Black gum	*Nyssa sylvatica*
Black oak	*Quercus velutina*
Black walnut	*Juglans nigra*
Black willow	*Salix nigra*
Blackberry	*Rubus argutus*
Black-eyed susan	*Rudbeckia fulgida*
Blackjack oak	*Quercus marilandica*
Blue skullcap	*Scutellaria integrifolia*
Blue-eyed grass	*Sisyrinchium atlanticum*
Bog-mint	*Macbridea caroliniana*
Box elder	*Acer negundo*
Bracken fern	*Pteridium aquilinum*
Broomstraw	*Andropogon virginicus*
Burning tragia	*Tragia urticifolia*
Butterfly pea	*Centrosema virginiana*
Butterfly-weed	*Asclepias tuberosa*
Camphor-weed	*Pluchea foetida*
Canarygrass	*Phalaris caroliniensis*
Carolina rose	*Rosa carolina*
Cattail	*Typha latifolia*
Chalky-stem sunflower	*Helianthus divaricatus*
Cheat	*Bromus secalinus*
Chestnut oak	*Quercus prinus*
Christman fern	*Polystichum acrostichoides*
Chrysanthemum	*Chrysanthemum leucanthemum*
Cinnamon vine	*Dioscorea villosa*
Cleavers	*Galium aparine*
Climbing hemp	*Mikania scandens*
Climbing hydrangea	*Decumaria barbara*

Climbing milkweed	*Gonolobus gonocarpus*
Corn salad	*Valerianella radiata*
Cow-itch vine	*Campsis radicans*
Crossvine	*Bignonia capreolata*
Cucumber tree	*Magnolia acuminata*
Cudweed	*Facelis retusa*
Cutleaf primrose	*Oenothera laciniata*
Dallis grass	*Paspalum dilatatum*
Deciduous holly	*Ilex decidua*
Desmodium	*Desmodium nudum*
Devil's shoestring	*Tephrosia virginiana*
Dewberry	*Rubus cuneuifolius*
Dogbane	*Apocynum cannabinum*
Dog-fennel	*Eupatorium capillifolium*
Dogwood	*Cornus florida*
Duck potato	*Sagittaria latiolia*
Dwarf meadow beauty	*Rhexia petiolata*
Ebony spleenwort	*Asplenium platyneuron*
Elderberry	*Sambucus canadensis*
False dandelion	*Krigia virginica*
False dandelion	*Pyrrhopappus carolinianus*
False indigo	*Indigofera caroliniana*
False nettle	*Boehmeria cylindrica*
Fescue	*Festuca elatior*
Field croton	*Croton capitatus*
Field onion	*Allium canadense*
Fireweed	*Erechtites hieracifolia*
Flannelplant	*Verbascum thapsus*
Flea-bane	*Erigeron strigosus*
Florida maple	*Acer floridanum*
Foxtail clubmoss	*Lycopodium alopecuroides*
Fragrant croton	*Croton septentrionalis*
Fragrant sumac	*Rhus aromatica*
Frost flower	*Helianthemum rosmarinifolium*
Geranium	*Geranium maculatum*
Golden alexander	*Zizia trifoliata*
Gooseberry	*Vaccinium stamineum*
Granddaddy greybeard	*Chionanthus virginicus*
Green milkweed	*Asclepias viridiflora*
Ground cherry	*Physalis viscosa*
Hackberry	*Celtis laevigata*
Hairgrass	*Aira elegans*
Hairy brome	*Bromus commutatus*
Harparella	*Ptilmnium nodosum*
Heal-all	*Prunella vulgaris*
Helenium	*Helenium flexuosum*
Heliotrope	*Heliotropium amplexicaule*
Hepatica	*Hepatica americana*
High-pond hypericum	***Hypericum adpressum***
Highway lespedeza	*Lespedeza cuneata*
Himalaya berry	*Rubus bifrons*

Hop hornbeam	*Ostrya virginiana*
Horse nettle	*Solanum carolinense*
Indian cherry	*Rhamnus caroliniana*
Indian chickweed	*Mollugo verticillata*
Indian pink	*Spigelia marilandica*
Ironweed	*Vernonia acaulis*
Ironwood	*Carpinus caroliniana*
Italian ryegrass	*Lolium perenne*
Joe-pye weed	*Eupatorium dubium*
Johnson grass	*Sorghum halapense*
Jointweed	*Polygonella americana*
Ladies' tresses	*Spiranthes cernua*
Ladino clover	*Trifolium repens*
Licorice goldenrod	*Solidago odorata*
Little nutrush	*Scleria oligantha*
Lizard's tail	*Saururus cernuus*
Lloyd's hypericum	*Hypericum lloydii*
Loblolly pine	*Pinus taeda*
Longleaf pine	*Pinus palustris*
Lyre-leaved sage	*Salvia lyrata*
Mall grass	*Eragrostis curvula*
Manna grass	*Glyceria septentrionalis*
Manroot	*Ipomoea pandurata*
Mayapple	*Podophyllum peltatum*
Maypop	*Passiflora incarnata*
Mockernut hickory	*Carya tomentosa*
Monkey flower	*Mimulus ringens*
Moth mullein	*Verbascum blattaria*
Mountain laurel	*Kalmia latifolia*
Mountain mint	*Pycnanthemum tenuifolium*
Muscadine	*Vitis rotundifolia*
Nanny-berry	*Viburnum prunifolium*
Narrow-leaf beakrush	***Rhynchospora stenophylla***
Narrow-leaf ironweed	*Vernonia angustifolia*
Narrow-leaf milkweed	*Asclepias verticillata*
Oat-grass	*Danthonia spicata*
Orange milkwort	*Polygala lutea*
Orchard grass	*Dactylis glomerata*
Ox-eye daisy	*Heliopsis helianthoides*
Painted buckeye	*Ausculus flava*
Panic grass	*Panicum boscii*
Parrot feather	*Myriophyllum aquaticum*
Pawpaw	*Asimina triloba*
Pencil flower	*Stylosanthes biflora*
Pennyroyal	*Hedeoma hispida*
Persimmon	*Diospyros virginiana*
Phlox	*Phlox divaricata*
Pickering's morning-glory	***Stylisma pickeringii***
Pignut hickory	*Carya glabra*
Pink meadow beauty	*Rhexia mariana var. mariana*
Plantain	*Plantago virginica*

Poison hemlock	*Cicuta maculata*
Poison ivy	*Toxicodendron radicans*
Post oak	*Quercus stellata*
Prickly pear cactus	*Opuntia humifusa*
Purple vetch	*Vicia cracca*
Pussy-toes	*Antennaria plantaginifolia*
Quaking grass	*Briza minor*
Queen's delight	*Stillingia sylvatica*
Rabbit tobacco	*Gnaphalium obtusifolium*
Rabbit-foot clover	*Trifolium arvense*
Ragweed	*Ambrosia artemesiifolia*
Red cedar	*Juniperus virginiana*
Red maple	*Acer rubrum*
Red mulberry	*Morus rubra*
Red oak	*Quercus rubra*
Red pitcher plant	***Sarracenia rubra***
Red treasure lily	***Lilium gazarubrum***
Redbud	*Cercis canadensis*
Rose pink	*Sabatia angularis*
Rosin plant	*Silphium compositum*
Rosy tickseed	***Coreopsis rosea***
Rough-leafed loosestrife	***Lysimachia asperulaefolia***
Round-leaf boneset	*Eupatorium rotundifolium*
Round-leaf catbriar	*Smilax rotundifolia*
Rush	*Juncus marginatus*
Russian olive	*Eleagnus umbellata*
Sand thistle	*Cirsium repandum*
Sandbog beakrush	***Rhynchospora oligantha***
Sandhill milk-vetch	***Astragalus michauxii***
Sandhill morning-glory	*Stylisma patens*
Sandhill rosemary	*Ceratiola ericoides*
Sanicle	*Sanicula marilandica*
Sedge	*Carex debilis*
Sedge	*Carex frankii*
Sedge	*Carex howei*
Sedge	*Carex lupulina*
Sedge	*Carex lurida*
Sedge	*Carex superata*
Sedge	*Cyperus echinatus*
Sedge	*Cyperus retrofractus*
Sedge	*Cyperus strigosus*
Sedge	*Eleocharis obtusa*
Sedge	*Carex cephalophora*
Sedge	*Carex crinita*
Sedge	*Cyperus compressus*
Sensitive briar	*Schrankia microphylla*
Sensitive fern	*Onoclea sensibilis*
She-pea	*Clitoria mariana*
Shining panic grass	*Panicum lucidum*
Shortleaf pine	*Pinus echinata*
Sicklepod	*Arabis laevigata*

Silkyscale	*Anthaenantia villosa*
Skullcap	*Scutellaria elliptica*
Sleepy catchfly	*Silene antirrhina*
Slippery elm	*Ulmus rubra*
Smooth nutrush	*Scleria triglomerata*
Snakeroot	*Aristolochia serpentaria*
Sneeze-weed	*Senecio anonymus*
Sourweed	*Rumex acetosella*
Sourwood	*Oxydendron arboreum*
Southern red oak	*Quercus falcata*
Sparkleberry	*Vaccinium arboreum*
Spoonleaf seedbox	***Ludwigia spathulata***
Spotted wintergreen	*Chimaphila maculata*
Sticky foxglove	*Aureolaria pectinata*
Summer grape	*Vitis aestivalis*
Sundrops	*Oenothera fruticosa*
Sunflower	*Helianthus atrorubens*
Swamp dayflower	*Commelina virginica*
Swamp dogwood	*Cornus amomum*
Swamp skullcap	*Scutellaria lateriflora*
Sweetbay	*Magnolia virginiana*
Sweet-gum	*Liquidambar styraciflua*
Tall windflower	*Anemone virginica*
Thistle	*Cirsium vulgare*
Three-seeded mercury	*Acalypha rhomboidea*
Tickseed	*Coreopsis major*
Toad-flax	*Linaria canadensis*
Touch-me-not	*Impatiens capensis*
Tree of heaven	*Ailanthus altissima*
Turkey-foot grass	*Tripsacum dactyloides*
Venus' looking glass	*Triodanis perfoliata*
Verbena	*Verbena brasiliensis*
Vietnam grass	*Microstegium vimineum*
Virginia creeper	*Parthenocissus quinquefolia*
Wahlenbergia	*Wahlenbergia marginata*
Walter's violet	*Viola walteri*
Water oak	*Quercus nigra*
Water pimpernel	*Samolus parviflorus*
White meadow beauty	*Rhexia mariana var. exalbida*
White milkweed	*Asclepias variegata*
White oak	*Quercus alba*
White-topped aster	*Aster solidagineus*
Wild carrot	*Daucus carota*
Wild ginger	*Hexastylis arifolia*
Wild petunia	*Ruellia caroliniensis*
Wild radish	*Raphanus raphanistrum*
Wild savory	*Cunila origanoides*
Wild senna	*Cassia marilandica*
Windflower	*Thalictrum thalictroides*
Wing stem	*Verbesina occidentalis*
Winged elm	*Ulmus alata*

Winged sumac	*Rhus copallina*
Witch-hazel	*Hamamelis virginiana*
Woodgrass	*Melica mutica*
Woods iris	*Iris verna*
Wool-grass	*Scirpus cyperinus*
Yellow baptisia	*Baptisia tinctoria*
Yellow maypop	*Passiflora lutea*
Yellow poplar	*Liriodendron tulipifera*

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South Carolina Electric & Gas Company
230 kV Electric Transmission Right-of-Way Vegetation Management Program
Revision 2 dated January 3, 2006 – JBL

I. PURPOSE
Our goal is to control all types of vegetation that could affect the reliability and safety of the 987 miles of 230 kV transmission rights-of-way on our system. This will be achieved through various methods such as tree trimming, herbicide application, vegetation encroachment removal, mowing, and danger tree removal, all contingent upon local ordinances, codes, federal and state property owner issues, and other property owner issues. All work performed under this vegetation management program will be directed by the System Forester. The System Forester is required to be a registered forester in the state of South Carolina.

II. METHODS

A. Tree Trimming
Both aerial and ground crews will conduct routine tree trimming along our rights-of-way. These crews will trim all vegetation back to the original trim line or easement width depending upon what is best for the tree. Tree trimming will be conducted on an established rotation, which will be determined on a line-by-line basis depending upon the right-of-way width and transmission line structure configurations. This could range from three to twelve years.

B. Herbicide Application
We will apply herbicides to control any vegetation that might grow and interfere with our 230 kV rights-of-way. This will be conducted on a five-year rotation or as needed. Only herbicides that are safe to the environment will be used. All herbicides will be used in accordance to the recommended rates on the label.

C. Vegetation Encroachments
Crews will maintain the rights-of-way by removing any vegetation that has grown into the R/W corridor pursuant to the reconciliation of any outstanding property owner issues. Any vegetation encroachment posing an imminent threat to the dielectric integrity of the line will be immediately removed. Vegetation encroachment schedules will be determined based on inspection results and other information from company personnel, contractors, or property owners.

D. Mowing
When the use of herbicides isn't practical, we will mow the right-of-way. This will be determined by an inspection of the area. All mowing will be done on a three-year cycle, or as needed.

E. Danger Tree Removal
Danger trees will be identified through routine aerial and ground patrols. A danger tree is a tree, on or off the R/W, that is within the fall zone of the line and is dead, diseased, or

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has any obvious potential risk to the system. As these trees are identified, they will be removed.
Trimming

III. INSPECTIONS

Aerial Inspections will be performed over the entire 230 kV transmission system once a year except for those parts of the system that must be patrolled from the ground due to FAA regulations or other restrictions. Additional ground patrols will be performed on an as needed, or demand basis.

Additional unscheduled inspections will naturally occur as a result of other line work being conducted as a part of capital projects or other routine line hardware inspections. In all cases, upon discovering any situation that presents an immediate threat of a transmission outage, the discovering party will immediately notify the Transmission System Dispatcher so that remedial action can be taken until the threat is resolved.

IV. TRIMMING CLEARANCES

Clearance 1 – (Clearance at the time the work is performed) – Trimming clearances for each transmission corridor will be either to the edge of the R/W or will be of sufficient width and clearance to satisfy the reliability requirements of the trimming cycle.

Clearance 2 – (Minimum clearance allowed at any time during the trim cycle for designed operating conditions) – Minimum clearances allowed under all designed operating conditions, including emergency ratings for blow-out and sag, are based on IEEE 516-2003, table 5 which specifies a minimum clearance of **1.57 meters** for 230kV phase-to-ground.

V. ANNUAL WORK PLAN - 2006

The following 230KV lines and line sections are scheduled for completion in 2006. Variances to this schedule will be noted as they occur:

A. Inspections

As indicated above, all 230 kV transmission line rights-of-way will undergo visual inspections in 2006. These will be aerial inspections except for those parts of the transmission system that cannot be flown over due to FAA regulations or other restrictions. In those cases, ground patrols will be conducted. R/W maintenance schedules may be adjusted based on inspections results and other information from company personnel, contractors, or property owners.

B. Line Trimming

Line Description	Qrtly Schd	Rev. Schd	Reason for Schedule Revision	Cmpl Qtr
Canadys-Mateeba 230kV	1st.			100%
Mateeba-Williams 230kV	3rd.			40%
Summerville-Williams (To	3rd.			20%

Naval Base Fence)230kV				
Pepper Hill-Ladson Jct. 230kV	2nd.			90%
Goose Creek –Williams 230kV	4th.			0%
Summer- Graniteville 230kV	2nd.			80%
Timberlake Tap 230kV	2nd.			80%
Edenwood-McMeekin 230kV	4th.			0%

C. Herbicide (supports the specified 5 year cycle)

Line Description	Qrtly Schd	Rev. Schd	Reason for Schedule Revision	Cmpl Qtr
Summer-Graniteville 230kV	3rd.			0%
Summer-Newberry 230KV	3rd.			0%
Timberlake Tap 230kV	3rd.			0%
Graniteville-Urquhart 230kV	3rd.			0%
Canadys-Urquhart (Urquhart to SRS fence) 230kV	3rd.			0%

D. Mowing

No R/W is scheduled for mowing in 2006

Reviewed by:

Alan Brock, System Forester — Date

David Burkhalter — Date
Manager - Power Delivery Operations – Northern Region

Jerry B. Lindler — Date
General Manager - Electric Transmission and Construction

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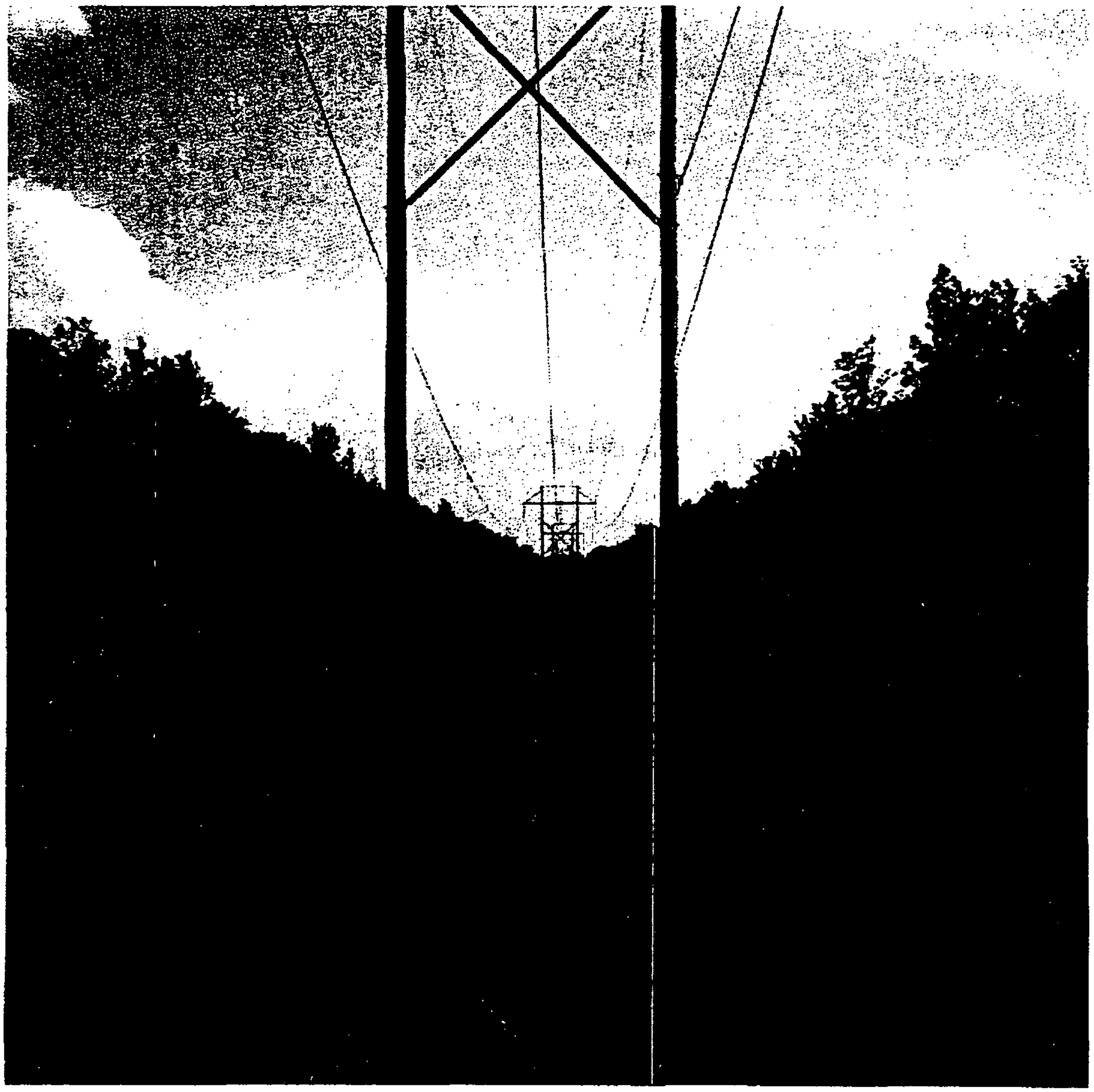
SANTEE COOPER
TRANSMISSION VEGETATION MANAGEMENT PROGRAM



Prepared by: Kenneth R. Sott
Date: February 17, 2006

Objectives

To provide an integrated Transmission Vegetation Maintenance Program (TVMP) that protects transmission system availability, provides safety to the public, promotes a positive public image, and complies with NERC Standard FAC-003-1.

To insure that the following key components that make up Santee Cooper's Transmission Vegetation Management Program are systematically reviewed and implemented appropriately.

- Consistent vegetation maintenance cycles
- Routine rights-of-way vegetation inspections
- Effective maintenance reporting tools
- Scheduling flexibility
- Utilization of best management vegetation practices
- Respect for individual property rights

Introduction

Santee Cooper is responsible for maintaining approximately 35,000 brush acres and trees on the periphery of the right-of-way on over 3,900 miles of transmission rights-of-way. The Santee Cooper transmission system is located throughout the state, except in the extreme northwest section, which creates a number of vegetation maintenance problems due to the differing topography, soil types and climates found throughout the state. In order to maintain an effective vegetation maintenance program, it is important to consider these problems and provide an integrated, proactive approach that is cyclic in nature.

Currently, the transmission system (figure 1) is divided into three (3) transmission areas (Southern Transmission Area – Green, Central Transmission Area – Peach, and the Northern Transmission Area – Purple) from a line maintenance perspective. From a vegetation management view point, this is very important since line personnel are very knowledgeable of the changing vegetation conditions in their respective areas. Their routine right-of-way inspections and associated feedback provide a quality check that ensures established vegetation maintenance cycles continue to be effective. Further, they routinely recognize and report critical vegetation problems (e.g., dead & leaning trees) that were not present during scheduled vegetation maintenance activities.

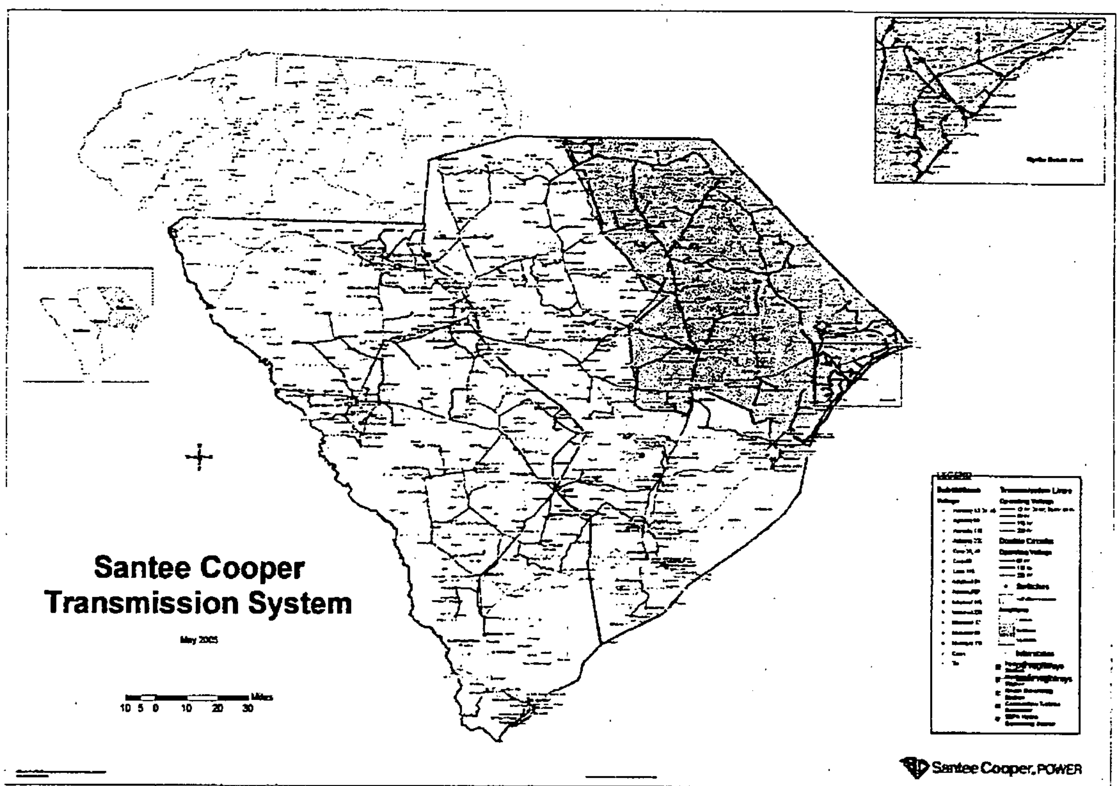


Figure 1

Organization

The *Right-of-Way Management* section (see Appendix A) is responsible for the scheduling and completion of all vegetation related issues located within and along transmission rights-of-way. This section is divided into three units which are responsible for a variety of right-of-way vegetation maintenance activities. Each unit is supported by individuals with varying degrees of professional work experience (e.g., clearing equipment operation, rights-of-way management, contract service administration, herbicide application, etc.) & educational backgrounds/certifications (forestry, arboriculture, wetland delineation, biology, etc.).

Mechanical Reclearing is the largest of the three units with respect to the number of company personnel and is responsible for the mechanical reclearing of selected transmission rights-of-way. This unit is made up of a Supervisor, two (2) crew leaders, and ten (10) equipment operators. A second unit, *Vegetation Management* is responsible for all herbicide related vegetation maintenance, scheduling of reported vegetation maintenance problems, and administering a wildlife habitat enhancement program that complements other vegetation management activities. This unit is made up of a Supervisor, Vegetation Management, Sr. Right-of-Way Specialist, Technical Assistant, Administrative Associate, and one (1) Equipment Operator. A third unit, *Contract Services*, is responsible for all tree related maintenance throughout the transmission system. This unit is made up of a Supervisor, Contract Services and a Right-of-Way Forester.

The overall supervision and direction of this section is the responsibility of the Superintendent, Right-of-Way Management.

Right-of-Way Vegetation Maintenance Standards

Ground Floor Maintenance

1) Right-of-way vegetation maintenance is scheduled, on average, every 3 years to effectively maintain the different vegetation species and associated growth potentials found throughout the transmission system. Mechanical reclearing equipment and/or herbicides are the primary tools that are used to achieve effective maintenance.

    a. Exceptions: Rights-of-way that have low site quality and/or treated with herbicides may produce a slow growing woody vegetation component as well as a herbaceous plant community that competes with new woody plants. In this situation, maintenance cycles can be extended in order to accommodate higher priority vegetation maintenance items and/or inclement weather situations where scheduled maintenance activities may damage (e.g., rutting) rights-of-way.

2) Easements, GIS data base, and Plan & Profiles are reviewed prior to maintenance activities to understand right-of-way widths and maintenance restrictions/provisions. Any atypical restrictions/provisions are provided to the appropriate maintenance personnel prior to beginning vegetation maintenance work.

3) All woody vegetation, capable of growing into transmission conductors and growing within the bounds of the right-of-way, will be maintained by the appropriate maintenance personnel. To ensure this, maintenance personnel routinely measure and flag the edges of the right-of-way to delineate the boundaries of the right-of-way.

   a. Exceptions: large diameter trees that can not be safely maintained by reclearing personnel will be maintained by professional tree maintenance personnel. Where easement restrictions/provisions exclude tree removals, maintenance personnel insure that sufficient clearances are gained through sound trimming practices (ANSI 300A) so reliability is not compromised prior to the next maintenance cycle.

4) Post maintenance clearances will vary depending on the design (i.e., the established height of the conductor in relation to the ground) of the line. However, a minimum of 15' clearance (Clearance 1 - R1.2.1 of Standard FAC-003-1) will be established between the conductor and remaining ground floor vegetation. Prior to the next scheduled maintenance cycle, no ground floor vegetation will be allowed to grow closer to conductors than the minimum clearances (Clearance 2 - R1.2.2 of Standard FAC-003-1) set forth in the Institute of Electrical and Electronics Engineering (IEEE) Standard 516-2003, section 4.2.2.3.

   a. Exceptions: Landowner conflicts may require certain maintenance items (e.g., removal/trimming of established trees) to be scheduled at a later date. In this event, minimal clearances (IEEE Standard 516-2003) will be established until the conflict is resolved. To ensure the follow-up maintenance is not over looked, a work request will be generated and assigned to the appropriate maintenance unit.

   b. Exceptions: Landscape and ornamental plantings (e.g., wax myrtle, crape myrtles, etc.) that have a maximum height growth potential that will bring them no closer that 15' from the conductor and/or slow growing species that can be effectively pruned to 15' from conductor and will not violate IEEE Standard 516-2003 prior to the next maintenance cycle may be left.

5) Daily progress sheets will be completed by the appropriate maintenance unit detailing when and where maintenance took place. This will include the current line name, location (structure/pole numbers) where maintenance was completed, and any atypical maintenance items that could not be completed and require alternative maintenance scheduling. Copies of the progress sheets will be forwarded to the Right-of-Way Management secretary so vegetation

maintenance information can be inputted into a GIS data base and hard copy progress sheets filed in a central location. Also, the Right-of-Way Management planner is to be notified of completed work, via e-mail, so work requests can be closed out.

6) Vegetation maintenance items that could not be completed by ground floor maintenance personnel will be forwarded to the planner via work request creation information forms so a work requests can be created for the appropriate maintenance activity. This may include the use of tree professionals and aerial reach devices where maintenance items are out of reach for normal ground maintenance personnel.

7) Maintenance production (e.g., acreage and brush miles) is reconciled annually for existing rights-of-way while new rights-of-way acreage is added to the total. This information is used to support future maintenance resources and insure that the three (3) year maintenance cycle is not compromised by new responsibilities.

Periphery of Right-of-Way

1) Contract services are used exclusively to maintain trees and tree limbs growing along the 3,900 miles of forested areas growing adjacent to transmission rights-of-way. Typically, a three (3) year maintenance contract is awarded to an established tree maintenance care company to ensure that scheduled tree maintenance work is completed within established time frames. Also, an annual aerial side trimming contract is also awarded to help supplement other long term contract services.

2) Established maintenance cycles are in place to deal with tree limbs that extend into rights-of-way. These maintenance cycles vary in length between 1 – 7 years depending on the width of the right-of-way and location & design of the transmission line within the right-of-way.

3) Easements are researched for maintenance restrictions/provisions and landowners contacted prior to tree maintenance activities, if necessary.

   a. Exception: Majority of landowner contacts are made when live trees are maintained outside of the right-of-way and/or growing in a maintained area within the right-of-way. Trimming of tree limbs along the along the right-of-way does not normally merit a landowner contact.

4) Maintenance reports, generated from the work management system, are run every Monday to ensure that new tree maintenance items are provided to the appropriate tree maintenance personnel to be completed. Typically, these are items (e.g., dead tree, leaning tree, etc.) generated from line patrols and/or during normal ground floor maintenance activities. To ensure that these items are completed per the vegetation maintenance template time frames, a dedicated patrol crew(s) is assigned solely to this task.

5) Daily progress information is recorded and then forwarded to an Administrative Associate who has the responsibility of inputting this information into a GIS data base as well as filing of the hard copy information in a central location. Also, completed work request information is forwarded to the Right-of-Way Management planner so they can be closed out in the work management system.

6) Post maintenance clearances will vary depending on the location of the outside conductor in relation to the edge of the right-of-way with a minimum clearance (Clearance 1 - R1.2.1 of Standard FAC-003-1) not less than 15'. Prior to the next scheduled maintenance cycle, limbs will be allowed to grow no closer to conductors than the minimum clearances (Clearance 2 - R1.2.2 of Standard FAC-003-1) set forth in IEEE Standard 516-2003.

    a. Exceptions: Landowner conflicts may require certain maintenance items (e.g., removal/trimming of established trees) to be scheduled at a later date. In this event, minimum clearances set forth in IEEE Standard 516-2003 will be established until the conflict is resolved.

    b. Exceptions: Lines designed to be off-set and/or stacked on rights-of-way may not allow maintenance personnel to achieve a 15' minimum clearance. In this case, limbs will be removed to the edge of the right-of-way with the clearance not being less than the minimum clearances set forth in IEEE Standard 516-2003.

Rights-of-Way Inspection

Electrical line personnel routinely inspect all transmission rights-of-way twice a year (spring & fall) by air patrol and once a year by ground. Along with electrical facility inspections, line personnel incorporate a right-of-way vegetation inspection that produces records of any vegetation related problems that could compromise system reliability. To aid in the identification and prioritization of found vegetation related problems, line personnel utilize a vegetation maintenance template (i.e., a working template that describes various vegetation condition categories along with a recommended maintenance completion time frame – Appendix B). Additionally, right-of-way vegetation maintenance personnel utilize the same template to report items outside of their respective maintenance capabilities that are found during their scheduled maintenance activities. This provides an additional inspection source that has the potential of identifying new maintenance problems that developed after lineman have completed their patrols.

Vegetation Maintenance Reporting & Scheduling

Vegetation maintenance problems identified by linemen and vegetation maintenance personnel are recorded onto a patrol or daily progress sheet that represents a specific line section. Information included on these sheets include a description (e.g., dead tree) of the problem, location of the problem with respect to transmission structure/pole numbers, and a priority code that sets a recommended time frame in which the problem is to be mitigated. Completed sheets are then forwarded to the appropriate transmission planner who will in turn create individual maintenance work requests using a work management system.

Once the individual work requests have been created in the work management system, a Right-of-Way Maintenance planner utilizes the work request information to schedule the work as well as assign the work to the appropriate vegetation maintenance unit. Maintenance personnel are then able to access maintenance reports that provide a specific work request number, description of the maintenance problem, and a recommended completion date. After maintenance is completed, maintenance personnel provide a completion date so the planner can close out the work request.

Schedules for normal rotational vegetation maintenance (e.g., mowing, spraying, side trimming, etc.) are developed by the respective maintenance units in Right-of-Way Management. Work requests are then generated from these schedules and are available via a company reporting system (Brio).

In the event a maintenance problem (e.g., leaning tree close to conductor) is considered an immediate threat to the line, personnel will contact the Right-of-Way Maintenance planner, by phone, upon identifying the problem. In turn, the appropriate maintenance personnel will be dispatched to mitigate the problem. If required, line personnel will be contacted to obtain the proper line clearance(s) (e.g., hot line tag) to ensure the safety of maintenance personnel.

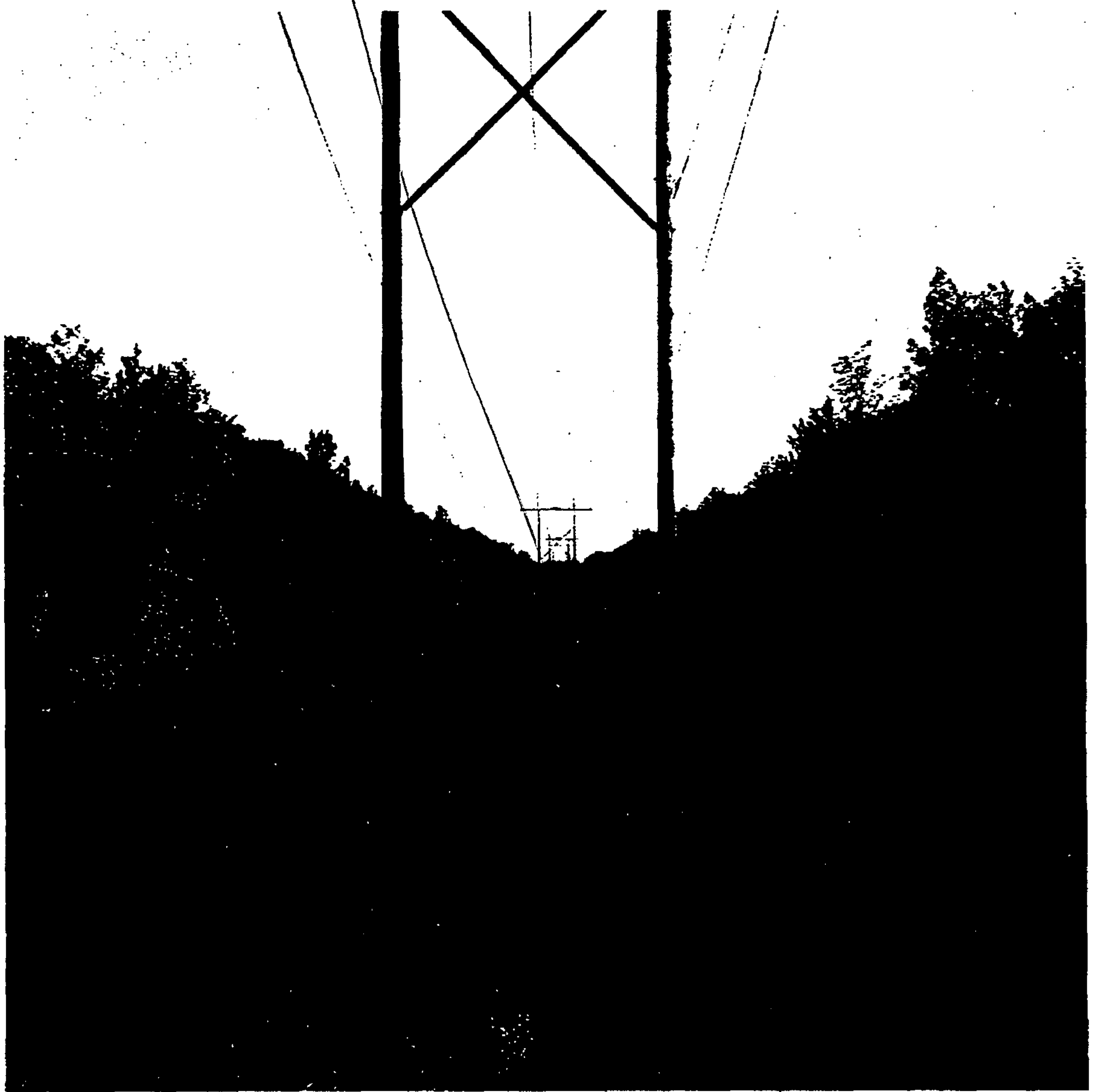
Annual Work Plan

Based on established vegetation maintenance cycles, selected rights-of-way are placed on an annual maintenance schedule that is developed in late December for the upcoming year. Schedules will be available no later than January 15th and can be viewed on the Right-of-Way Management web site (access instructions below) and/or as an attachment (see Appendix C) to this document. Maintenance completion dates for specific line sections will be available on the Right-of-Way Management web site and will updated on a monthly basis.

Electronic Access to Right-of-Way Maintenance Schedules

- Using iPort, select "Departments" Tab
- Select "Transmission Operations" under the "Operations" listing
- Select the "Right-of-Way" Tab
- Under the "Right-of-Way Schedule Yr" list, select the maintenance operation you require a schedule for

SANTEE COOPER
TRANSMISSION VEGETATION MANAGEMENT PROGRAM



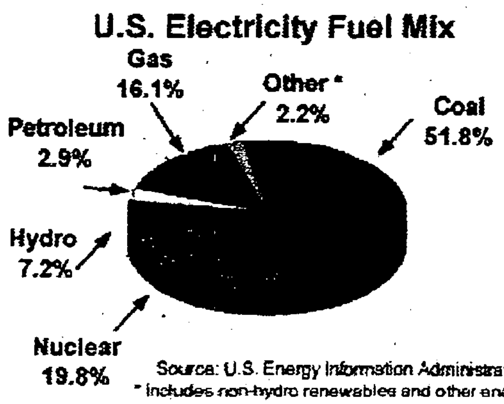
Prepared by: Kenneth R. Sott
Date: February 17, 2006

CEED Center for Energy and Economic Development

Essential
Affordable
Increasingly Clean

Fuel Diversity

History has taught us that it is risky to develop an over-reliance on any one energy source. In fact, a balanced energy portfolio has been the key to providing America with a growing supply of affordable electricity for the past 30 years.



Source: U.S. Energy Information Administration, 2002
* Includes non-hydro renewables and other energy sources

Fuel diversity helps to protect consumers against the threat of supply disruptions or price volatility. With America's demand for electricity expected to grow 40% by 2020, meeting the nation's growing demand for reliable, affordable electricity will require the continued utilization of all domestic energy resources. And that includes coal, which is the primary source of the electricity that powers America's homes and businesses.

- Currently, more than half of the electricity consumed by U.S. homes and businesses (51.8%) comes from coal.
- Other fuels used to generate electricity include nuclear (19.8%), natural gas (16.1%), hydroelectric facilities

Sec 2.4 Ref 45

Mayo Creek Aquatic Survey

V.C. Summer Units 2 and 3
Combined Construction/Operating License Project

Prepared for:
South Carolina Electric & Gas Company

Prepared by:
Tetra Tech NUS
Aiken, South Carolina

June 2007

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1.0 INTRODUCTION

In February 2006, SCE&G and Santee Cooper announced that they had selected a preferred site and a preferred reactor design for two new nuclear units. The new units would be built on the existing V.C. Summer Nuclear Station site near Jenkinsville, South Carolina. By mid-2006, SCE&G made the determination that new nuclear units 2 and 3 and important support facilities (e.g., cooling towers) would be placed approximately one mile south of existing Unit 1, in an area dominated by young planted pines and older mixed pine-hardwood stands. Because land clearing and earth moving associated with construction of new facilities could potentially degrade water quality in the Mayo Creek watershed, SCE&G commissioned Tetra Tech NUS to conduct studies of fish and mussels in Mayo Creek and its tributaries. The goal of the studies was to establish baseline conditions in Mayo Creek for purposes of impact assessment and to identify any special-status aquatic species that might be present.

2.0 THE SITE AND VICINITY

Mayo Creek (Figure 1) is the only stream in the project area that offers substantial year-round flow and habitat adequate to support reasonably diverse assemblages of benthic organisms and fish. Several other unnamed drainages that appear on U.S. Geological Survey (USGS) topographic maps as streams flowing into Parr Reservoir immediately north and south of the project site are either intermittent streams (known locally as "wet weather" streams) or small perennial streams that may be only inches wide in late summer.

In some places, these small streams are dammed by snags and leafpack, creating pools that may be 6-8 feet wide after heavy rains. Based on a July 2006 reconnaissance conducted by SCE&G and Tetra Tech NUS biologists, these pools serve as refuges for fish, crayfish, and aquatic insects during droughts and low-water periods. The importance of these "pool refugia" to fish and aquatic insects in intermittent streams is well known (Labbe and Fausch 2000; Magoulick 2000). Pools with relatively stable hydrology (water levels) in intermittent streams are associated with successful reproduction, population growth, and immigration of fish, whereas pools with more variable hydrology (drying completely or nearly so) tend to be characterized by population declines and emigration (Magoulick and Kobza 2003; Love 2004).

Mayo Creek is approximately three miles long and drains an area of about four square miles (Figure 1). It rises a half-mile southeast of the VCSNS Unit 1 generating facilities, flows south for approximately one mile then curves to the southwest before emptying into the Broad River at Hampton Island, just below the Parr Shoals dam. For much of its length, it flows through a mixed hardwood forest, and is almost completed shaded by a well-developed tree canopy. The tree canopy (shade) apparently moderates water temperatures in summer, which ranged from 23 to 25°C (74 to 76°F) on July 20, 2006 when stream levels were relatively low and ambient temperatures approached 100°F. Fish are found in all stream reaches, but are most numerous in

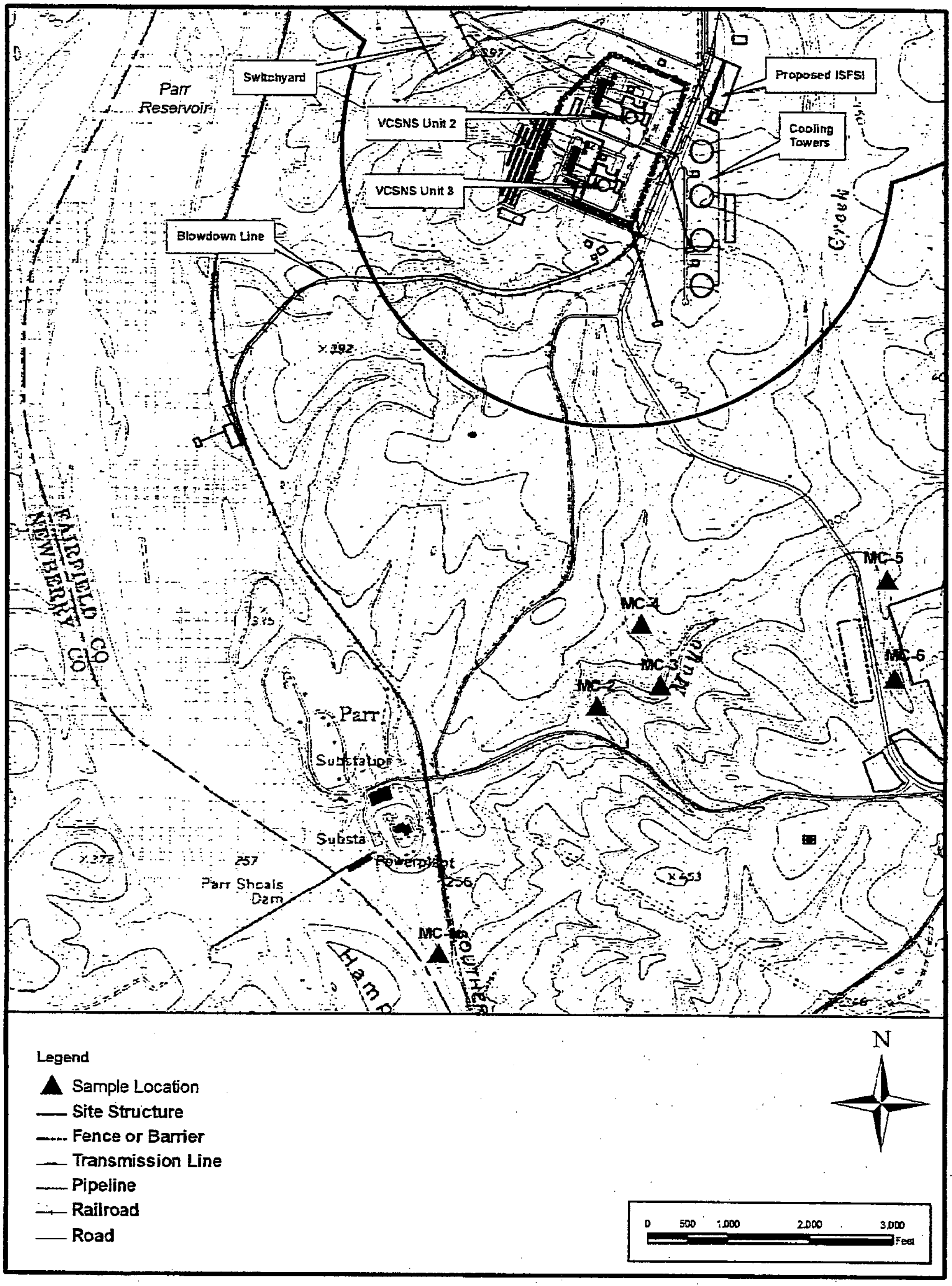


Figure 1. Fish Survey Sampling Locations

middle reaches that contain a mix of substrate and habitat types. The lower portion of Mayo Creek, immediately above its confluence with the Broad River, is noticeably wider and deeper than the rest of the stream, because of back-flow from the Broad River. The stream bottom here has a thick covering of silt, and habitat for fish and invertebrates is marginal at best.

Although the Mayo Creek drainage is almost completely undeveloped and there has been no logging in its floodplain, there has been significant logging activity in the watershed. Some sediment is presumed to have entered the stream with stormwater runoff from logging areas. For reasons that are unclear and are apparently related to characteristics of the watershed and the stream's morphology, it is subject to flash floods after heavy rains. These floods have eroded and undercut the stream's banks along much of its length and covered the stream bottom in many places with a heavy layer of silt.

Surveys of Mayo Creek fish and mussels were conducted in July and November 2006. Supplemental fish sampling was conducted in April 2007 to collect baseline information on a Mayo Creek tributary that could be affected by construction of an access road. The Mayo Creek aquatic surveys were designed to gather baseline information on the stream's biotic communities, supporting the assessment of construction impacts in the COL Environmental Report. The surveys were also intended to identify any special-status species that might be present, so that protection of any such species could be factored into project planning. Mayo Creek was selected for surveys because it is the only substantial stream in the project area, and the only one likely to contain significant numbers of fish and macrobenthos. Other streams in the project area are assumed to support smaller, less diverse benthic and fish communities that are a subset of the Mayo Creek communities, with species predominating that are able to tolerate high levels of turbidity and high summer water temperatures.

3.0 METHODS

Sampling Locations

Tetra Tech NUS and SCE&G biologists conducted a reconnaissance of project area streams and drainages in early July 2006. The goal of the reconnaissance was to identify sampling locations downstream of proposed construction sites that would yield representative baseline data on aquatic biota. This reconnaissance suggested that the small streams draining areas immediately north, west, and south of the proposed construction area were too small to effectively sample in summer: none was more than 2 feet wide or more than a few inches deep. The decision was made to focus sampling efforts on the middle reaches of Mayo Creek, downstream of the point where the west branch of the creek joins the mainstem. This portion of the stream appeared to offer year-round flows that would make electrofishing, the preferred sampling method, possible. Portions of Mayo Creek above this confluence had substantially less flow and were less accessible.

Three sampling transects (MC-1, MC-2, and MC-3) were initially established on the mainstem of Mayo Creek and sampled in July 2006 (see Figure 1). Transect MC-1, intended to serve as an indicator of fish movement between Mayo Creek and the Broad River, was abandoned after the July sampling round because so few fish were present and because its soft, silt-laden bottom made sampling difficult. In November 2006, an additional sampling station (MC-4) was established on an upstream tributary of Mayo Creek to validate the assumption that tributary fish assemblages represent a subset of mainstem fish assemblages. SCE&G determined in early 2007 that it would be necessary to build an access road from the existing Parr Road to the proposed site of Units 2 and 3. Because the construction of this road appeared to have potential for impacting a small, north-flowing tributary of Mayo Creek, this tributary was sampled in April 2007 with minnow traps, at new sampling stations designated MC-5 and MC-6. Sampling sites are described in Table 1.

Table 1. Descriptions of Mayo Creek Sampling Sites

Transect	Length (ft)	Average Width	Average Depth	Substrate	Notes
Transect MC-1	189	19 ft. 2 in.	1.5 ft.	Silty	Well-developed canopy; fully shaded; undercut banks, heavy silt load (turbid)
Transect MC-2	205	8 ft. 6 in.	8 inches	Boulder, rubble, cobble, gravel, or sand, depending on stream gradient/location	Well-developed canopy, almost completely shaded; alternating riffle-run-pool habitats.
Transect MC-3	166	6 ft.	6 inches	Boulder, rubble, cobble, gravel, sand, or silt, depending on stream gradient/location	Well-developed canopy, almost completely shaded; alternating riffle-run-pool habitats.
Station MC-4	N/A	3 ft.	1.0 ft.	Sand, leaves, litter	Pool in small tributary
Station MC-5	N/A	6 ft.	12 in.	Sand, litter	Pool in small tributary
Station MC-6	N/A	6 ft.	16 in	Sand, litter	Pool in small tributary

Biologist retrieves minnow trap at Station MC-5.

Water Quality

Water quality measurements were taken at each transect/station on the first day of each sampling round. In July, temperature, dissolved oxygen, conductivity, turbidity, and pH measurements were taken with a Horiba Model U-10 water quality instrument. Although the instrument was calibrated in advance of fieldwork, all field turbidity readings in July were zero, suggesting a probe malfunction. In November, temperature, dissolved oxygen, and conductivity measurements were taken with a YSI Model 85 water quality instrument. An Orion portable pH meter was used in November.

Fish Sampling and Handling

Transects MC-1, MC-2, and MC-3 were sampled using a Smith-Root Model LR-24 backpack electrofisher with settings intended to produce maximum amperage, as conductivity was relatively low. Current strength varied little, and was generally around 0.15-0.2 amp. Two netters followed the operator of the backpack unit as he moved upstream, collecting stunned fish. Standard galvanized minnow traps were set up- and downstream of the three electrofishing transects after the completion of electrofishing and retrieved approximately 24 hours later. Tributary streams (Sampling Stations MC-4, MC-5, and MC-6) were sampled using wire minnow traps exclusively; these streams were either too small or too steep-sided to effectively and safely electrofish. Table 2 shows how the various transects and stations were sampled.

All fish collected, regardless of sampling method, were placed in a 10 percent buffered formalin solution and returned to the Aiken Office of Tetra Tech NUS to be measured, weighed, and identified to species. Although field identification and processing of fish would have been preferable, and would not have required sacrificing fish, concerns about possible mis-identification of small specimens and potentially rare species argued against it.

Fish were identified by an experienced Tetra Tech NUS fishery biologist, but identities of more obscure species and small (< 75 mm TL) catastomids were confirmed by either Dean Fletcher or Fred C. Rohde. Dean Fletcher is Research Coordinator of the Fish Ecology Program at the Savannah River Ecology Laboratory and co-author of *Fishes of the Middle Savannah River Basin*. Fred Rohde, a Fisheries Scientist with North Carolina Division of Marine Resources, is senior author of *Freshwater Fishes of the Carolinas, Virginia, Maryland, and Delaware*, and co-author of *Freshwater Fishes of South Carolina* (in preparation).

Table 2. Sampling Locations and Sampling Methods.

	July 2006		November 2006		April 2007
	Electrofishing	Minnow Traps	Electrofishing	Minnow Traps	Minnow Traps
MC-1	√	√			
MC-2	√	√	√	√	
MC-3	√	√	√	√	
MC-4				√	
MC-5					√
MC-6					√

Although quantitative surveys of freshwater mussels were not conducted, field personnel were instructed to be alert to the presence of bivalves, whether mussels or (Asiatic) clams. No live clams or mussels and no dead shells were observed in any of the stream reaches. No dead shells or midden piles were observed on stream banks. Mussels are common in portions of the Broad River (Bettinger, Crane, and Bulak 2003), but conditions in Mayo Creek appear to be unsuitable for these organisms. Because Mayo Creek is shallow and the bottom is visible in most locations and because representative segments (gravel bottom, sandy bottom, silty bottom) of the stream were searched and no mussels were found, there is no reason to believe that freshwater mussels are present in deeper pools or less-accessible areas of the creek.

4.0 RESULTS AND DISCUSSION

Water Quality

Water temperatures in Mayo Creek ranged from 23.6°C to 24.6°C (74°F to 76°F) in July and 12.5°C to 13.0°C (54°F to 55°F) in November. Temperatures in late summer appear to be moderated by the well-developed tree canopy, which shades most portions of the stream. Temperature and dissolved oxygen showed the expected inverse relationship, with dissolved oxygen concentrations at all stations higher in fall than summer. In July 2006, when air temperatures exceeded 36°C/97°F and stream temperatures reached almost 25°C/77°F, dissolved oxygen concentrations in all three mainstem reaches were higher than 5.0 mg/L. Most southeastern states use 5.0 mg/L (daily average) and 4.0 mg/L (instantaneous minimum) as criteria in establishing water quality standards for protection of aquatic life in warmwater streams (EPA 2007). In November, dissolved oxygen concentrations were somewhat higher, 8.5 to 8.8 mg/L. Mayo Creek's conductivity, which ranged from 110 to 117 millisiemens/cm, would place the stream in the lowest quartile (< 180 millisiemens/cm) of U.S. rivers (Potapova and Charles 2003) but was slightly higher than other streams in the Broad River drainage (Cooney et al. 2006). Measurements of pH in Mayo Creek generally ranged between 6.0 and 6.6, whereas pH measurements at other streams in the Broad River drainage in water year 2005 (last year for which USGS data are available) ranged between 6.6 – 7.6 (Tyger River) and 6.3 -7.7 (Enoree River) (Cooney et al. 2006).

Fish Populations

A total of 495 fish representing 14 species were collected during the 2006 Mayo Creek study (Table 3). Collections were dominated by Cyprinids (minnows) and Lepomids (sunfish); 92.2 percent of all fish collected were members of these two families. Bluehead chub (37.2 percent of total), yellowfin shiner (18.2 percent of total), sandbar shiner (16.4 percent), redbreast (9.7 percent), and creek chub (8.1 percent) were the species most often collected. Cyprinids (5 species) made up 80.7 percent of all fish collected.

Table 3. Summary of 2006 Mayo Creek Fish Collections

Common Name	Scientific Name	Total Number[a]	Relative Abundance (%)
Bluehead Chub	*Nocomis leptocephalus*	184	37.2
Yellowfin Shiner	*Notropis lutipinnis*	90	18.2
Sandbar Shiner	*Notropis scepticus*	81	16.4
Redbreast sunfish	*Lepomis auritus*	48	9.7
Creek Chub	*Semotilus atromaculatus*	40	8.1
Brassy jumprock	*Scartomyzon sp.*	19	3.8

Table 3. Summary of 2006 Mayo Creek Fish Collections (continued)

Common Name	Scientific Name	Total Number[a]	Relative Abundance (%)
Tesselated Darter	*Etheostoma olmstedi*	9	1.8
Seagreen Darter	*Etheostoma thalassinum*	8	1.6
Bluegill	*Lepomis machrochirus*	7	1.4
Greenfin Shiner	*Cyprinella chloristia*	4	0.8
Largemouth Bass	*Micropterus salmoides*	2	0.4
Margined Madtom	*Noturus insignis*	1	0.2
Piedmont Darter	*Percina crassa*	1	0.2
Flat Bullhead	*Ameirus platycephalus*	1	0.2
		495	100

a. includes electrofishing and minnow trap collections

Measures of abundance and species richness (Table 4) were markedly higher at Transects 2 and 3, a portion of the stream with a well-developed canopy, good water quality, a mix of aquatic habitats, and substantial year-round flow. Other transects/stations tended to be characterized by heavier silt, sediment, and debris loads, less optimal water quality, and/or extreme low flows in summer and early fall. Transects MC-2 and MC-3 had lower water temperatures and higher concentrations of dissolved oxygen than Transect MC-1 in July 2006, presumably reflecting a better-developed canopy (more completely shaded) and lower levels of solids, which absorb solar energy and raise water temperatures. There may also be cool seeps and springs in this stretch of the creek that buffer the stream's water temperatures. Stations MC-4, MC-5, and MC-6 were established on small tributaries of Mayo Creek. These small tributaries are subject to sudden changes in temperature and flow, and may turn from tiny (several inches wide) rills into debris-filled torrents after heavy rains.

Table 4. Number of Fish Collected in 2006-2007 by Sampling Location

	MC-1[a]	MC-2[b]	MC-3[b]	MC-4[c]	MC-5[d]	MC-6[d]
Bluegill	1	1	5			
Bluehead chub		92	88	4		
Brassy jumprock		12	7			
Creek chub		9	20	11	3	14
Flat bullhead			1			
Greenfin shiner		4				
Largemouth bass		1	1			

Table 4. Number of Fish Collected in 2006-2007 by Sampling Location (continued)

	MC-1[a]	MC-2[b]	MC-3[b]	MC-4[c]	MC-5[d]	MC-6[d]
Margined madtom		1				
Piedmont darter			1			
Redbreast sunfish	13	11	10	14		
Sandbar shiner		45	36			
Seagreen darter		5	3			
Tesselated darter		5	4			
Yellowfin shiner		54	36			
Number of Fish	14	240	212	29	3	14
Number of Species	2	12	12	3	1	1

a. July 2006 only

b. July and November 2006

c. November 2006 only

d. April 2007 only

All fish sampling gear are selective to some degree; however, electrofishing has proven to be the least selective and most effective single method for collecting stream fishes (EPA 1999). Pulsed DC (direct current) electrofishing is the method of choice to obtain a representative sample of the fish in wadeable streams, and was the method employed at V.C. Summer Nuclear Station. Because the goal of the sampling was to develop a list of species present and their relative abundance, rather than population estimates, "single-pass" sampling was employed rather than multiple-pass sampling.

Electrofishing success was dramatically higher at MC-2 and MC-3 than MC-1, reflecting substantially higher abundance of fish in these stream reaches (Table 5). Catch-per-unit effort was higher in the fall than in the summer, but statistical tests were not applied to the data to determine if differences were significant. These differences could have been the result of fish being more evenly distributed in the fall, fish being less active (water temperatures ranged from 12.5 to 13.0°C in November), or even netting efficiency (there were changes in field personnel between July and November).

Table 5. Electrofishing Catch-Per-Unit-Effort (CPUE) in 2006.

Sampling Location	July 2006			November 2006		
	Total Number of Fish	CPUE (fish/ min)	CPUE (fish/ hour)	Total Number of Fish	CPUE (fish/ min)	CPUE (fish/ hour)
MC-1	2	0.204	12.2	Not Sampled	N/A	N/A
MC-2	83	6.975	418.5	145	12.29	737.3
MC-3	66	5.789	347.4	92	8.364	501.8

Only two fish were collected at MC-1 in July 2006, which was the primary reason this transect was abandoned. A handful of species dominated electrofishing collections at MC-2 and MC-3, bluehead chub, yellowfin shiner, and sandbar shiner being the species with highest CPUE (Tables 6 and 7). Bluehead chub are found in a variety of habitats across the southeastern U.S. They were found at 42 of the 45 sites in the Broad River drainage sampled by SCDNR in 2003-2004 (Bettinger, Crane, and Bulak 2006). Yellowfin shiners have more restrictive habitat requirements, typically being found in clear-water streams in forested areas, but were also common in collections. Yellowfin shiners were found at 39 of 45 Broad River drainage sites sampled by SCDNR in 2003-2004 (Bettinger, Crane, and Bulak 2006). Sandbar shiners, which are often associated with clear, sandy-bottomed streams, were also numerous at both MC-2 and MC-3. They were found at 27 of 45 sites in the Broad River drainage sampled by SCDNR (Bettinger, Crane, and Bulak 2006).

Table 6. Electrofishing Catch by Species in July 2006.

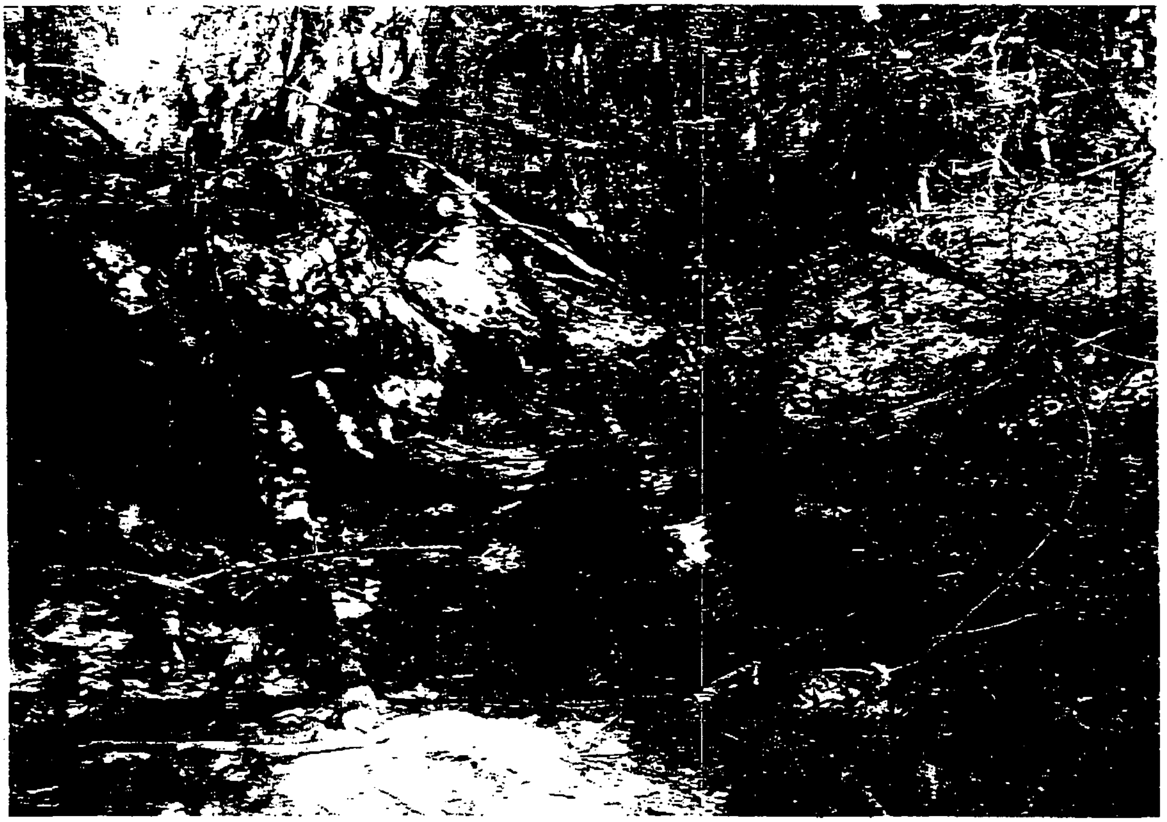
	Total Number of Fish			Catch-Per-Unit-Effort		
	MC-1	MC-2	MC-3	MC-1	MC-2	MC-3
Bluehead Chub	0	36	15	---	181.5	78.9
Yellowfin Shiner	0	17	8	---	85.7	42.1
Sandbar Shiner	0	17	28	---	85.7	147.4
Redbreast sunfish	1	1	3	6.1	5.0	15.8
Creek Chub	0	1	2	---	5.0	10.5
Brassy jumprock	0	3	3	---	15.1	15.8
Tesselated Darter	0	4	3	---	20.2	15.8
Seagreen Darter	0	3	1	---	15.1	5.3
Bluegill	1	0	2	6.1	---	10.5
Largemouth Bass	0	0	1	---	---	5.3
Margined Madtom	0	1	0	---	5.0	---

Table 7. Electrofishing Catch by Species in November 2006.

	Total Number of Fish		Catch-Per-Unit-Effort	
	MC-2	**MC-3**	**MC-2**	**MC-3**
Bluehead Chub	50	49	254.2	267.3
Yellowfin Shiner	37	27	188.1	147.3
Sandbar Shiner	28	5	142.4	27.3
Redbreast sunfish	8	2	40.7	10.9
Creek Chub	5	1	25.4	5.5
Brassy jumprock	9	4	45.8	21.8
Tesselated Darter	1	1	5.1	5.5
Seagreen Darter	2	0	10.2	---
Greenfin shiner	4	2	20.3	10.9
Largemouth Bass	1	0	5.1	---
Piedmont darter	0	1	---	5.5

Three species were collected in minnow traps at sampling station MC-4: creek chub (11 fish), bluehead chub (4 fish), and redbreast sunfish (14 fish). The number and relative abundance of redbreast at this station were surprisingly high, given that the stream was only 2-3 feet wide when sampled and clogged with fallen leaves. All of the redbreast collected were small (49-90 mm TL) and probably moved into this small tributary when stream levels were higher and were trapped when waters receded.

Only one species (17 individuals), the creek chub, was found in the unnamed, north-flowing Mayo Creek tributary sampled (Stations MC-5 and MC-6) with minnow traps in April 2007. When sampling was conducted, there was a modest flow in some portions of this tributary, and no water (see photograph that follows) in others, making it difficult to sample. Minnow traps were placed in the four deepest pools available, and retrieved the following day. Two of the four pools contained traps with fish; these pools were designated sampling stations MC-5 and MC-6 and marked with day-glo plastic flagging, should additional sampling be conducted.



Unnamed Mayo Creek tributary stream sampled in April 2007, showing dry streambed.

The fish community structure of Mayo Creek bears a striking resemblance to those of other small Piedmont streams in Georgia and South Carolina. Yellowfin shiners (35.7 percent of total) and bluehead chubs (24.3 percent of total) dominated collections from four of five habitat types in Moore Creek, a third-order lower Piedmont stream in central Georgia (Parmley and Gaddis 2001). Cyprinids comprised 70 percent of all fish collected from Moore Creek. Three Cyprinids (bluehead chub, yellowfin shiner, creek chub) were numerically dominant in samples from two (Newberry County) South Carolina Piedmont streams in both dry (2000) and wet years (2003), but creek chubs were relatively more abundant in the wet ("post-drought") year (Keaton et al. 2005). Keaton et al. hypothesized that turbidity associated with higher rainfall and higher streamflows in 2003 drove bluehead chubs and yellowfin shiners upstream into less-turbid tributaries. They also hypothesized that deeper water created conditions more favorable to the creek chub, a large (up to 12 inches long), "aggressive," omnivorous minnow species that can feed on smaller minnows.

Most of the fish species collected in Mayo Creek and its tributaries are common species that are typically associated with streams and rivers in the Piedmont of the Carolinas and Georgia. Appendix A contains life history information on each of the species collected. Most fish species collected are common-to-abundant in the Broad River drainage (Bettinger, Crane, and Bulak 2006). No fish species listed by the state of South Carolina or the United States Fish & Wildlife

Service (SCDNR 2006; USFWS 2006) was collected. No fish species designated a "species of concern" by the state of South Carolina or USFWS (SCDNR 2006; USFWS 2006) was collected. Species of concern are not protected by law, but are considered by state and federal agencies in conservation planning and during project reviews.

The South Carolina Department of Natural Resources (SCDNR) has been engaged in a state-wide assessment of fisheries resources since 2002, part of a larger effort (termed the "Comprehensive Wildlife Conservation Strategy") intended to benefit the state's fish and wildlife. As part of this effort, fishes of wadeable streams in the Broad River drainage were inventoried in 2003 and 2004 (Bettinger, Crane, and Bulak 2006). Forty-five sites were sampled, yielding more than 20,000 fish specimens that represented 8 families and 45 species. Eleven of these species were assigned moderate, high, or highest "conservation priorities," meaning these species, although not protected by law, are given special attention in agency conservation planning and project reviews. Three of the species collected from Mayo Creek have been designated species of conservation concern by SCDNR: greenfin shiner (Moderate), flat bullhead (Moderate), and Piedmont darter (High).

5.0 SUMMARY

Surveys of Mayo Creek and two of its tributaries revealed a surprisingly diverse assemblage of fishes (14 species) dominated numerically by Cyprinids (minnows). Five minnow species comprised almost 81 percent of all fish collected. Three centrarchid (sunfish) species and three percid (darter) species were also present, but tended to be less abundant. Smaller numbers of catastomids (suckers; one species) and ictalurids (catfish; two species) were also present. No state- or federally-listed fish species were collected. No species designated "species of concern" by the state of South Carolina or USFWS were collected. Several uncommon fish species were collected, but none has been afforded state or federal protection.

Several species of freshwater mussel and the non-native clam *Corbicula* are found in the lower Broad River (Bettinger, Crane, and Bulak 2003) into which Mayo Creek flows. However, it appears that conditions in Mayo Creek and its tributaries are not conducive to survival and/or propagation of bivalves. Although systematic surveys of mussels and clams were not conducted, biologists were instructed to note their presence and collect specimens if any were discovered. No live specimens and no shells were observed in any of the streams surveyed

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APPENDIX A

SPECIES DESCRIPTIONS

Cyprinidae (carps and minnows)

Greenfin shiner. Medium-sized (to 72 mm SL) minnow found above Fall Line in Upper Piedmont of South Carolina and North Carolina (Lee et al. 1980; Bettinger undated). Endemic to Santee Drainage, which includes three major river systems in South Carolina --- the Wateree, the Broad, and the Saluda. Greenfin shiners are found in creeks and small rivers with cool, clear water (Bettinger undated). In these habitats, prefers the slower areas and margins of pools and runs with clean sand and rocky substrates. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as an insectivore and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Bluehead chub. Common, thick-bodied (up to 214 mm SL) minnow found in Piedmont and mountain streams from South Branch of Potomac River in Virginia to Altamaha River, Georgia (Lee et al. 1980). Found in a variety of habitats from cool, high-gradient and clear streams to warm, lower-gradient, turbid streams. Substrates in these streams can range from bedrock to silt. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as an omnivore and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Yellowfin shiner. Small to medium-sized (60 mm SL max) minnow found in Santee River drainage (SC), Savannah River drainage (SC-Ga), and Altamaha River drainage (Ga) (Lee et al 1980). Generally found in small, clear headwater streams; where found, often abundant. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as a "specialized insectivore" and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Sandbar shiner. Medium-sized (50-75 mm SL) minnow found in Blue Ridge foothill and Piedmont streams, from Cape Fear drainage (N.C.) to Savannah drainage (S.C. and Georgia) (Lee et al. 1980). Typically inhabits pools of small-to-medium size streams with sandy substrates. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as a "specialized insectivore" and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Creek chub. Large (to 305 mm TL) minnow found in ponds, creeks, and rivers throughout the eastern and Midwestern U.S. and, less commonly, in Great Plains and Prairie Provinces of Canada (Lee et al. 1980). Found in streams and river across the Piedmont of North and South

Carolina. Most abundant in small streams and brooks; less abundant in shallows of lakes and impoundments. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as an insectivore and rates it as "tolerant" of pollution (NCDWQ 1999). Lee et al. (1980) and most other authorities describe it as a sight-feeding omnivore that eats algae, insects, and even small fish.

Catastomidae (suckers)

Brassy jumprock. This as yet-undescribed species was created when the taxonomy of the genus *Moxostoma* was re-examined by Dr. Robert Jenkins in 1990s (Rohde 1998). Formerly known as the "smallfin redhorse" (*Moxostoma robustum*), this species was placed in the genus *Scartomyzon*, while the newly-named robust redhorse inherited the Latin name *Moxostoma robustum*. Found from the Cape Fear River drainage in North Carolina to the Altamaha River drainage in Georgia in medium-sized streams to large rivers with varied substrates ((Marcy et al. 2005). North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the brassy jumprock as an insectivore and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Ictaluridae (freshwater catfishes)

Margined madtom. Small catfish (47-90 mm SL) that ranges from New Hampshire to Georgia. Found chiefly in clearwater streams with moderate current. More abundant in riffle areas with gravel-rubble substrates. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as an insectivore and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Flat bullhead. Medium-sized catfish (179-286 mm TL) found in Piedmont and Coastal Plain streams from southern Virginia to Georgia (Lee et al. 1980). Within these streams, adults occur mostly in low-flow areas with silty, muddy, or sandy bottoms while young tend to inhabit areas with higher flow and clearer water. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as an insectivore and rates it as "tolerant" of pollution (NCDWQ 1999).

Centrarchidae (sunfishes)

Redbreast sunfish. Common sunfish that is found in Coastal Plain and Piedmont streams and rivers from Canada to Florida (Lee et al. 1980; Jenkins and Burkhead 1994). Found most often in pools and backwaters of these streams and rivers in water that may be clear to turbid. Also found in ponds, oxbow lakes, and large impoundments. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as an insectivore and rates it as "tolerant" of pollution (NCDWQ 1999).

Bluegill. Common sunfish that is found in streams, rivers, ponds, lakes, and impoundments across the eastern and midwestern U.S. Found in all southeastern waters except high-gradient trout streams in Appalachians (Jenkins and Burkhead 1994; Marcy et al. 2005). North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the bluegill as an insectivore and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Largemouth bass. Popular sport fish that is found throughout the U.S. and has been introduced to Central America, South America, and parts of Europe. Inhabits streams, rivers, ponds, and impoundments throughout its range, but is most often associated with the weedy shallows of ponds and impoundments. More tolerant of turbidity than other black basses and less tied to flowing water (Marcy et al. 2005). North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies this aggressive predator as a piscivore and rates its pollution tolerance as "intermediate" (NCDWQ 1999). Although largely piscivorous, largemouth bass also eat insects, crayfish, frogs, snakes, mice, baby birds and "almost any other animal of appropriate size that has fallen in or is swimming in the water" (Marcy et al. 2005).

Percidae (perches/darters)

Tesselated darter. One of the most widely-distributed North American darters, found from Quebec to Georgia (Lee et al. 1980). Common in streams and larger, low-gradient rivers under a variety of temperature and water-clarity conditions (Jenkins and Burkhead 1994). Also found in brackish water in estuaries. Typically found in pools and calmer areas; avoids riffles. Found on substrates ranging from mud to clean gravel to rubble (Jenkins and Burkhead 1994). North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as a "specialized insectivore" and rates its pollution tolerance as "intermediate" (NCDWQ 1999).

Seagreen darter. Restricted to the Santee Drainage of North and South Carolina (Lee et al. 1980). Within the Santee Drainage it is found in all the major river systems --- Saluda, Broad, Catawba, Congaree, and Wateree (Lee et al. 1980; Hayes and Bettinger undated). More common in Blue Ridge foothills and upper Piedmont streams over rubble, cobble and bedrock; less common in lower Piedmont and upper Coastal Plain. North Carolina Department of Environment and Natural Resources' Division of Water Quality classifies the species as a "specialized insectivore" and rates it as "intolerant" of pollution (NCDWQ 1999).

Piedmont darter. The Piedmont darter is found primarily in North and South Carolina in the Cape Fear, Pee Dee, and Santee drainages (Lee et al. 1980). There are a few populations in south-central Virginia, just north of the North Carolina state line (Jenkins and Burkhead 1994). The species prefers moderate-gradient creeks, streams, and rivers. It is commonly associated with rubble and gravel riffles and runs. North Carolina Department of Environment and Natural

Resources' Division of Water Quality classifies the species as a "specialized insectivore" and rates it as "intolerant" of pollution (NCDWQ 1999).

U.S. Fish & Wildlife Service

Southeast Region

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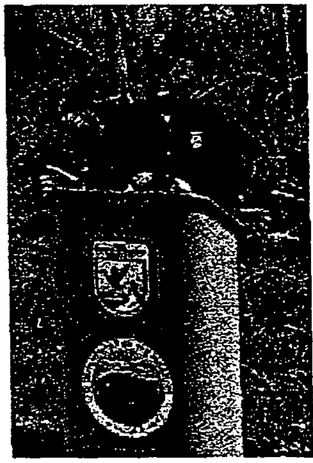

Secretary of the Interior Dirk Kempthorne. Photo by Ron Dixson.

Kempthorne: Refuge and Park Recovery Funding to Restore Gulf Coast Wetlands, Undertake Other Projects

(New Orleans) – Secretary of the Interior Dirk Kempthorne announced a $256 million in new federal funds to restore vital Gulf coastal wetlands on national wildlife refuges, rebuild Interior facilities, and undertake other hurricane recovery projects.

"We stand with the people of Louisiana and other Gulf states as they seek to rebuild their communities and restore their coastal ecosystems," Kempthorne said. "This includes providing new funding to restore national wildlife refuges, national parks and other Interior facilities in Gulf Coast states that were devastated by hurricanes Katrina and Rita." – Learn more...

Despite Island Wildfire, Number of Sea Turtle Nest Sites Are Up on Blackbeard Island National Wildlife Refuge

Turtle Laying. Photo taken during 2005 nesting season (July 8, 2005). Photo by Heather Cason.

Nesting activity for the threatened Loggerhead Sea Turtle on Blackbeard Island National Wildlife Refuge (NWR) in McIntosh County, Georgia, has increased from last year's totals, as U.S. Fish & Wildlife Service (FWS) firefighters continue to battle a 117-acre wildfire. – Learn more...

Blackbeards Revenge Wildfire, Fire as seen from Blackbeard Creek. Photo credit: John Tuttle, FWS

Wildfire on Blackbeard Island National Wildlife Refuge

Firefighters continue to monitor a 117-acre, lightening caused wildfire on Blackbeard Island National Wildlife Refuge in McIntosh County, Georgia. The fire is burning in a federally designated

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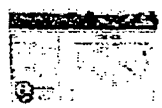

U.S. Fish & Wildlif Service announc decision on Corbett Wildlife Management Area Land Proposal – Learn more ...

Natural Resource

Wilderness area on the south end of the refuge, forcing the temporary closure of both the East and West Wilderness Trails and the south beach. All trails and beaches on the north end of the island and all navigable waterways around the island remain open.

The fire, which has been designated "Blackbeard's Revenge", began as a lightning strike Thursday, July 6. The fire smoldered undetected until Saturday, when it was observed by the captain of a passing barge. U.S. Fish and Wildlife Service personnel were dispatched to the island Sunday morning, and by Sunday evening, they had contained the fire. – Learn more...

Damage Assessment and Restoration Program – Learn more ...

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South Carolina

As of 1999

Common Name	Scientific Name	Status
Abbeville		
Bald eagle	*Haliaeetus leucocephalus*	T
Aiken		
Bald eagle	*Haliaeetus leucocephalus*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Relict trillium	*Trillium reliquum*	E
Harperella	*Ptilimnium nodosum*	E
Smooth coneflower	*Echinacea laevigata*	E
Allendale		
Bald eagle	*Haliaeetus leucocephalus*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Smooth coneflower	*Echinacea laevigata*	E
Canby's dropwort	*Oxypolis canbyi*	E
Anderson		
Bald eagle	*Haliaeetus leucocephalus*	T
Smooth coneflower	*Echinacea laevigata*	E
Bamberg		
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Canby's dropwort	*Oxypolis canbyi*	E
Barnwell		
Bald eagle	*Haliaeetus leucocephalus*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Sooth coneflower	*Echinacea laevigata*	E
Pondberry	*Lindera melissifolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
Harperella	*Ptilimnium nodosum*	E
American chaffseed	*Schwalbea americana*	E
Beaufort		
West Indian manatee	*Trichechus manatus*	E
Finback whale	*Balaenoptera physalus**	E
Humpback whale	*Megaptera novaeangliae**	E

Northern right whale	*Eubaleana glacialis**	E
Sei whale	*Balaenoptera borealis**	E
Sperm whale	*Physeter catodon**	E
Bald eagle	*Haliaeetus leucocephalus*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Piping plover	*Charadrius melodus*	T
Kemp's ridley sea turtle	*Lepidochelys kempii**	E
Leatherback sea turtle	*Dermochelys coriacea**	E
Loggerhead sea turtle	*Caretta caretta*	T
Green sea turtle	*Chelonia mydas**	T
Flatwoods salamander	*Ambystoma cingulatum*	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Pondberry	*Lindera melissifolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E
Dusky shark	*Carcharhinus obscurus**	C
Sand tiger shark	*Odontaspis taurus**	C
Night shark	*Carcharinus signatus**	C
Speckled hind	*Epinephelus drummondhayi**	C
Jewfish	*Epinephelus itijara**	C
Warsaw grouper	*Epinephelus nigritus**	C
Nassau grouper	*Epinephelus striatus**	C

Berkeley

West Indian manatee	*Trichechus manatus*	E
Bald eagle	*Haliaeetus leucocephalus*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Loggerhead sea turtle	*Caretta caretta*	T
Flatwoods salamander	*Ambystoma cingulatum*	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Pondberry	*Lindera melissifolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E

Calhoun

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E

Charleston

West Indian manatee	*Trichechus manatus*	E
Finback whale	*Balaenoptera physalus**	E
Humpback whale	*Megaptera novaeanqliae**	E
Northern right whale	*Eubaleana glacialis**	E
Sei whale	*Balaenoptera borealis**	E
Sperm whale	*Physeter catodon**	E
Bald eagle	*Haliaeetus leucocephalus*	T
Bachman's warbler	*Vermivora bachmanii*	E
Wood stork	*Mycteria americana*	E

Red-cockaded woodpecker	*Picoides borealis*	E
Piping plover	*Charadrius melodus*	T
Kemp's ridley sea turtle	*Lepidochelys kempii**	E
:herback sea turtle	*Dermochelys coriacea**	E
Loggerhead sea turtle	*Caretta caretta*	T
Green sea turtle	*Chelonia mydas**	T
Flatwoods salamander	*Ambystoma cingulatum*	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Sea-beach amaranth	*Amaranthus pumilus*	T
Canby's dropwort	*Oxypolis canbyi*	E
Pondberry	*Lindera melissifolia*	E
American chaffseed	*Schwalbea americana*	E
Dusky shark	*Carcharhinus obscurus**	C
Sand tiger shark	*Odontaspis taurus**	C
Night shark	*Carcharinus signatus**	C
Speckled hind	*Epinephelus drummondhayi**	C
Jewfish	*Epinephelus itijara**	C
Warsaw grouper	*Epinephelus nigritus**	C
Nassau grouper	*Epinephelus striatus**	C

Cherokee

Dwarf-flowered heartleaf	*Hexastylis naniflora*	T

Chester

Bald eagle	*Haliaeetus leucocephalus*	T
.d-cockaded woodpecker	*Picoides borealis*	E

Chesterfield

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Carolina heelsplitter	*Lasmigona decorata*	E

Clarendon

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E

Colleton

Bald eagle	*Haliaeetus leucocephalus*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Kemp's ridley sea turtle	*Lepidochelys kempii**	E
eatherback sea turtle	*Dermochelys coriacea**	E
Loggerhead sea turtle	*Caretta caretta*	T
Green sea turtle	*Chelonia mydas**	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Pondberry	*Lindera melissifolia*	E

Canby's dropwort	*Oxypolis canbyi*	E
Dusky shark	*Carcharhinus obscurus**	C
Sand tiger shark	*Odontaspis taurus**	C
Night shark	*Carcharinus signatus**	C
Speckled hind	*Epinephelus drummondhayi**	C
Jewfish	*Epinephelus itijara**	C
Warsaw grouper	*Epinephelus nigritus**	C
Nassau grouper	*Epinephelus striatus**	C

Darlington

Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E

Dillon

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E

Dorchester

Bald eagle	*Haliaeetus leucocephalus*	T
Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Pondberry	*Lindera melissifolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
Bog asphodel	*Narthecium americanum*	C

Edgefield

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Carolina heelsplitter	*Lasmigona decorata*	E
Miccosukee gooseberry	*Ribes echinellum*	T
Relict trillium	*Trillium reliquum*	E

Fairfield

Bald eagle	*Haliaeetus leucocephalus*	T

Florence

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
American chaffseed	*Schwalbea americana*	E

Georgetown

West Indian manatee	*Trichechus manutus*	E
Finback whale	*Balaenoptera physalus**	E
Humpback whale	*Megaptera novaeanqliae**	E
Northern right whale	*Eubaleana glacialis**	E

Sei whale	*Balaenoptera borealis**	E
Sperm whale	*Physeter catodon**	E
Bald eagle	*Haliaeetus leucocephalus*	T
-cockaded woodpecker	*Picoides borealis*	E
Wood stork	*Mycteria americana*	E
Piping plover	*Charadrius melodus*	T
Kemp's ridley sea turtle	*Lepidochelys kempii**	E
Leatherback sea turtle	*Dermochelys coriacea**	E
Loggerhead sea turtle	*Caretta caretta*	T
Green sea turtle	*Chelonia mydas**	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Sea-beach amaranth	*Amaranthus pumilus*	T
Pondberry	*Lindera melissifolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E
Dusky shark	*Carcharhinus obscurus**	C
Sand tiger shark	*Odontaspis taurus**	C
Night shark	*Carcharinus signatus**	C
Speckled hind	*Epinephelus drummondhayi**	C
Jewfish	*Epinephelus itijara**	C
Warsaw grouper	*Epinephelus nigritus**	C
Nassau grouper	*Epinephelus striatus**	C

Greenville

Bog turtle	*Clemmys muhlenbergii*	PT S/A
vamp- pink	*Helonias bullata*	T
warf-flowered heartleaf	*Hexastylis naniflora*	T
Small whorled pogonia	*Isotria medeoloides*	T
Bunched arrowhead	*Sagittaria fasciculata*	E
Mountain sweet pitcher-plant	*Sarracenia rubra ssp. jonesii*	E
White irisette	*Sisyrinchium dichotomum*	E
Rock gnome lichen	*Gymnoderma lineare*	E

Greenwood

Carolina heelsplitter	*Lasmigona decorata*	E

Hampton

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Wood stork	*Mycteria americana*	E
Eastern indigo snake	*Drymarchon corais couperi*	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Canby's dropwort	*Oxypolis canbyi*	E

Horry

West Indian manatee	*Trichechus manutus*	E
inback whale	*Balaenoptera physalus**	E
Humpback whale	*Megaptera novaeanqliae**	E
Northern right whale	*Eubaleana glacialis**	E
Sei whale	*Balaenoptera borealis**	E
Sperm whale	*Physeter catodon**	E

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Wood stork	*Mycteria americana*	E
Piping plover	*Charadrius melodus*	T
Kemp's ridley sea turtle	*Lepidochelys kempii**	E
Leatherback sea turtle	*Dermochelys coriacea**	E
Loggerhead sea turtle	*Caretta caretta*	T
Green sea turtle	*Chelonia mydas**	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Sea-beach amaranth	*Amaranthus pumilus*	T
Pondberry	*Lindera melissifolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E
Dusky shark	*Carcharhinus obscurus**	C
Sand tiger shark	*Odontaspis taurus**	C
Night shark	*Carcharinus signatus**	C
Speckled hind	*Epinephelus drummondhayi**	C
Jewfish	*Epinephelus itijara**	C
Warsaw grouper	*Epinephelus nigritus**	C
Nassau grouper	*Epinephelus striatus**	C

Jasper

West Indian manatee	*Trichechus manutus*	E
Finback whale	*Balaenoptera physalus*	E
Humpback whale	*Megaptera novaeanqliae*	E
Right whale	*Eubaleana glacialis*	E
Sei whale	*Balaenoptera borealis*	E
Sperm whale	*Physeter catodon*	E
Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Wood stork	*Mycteria americana*	E
Piping plover	*Charadrius melodus*	T
Eastern indigo snake	*Drymarchon corais couperi*	T
Kemp's ridley sea turtle	*Lepidochelys kempii**	E
Leatherback sea turtle	*Dermochelys coriacea**	E
Loggerhead sea turtle	*Caretta caretta*	T
Green sea turtle	*Chelonia mydas**	T
Flatwoods salamander	*Ambystoma cingulatum*	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Pondberry	*Lindera melissifolia*	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E
Dusky shark	*Carcharhinus obscurus**	C
Sand tiger shark	*Odontaspis taurus**	C
Night shark	*Carcharinus signatus**	C
Speckled hind	*Epinephelus drummondhayi**	C
Jewfish	*Epinephelus itijara**	C
Warsaw grouper	*Epinephelus nigritus**	C
Nassau grouper	*Epinephelus striatus**	C

Kershaw

Bald eagle	*Haliaeetus leucocephalus*	T

Red-cockaded woodpecker	*Picoides borealis*	E
Carolina heelsplitter	*Lasmigona decorata*	E

caster

Carolina heelsplitter	*Lasmigona decorata*	E
Little amphianthus	*Amphianthus pusillus*	T
Smooth coneflower	*Echinacea laevigata*	E
Schweinitz' sunflower	*Helianthus schweinitzii*	E
Black-spored quillwort	*Isoetes melanospora*	E

Laurens

Red-cockaded woodpecker	*Picoides borealis*	E

Lee

Red-cockaded woodpecker	*Picoides borealis*	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E

Lexington

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Smooth coneflower	*Echinacea laevigata*	E
hweinitz's sunflower	*Helianthus schweinitzii*	E

Marion

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Wood stork	*Mycteria americana*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E

Marlboro

Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Canby's dropwort	*Oxypolis canbyi*	E

McCormick

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Carolina heelsplitter	*Lasmigona decorata*	E
Miccosukee gooseberry	*Ribes echinellum*	T

Newberry

Bald eagle	*Haliaeetus leucocephalus*	T

Oconee

Indiana bat	*Myotis sodalis*	E

Bald eagle	*Haliaeetus leucocephalus*	T
Smooth coneflower	*Echinacea laevigata*	E
Small whorled pogonia	*Isotria medeoloides*	T
Persistent trillium	*Trillium persistens*	E

Orangeburg

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Flatwoods salamander	*Ambystoma cingulatum*	T
Shortnose sturgeon	*Acipenser brevirostrum**	E
Canby's dropwort	*Oxypolis canbyi*	E

Pickens

Bald eagle	*Haliaeetus leucocephalus*	T
Bog turtle	*Clemmys muhlenbergii*	T S/A
Smooth coneflower	*Echinacea laevigata*	E
Dwarf-flowered heartleaf	*Hexastylis naniflora*	T
Black-spored quillwort	*Isoetes melanospora*	E
Mountain sweet pitcher-plant	*Sarracenia rubra ssp. jonesii*	E

Richland

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Smooth coneflower	*Echinacea laevigata*	E
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E
Canby's dropwort	*Oxypolis canbyi*	E

Saluda

Red-cockaded woodpecker	*Picoides borealis*	E
Little amphianthus	*Amphianthus pusillus*	T
Harperella	*Ptilimnium nodosum*	E

Spartanburg

Dwarf-flowered heartleaf	*Hexastylis naniflora*	T

Sumter

Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
Canby's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E

Union

No species

Williamsburg

Bald eagle	*Haliaeetus leucocephalus*	T

Wood stork	*Mycteria americana*	E
Red-cockaded woodpecker	*Picoides borealis*	E
Shortnose sturgeon	*Acipenser brevirostrum**	E
...y's dropwort	*Oxypolis canbyi*	E
American chaffseed	*Schwalbea americana*	E

York

Bald eagle	*Haliaeetus leucocephalus*	T
Little amphianthus	*Amphianthus pusillus*	T
Schweinitz' sunflower	*Helianthus schweinitzii*	E
Dwarf-flowered heartleaf	*Hexastylis naniflora*	T

Key to codes on list:
E - Endangered
T - Threatened
CH - Critical Habitat Designated
C - Candidate Species
PT - Proposed Threatened
PE - Proposed Endangered
(P) - Possible Occurrence
S/A - Similarity of Appearance
*** - Contact National Marine Fisheries Service for more information**

USFWS 2006

Sec. 2.4 Ref 47

South Carolina Distribution Records of Endangered, Threatened, Candidate and Species of Concern
March, 2006

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
Abbeville				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Carolina heelsplitter	Lasmigona decorata	E	Possible
	Georgia aster	Aster georgianus	C	Known
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Bachman's sparrow	Aimophila aestivalis	SC	Possible
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Swainson's warbler	Limnothlypis swainsonii	SC	Known
Aiken				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Wood stork	Mycteria americana	E	Known
	Red-cockaded woodpecker	Picoides borealis	E	Known
	Shortnose sturgeon	Acipenser brevirostrum*	E	Known
	Relict trillium	Trillium reliquum	E	Known
	Piedmont bishop-weed	Ptilimnium nodosum	E	Known
	Smooth coneflower	Echinacea laevigata	E	Known
	Southern Dusky Salamander	Desmognathus auriculatus	SC	Possible
	Gopher frog	Rana capito	SC	Known
	Small-flowered buckeye	Aesculus parviflora	SC	Known
	Sandhills milk-vetch	Astragalus michauxii	SC	Known
	Elliott's croton	Croton elliottii	SC	Known
	Dwarf burhead	Echinodorus parvulus	SC	Known

SCEG-2

County	Common Name	Scientific Name	Status	Occurrence
dgefield cont.	Shoals spider-lily	Hymenocallis coronaria	SC	Known
	Butternut	Juglans cinerea	SC	Possible
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Bachman's sparrow	Aimophila aestivalis	SC	Possible
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Brook floater	Alasmidonta varicosa	SC	Known
	Yellow lampmussel	Lampsilis cariosa	SC	Known
Fairfield				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Carolina heelsplitter	Lasmigona decorata	E	Possible
	Georgia aster	Aster georgianus	C	Known
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Bachman's sparrow	Aimophila aestivalis	SC	Possible
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Carolina darter	Etheostoma collis	SC	Known
Florence				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Red-cockaded woodpecker	Picoides borealis	E	Known
	Shortnose sturgeon	Acipenser brevirostrum*	E	Known
	Chaffseed	Schwalbea americana	E	Known
	Southern Dusky Salamander	Desmognathus auriculatus	SC	Possible
	Georgia lead-plant	Amorpha georgiana var. georgiana	SC	Known
	Boykin's lobelia	Lobelia boykinii	SC	Known
	Carolina bogmint	Macbridea caroliniana	SC	Known
	Awned meadowbeauty	Rhexia aristosa	SC	Known
	Ovate catchfly	Silene ovata	SC	Known
	White false-asphodel	Tofieldia glabra	SC	Known
	Bachman's sparrow	Aimophila aestivalis	SC	Possible
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Painted bunting	Passerina ciris ciris	SC	Possible
	Madtom, broadtail	Noturus sp 2	SC	Possible

County	Common Name	Scientific Name	Status	Occurrence
on	Northern pine snake	Pituophis melanoleucus melanoleucus	SC	Known
cont.	Rafinesque's big-eared bat	Corynorhinus rafinesquii	SC	Known
Marlboro				
	Red-cockaded woodpecker	Picoides borealis	E	Known
	Shortnose sturgeon	Acipenser brevirostrum*	E	Possible
	Canby's dropwort	Oxypolis canbyi	E	Possible
	Southern Dusky Salamander	Desmognathus auriculatus	SC	Possible
	Awned meadowbeauty	Rhexia aristosa	SC	Known
	Spring-flowering goldenrod	Solidago verna	SC	Known
	Pickering's morning-glory	Stylisma pickeringii var. pickeringii	SC	Known
	Bachman's sparrow	Aimophia aestivalis	SC	Known
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Painted bunting	Passerina ciris ciris	SC	Possible
	Yellow lampmussel	Lampsilis cariosa	SC	Known
	Redhorse, Robust	Moxostoma robustum	SC	Possible
McCormick				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Red-cockaded woodpecker	Picoides borealis	E	Known
	Wood stork	Mycteria americana	E	Known
	Carolina heelsplitter	Lasmigona decorata	E, CH	Known
	Miccosukee gooseberry	Ribes echinellum	T	Known
	Georgia aster	Aster georgianus	C	Known
	Shoals spider-lily	Hymenocallis coronaria	SC	Known
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Bachman's sparrow	Aimophia aestivalis	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Brook floater	Alasmidonta varicosa	SC	Known
	Yellow lampmussel	Lampsilis cariosa	SC	Known
Newberry				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	~~Carolina heelsplitter~~	~~Lasmigona decorata~~	~~E~~	~~Possible~~
	Butternut	Juglans cinerea	SC	Possible

County	Common Name	Scientific Name	Status	Occurrence
ewberry cont.	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Biltmore green briar	Smilax biltmoreana	SC	Known
	Sweet pinesap	Monotropsis odorata	SC	Known
	Bachman's sparrow	Aimophia aestivalis	SC	Known
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Saluda crayfish	Distocambarus youngineri	SC	Known
Oconee				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Smooth coneflower	Echinacea laevigata	E	Known
	Small whorled pogonia	Isotria medeoloides	T	Known
	Persistent trillium	Trillium persistens	E	Known
	Georgia aster	Aster georgianus	C	Known
	Green salamander	Aneides aeneus	SC	Known
	Hellbender	Cryptobranchus alleganiensis	SC	Known
	Fort mountain sedge	Carex amplisquama	SC	Known
	Manhart sedge	Carex manhartii	SC	Known
	Cuthbert turtlehead	Chelone cuthberti	SC	Possible
	Butternut	Juglans cinerea	SC	Possible
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Fraser loosestrife	Lysimachia fraseri	SC	Known
	Sweet pinesap	Monotropsis odorata	SC	Known
	Liverwort (no other name)	Porella japonica ssp. appalachium	SC	Known
	Sun-facing coneflower	Rudbeckia heliopsidis	SC	Known
	Oconee-bells	Shortia galacifolia	SC	Known
	Biltmore green briar	Smilax biltmoreana	SC	Known
	Granite dome goldenrod	Solidago simulans	SC	Possible
	Piedmont strawberry	Waldsteinia lobata	SC	Known
	Cerulean warbler	Dendroica cerulea	SC	Possible
	Black-throated green warbler	Dendroica virens	SC	Possible
	American kestrel	Falco sparverius	SC	Possible
	Swainson's warbler	Limnothlypis swainsonii	SC	Known
	Red crossbill	Loxia curvirostra	SC	Known
	Wren, Appalachian Bewick's	Thryomanes bewickii altus	SC	Known
	Golden-winged warbler	Vermivora chrysoptera	SC	Known
	Brook floater	Alasmidonta varicosa	SC	Known
	Rafinesque's big-eared bat	Corynorhinus rafinesquii	SC	Known

County	Common Name	Scientific Name	Status	Occurrence
Pickens cont.	Manhart sedge	Carex manhartii	SC	Known
	Radford's sedge	Carex radfordii	SC	Known
	Cuthbert turtlehead	Chelone cuthberti	SC	Possible
	Tunbridge fern	Hymenophyllum tunbridgnse	SC	Known
	Butternut	Juglans cinerea	SC	Possible
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Fraser loosestrife	Lysimachia fraseri	SC	Known
	Sweet pinesap	Monotropsis odorata	SC	Known
	Piedmont ragwort	Senecio millefolium	SC	Known
	Oconee-bells	Shortia galacifolia	SC	Known
	Biltmore greenbrier	Smilax biltmoreana	SC	Known
	Granite dome goldenrod	Solidago simulans	SC	Possible
	Cerulean warbler	Dendroica cerulea	SC	Possible
	Black-throated green warbler	Dendroica virens	SC	Possible
	American kestrel	Falco sparverius	SC	Possible
	Red crossbill	Loxia curvirostra	SC	Known
	Wren, Appalachian Bewick's	Thryomanes bewickii altus	SC	Possible
	Golden-winged warbler	Vermivora chrysoptera	SC	Known
	Margaret's river cruiser	Macromia margarita	SC	Known
	Carlson's polycentropis caddisfly	Polycentropis carlsoni	SC	Known
	Rafinesque's big-eared bat	Corynorhinus rafinesquii	SC	Known
	Southern appalachian woodrat	Neotoma floridana haematoreia	SC	Known
Richland				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Red-cockaded woodpecker	Picoides borealis	E	Known
	~~Shortnose sturgeon~~	~~Acipenser brevirostrum*~~	~~E~~	Known*
	Smooth coneflower	Echinacea laevigata	E	Known
	Rough-leaved loosestrife	Lysimachia asperulaefolia	E	Known
	Canby's dropwort	Oxypolis canbyi	E	Known
	~~Carolina heelsplitter~~	~~Lasmigona decorata~~	~~E~~	Possible
	Georgia aster	Aster georgianus	C	Known
	Southern Dusky Salamander	Desmognathus auriculatus	SC	Possible
	Sandhills milk-vetch	Astragalus michauxii	SC	Known
	Purple balduina	Balduina atropurpurea	SC	Known
	Shoals spider-lily	Hymenocallis coronaria	SC	Known
	Creeping St. John's wort	Hypericum adpressum	SC	Known

County	Common Name	Scientific Name	Status	Occurrence
ichland cont.	Bog spicebush	Lindera subcoriacea	SC	Known
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Carolina bogmint	Macbridea caroliniana	SC	Known
	Algae-like pondweed	Potamogeton confervoides	SC	known
	False coco	Pteroglossaspis ecristata	SC	Known
	Awned meadowbeauty	Rhexia aristosa	SC	Known
	Reclined meadow-rue	Thalictrum subrotundum	SC	Known
	White false-asphodel	Tofieldia glabra	SC	Known
	Rayner's blueberry	Vaccinium crassifolium ssp. empervirens	SC	Known
	Bachman's sparrow	Aimophia aestivalis	SC	Known
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	American kestrel	Falco sparverius	SC	Known
	Loggerhead shrike	Lanius ludovicianus	SC	Known
	Painted bunting	Passerina ciris ciris	SC	Possible
	Carolina darter	Etheostoma collis	SC	Known
	Rafinesque's big-eared bat	Corynorhinus rafinesquii	SC	Known
	Southern hognose snake	Heterodon simus	SC	Known
Saluda				
	Bald eagle	Haliaeetus leucocephalus	T	Known
	Red-cockaded woodpecker	Picoides borealis	E	Known
	Carolina heelsplitter	Lasmigona decorata	E	Possible
	Piedmont bishop-weed	Ptilimnium nodosum	E	Known
	Little amphianthus	Amphianthus pusillus	T	Known
	Dwarf burhead	Echinodorus parvulus	SC	Known
	Creeping St. John's wort	Hypericum adpressum	SC	Known
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible
	Bachman's sparrow	Aimophia aestivalis	SC	Known
	Henslow's sparrow	Ammodramus henslowii	SC	Known
	American kestrel	Falco sparverius	SC	Possible
	Loggerhead shrike	Lanius ludovicianus	SC	Possible
	Savannah lilliput	Toxolasma pullus	SC	Known
	Southern hognose snake	Heterodon simus	SC	Known
Spartanburg				
	Dwarf-flowered heartleaf	Hexastylis naniflora	T	Known
	Butternut	Juglans cinerea	SC	Possible
	Prairie birdsfoot-trefoil	Lotus purshianus var. helleri	SC	Possible

Moore, Phil -- NUS

From: Whitten, Mike -- NUS
Sent: Monday, August 07, 2006 2:39 PM
To: Moore, Phil -- NUS
Subject: FW: E/T County list

Attachments: etcountylist_3_06.doc; BAcontents.pdf

etcountylist_3_06.doc (1 MB) BAcontents.pdf (118 KB)

-----Original Message-----
From: Tera_Baird@fws.gov [mailto:Tera_Baird@fws.gov]
Sent: Wednesday, July 26, 2006 2:26 PM
To: mike.whitten@ttnus.com
Subject: E/T County list

Hi Mike-

This list should be used as a guide only. I've enclosed a biological assessment .pdf. This should be used as guidance when preparing a section 7 package for our office. Enjoy!

(See attached file: etcountylist_3_06.doc)(See attached file: BAcontents.pdf)

Tera Keeler Baird
Wildlife Biologist
US Fish and Wildlife Service
176 Croghan Spur Suite 200
Charleston, SC 29407

Sec 2.4 Ref 48

Federal Register

Monday,
July 9, 2007

Part III

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife; Final Rule; Endangered and Threatened Wildlife and Plants; Draft Post-Delisting and Monitoring Plan for the Bald Eagle (Haliaeetus leucocephalus) and Proposed Information Collection; Notice

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

RIN 1018–AF21

Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: The best available scientific and commercial data indicate that the bald eagle has recovered. Therefore, under the authority of the Endangered Species Act of 1973, as amended (Act), we, the U.S. Fish and Wildlife Service, remove (delist) the bald eagle (*Haliaeetus leucocephalus*) in the lower 48 States of the United States from the Federal List of Endangered and Threatened Wildlife. This determination is based on a thorough review of all available information, which indicates that the threats to this species have been eliminated or reduced to the point that the species has recovered and no longer meets the definition of threatened or endangered under the Act.

Fueled by a reduction in the threats to the bald eagle, the population in the lower 48 States has increased from approximately 487 breeding pairs in 1963, to an estimated 9,789 breeding pairs today. The recovery of the bald eagle is due in part to the reduction in levels of persistent organochlorine pesticides (such as DDT) occurring in the environment and habitat protection and management actions. The protections provided to the bald eagle under the Bald and Golden Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA) will continue to remain in place after the species is delisted. To help provide more clarity on the management of bald eagles after delisting, we recently published a regulatory definition of "disturb", the final National Bald Eagle Management Guidelines and a proposed rule for a new permit that would authorize limited take under BGEPA and grandfather existing Act authorizations.

DATES: This rule is effective August 8, 2007.

FOR FURTHER INFORMATION CONTACT: Chief, Branch of Recovery and Delisting, telephone (703) 358–2061 or facsimile (703) 358–1735.

Additional information is also available on our Web site at *http://www.fws.gov/migratorybirds/BaldEagle.htm*. Individuals who use a telecommunications device for the deaf (TDD) may call the Federal Relay Service at 1–800–877–8339 for TTY assistance, 24 hours a day, 7 days a week.

SUPPLEMENTARY INFORMATION:

Background

Information about the bald eagle's life history can be found in our February 16, 2006, reopening of the public comment period on the proposed delisting rule (71 FR 8238) (U.S. FWS 2006a) and our five recovery plans for the bald eagle (U.S. FWS 1982, 1983, 1986, 1989, 1990), Gerrard and Bortolotti (1988), and Buehler (2000).

Previous Federal Actions

Bald eagles gained protection under the Bald Eagle Protection Act (16 U.S.C. 668–668d) in 1940 and the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703–712) in 1972. A 1962 amendment to the Bald Eagle Protection Act added protection for the golden eagle and the amended statute became known as the Bald and Golden Eagle Protection Act (BGEPA).

On March 11, 1967 (32 FR 4001), the Secretary of the Interior listed bald eagles south of 40 north latitude as endangered under the Endangered Species Preservation Act of 1966 (Pub. L. 89–699, 80 Stat. 926) due to a population decline caused by DDT and other factors. On February 14, 1978, the Service listed the bald eagle as endangered under the Act (16 U.S.C. 1531 *et seq.*) in 43 of the contiguous States, and threatened in the States of Michigan, Minnesota, Wisconsin, Oregon, and Washington (43 FR 6230, February 14, 1978). Sub-specific designations for northern and southern eagles were removed.

On February 7, 1990, we published an advance notice of proposed rulemaking (55 FR 4209) to reclassify the bald eagle from endangered to threatened in the 43 States where it had been listed as endangered and retain the threatened status for the other 5 States. On July 12, 1994, we published a proposed rule to accomplish this reclassification (59 FR 35584), and the final rule was published on July 12, 1995 (60 FR 36000).

On July 6, 1999, we published a proposed rule to delist the bald eagle throughout the lower 48 States due to recovery (64 FR 36454). Due to the availability of new information, on February 16, 2006 (71 FR 8238), we reopened the public comment period on our July 6, 1999 (64 FR 36454), proposed rule to delist the bald eagle in the lower 48 States. The reopening notice contained updated information on several State survey efforts and population numbers. Simultaneously with the reopening of the public comment period on the proposed delisting, we also published two **Federal Register** documents soliciting public comments on two new items intended to clarify the BGEPA protections for the bald eagle after delisting: (1) A proposed rule for a regulatory definition of "disturb" (71 FR 8265, February 16, 2006), and (2) a notice of availability for draft National Bald Eagle Management Guidelines (71 FR 8309, February 16, 2006). On May 16, 2006, we published three separate notices in the **Federal Register** that extended the public comment period on the proposed delisting (71 FR 28293), the proposed regulatory definition of "disturb" (71 FR 28294), and the draft Guidelines (71 FR 28369). The comment period for all three documents was extended to June 19, 2006.

On December 12, 2006, we published in the **Federal Register** a notice requesting public comment on two BGEPA items. First, we re-opened the public comment period on our February 16, 2006, proposed regulatory definition of "disturb." Second, we also announced the availability the draft environmental assessment on the definition of "disturb" (71 FR 74483).

On October 6, 2004, we received a petition, dated October 6, 2004, from the Center for Biological Diversity, the Maricopa Audubon Society, and the Arizona Audubon Council requesting that the bald eagle population found in the Sonoran Desert (as defined by Brown 1994) or, alternately, in the upper and lower Sonoran Desert (as defined by Merriam (Northern Arizona University 2006, p. 2)) be classified as a distinct population segment (DPS), that this DPS be reclassified from a threatened species to an endangered species, and that we concurrently designate critical habitat for the DPS. On August 30, 2006, we made a 90-day finding (71 FR 51549) that the petition did not present substantial scientific or commercial information indicating that the petitioned action may be warranted.

On January 5, 2007, the Center for Biological Diversity and the Maricopa Audubon Society brought suit against the Service, *Center for Biological Diversity* v. *Kempthorne*, CV 07–0038–PHX–MHM (D. Ariz.), challenging the Service's 90-day finding that the Sonoran Desert population did not qualify as a DPS, and further challenging the Service's 90-day finding that the Sonoran Desert population should not be up-listed to endangered status. That suit is still pending. However, the Service's finding in this final delisting rule supersedes the Service's 90-day petition finding because it constitutes a final decision on whether the Southwestern bald eagles, including those in the Sonoran Desert, qualify for listing as a DPS. This decision was made after notice and comment, as described above, and was based on all of the relevant information that the Service has obtained. Even if the court in the 90-day finding suit were to find that the plaintiffs' petition warranted further review, this finding addresses the same issues that the Service would have considered as part of a 12-month finding had the Service made a positive 90-day finding on the petition. This document constitutes the Service's final determination on these issues, and is judicially reviewable with respect to them; therefore, any controversy regarding the August 30, 2006, 90-day finding is now moot.

On June 5, 2007, we published four documents in the **Federal Register** announcing one proposed action and three final actions under the BGEPA: (1) A final rule on the regulatory definition of "disturb" (72 FR 31132); (2) a notice of availability for the final National Bald Eagle Management Guidelines (72 FR 31156); (3) a notice of availability for the final environmental assessment on the definition of "disturb" (72 FR 31156); and (4) a proposed rule for a new permit that would authorize limited take under BGEPA, and to grandfather existing Act authorizations after delisting occurs under the Act (72 FR 31141).

Bald Eagle Recovery

Section 4(f) of the Act directs us to develop and implement recovery plans for listed species. In establishing the recovery program for the species in the mid-1970s, the Service divided the bald eagle population in the lower 48 States into five recovery regions. These recovery regions were administrative boundaries to help the Service plan for recovery, given the information we had at the time. During this timeframe the bald eagle population was continuing to decline and little was known about where the important areas might be. Given the lack of information on this issue, the Service generally decided that recovery planning should be conducted in all parts of the range. However, as discussed below in the Conclusion of the 5-Factors analysis section, based on the information present today, the southwest region is a not a significant portion of the range.

In some cases, we appoint experts to recovery teams to assist in the preparation of recovery plans. For the bald eagle, separate recovery teams composed of experts in each geographic area prepared recovery plans for their region. The teams established recovery objectives and criteria and identified tasks to achieve those objectives. Coordination meetings were held regularly among the five teams to exchange data and discuss progress towards recovery.

We used these five recovery plans to provide guidance to the Service, States, and other partners on methods to minimize and reduce the threats to the bald eagle and to provide measurable criteria that would be used to help determine when the threats to the bald eagle had been reduced so that the bald eagle could be removed from the Federal List of Endangered and Threatened Wildlife.

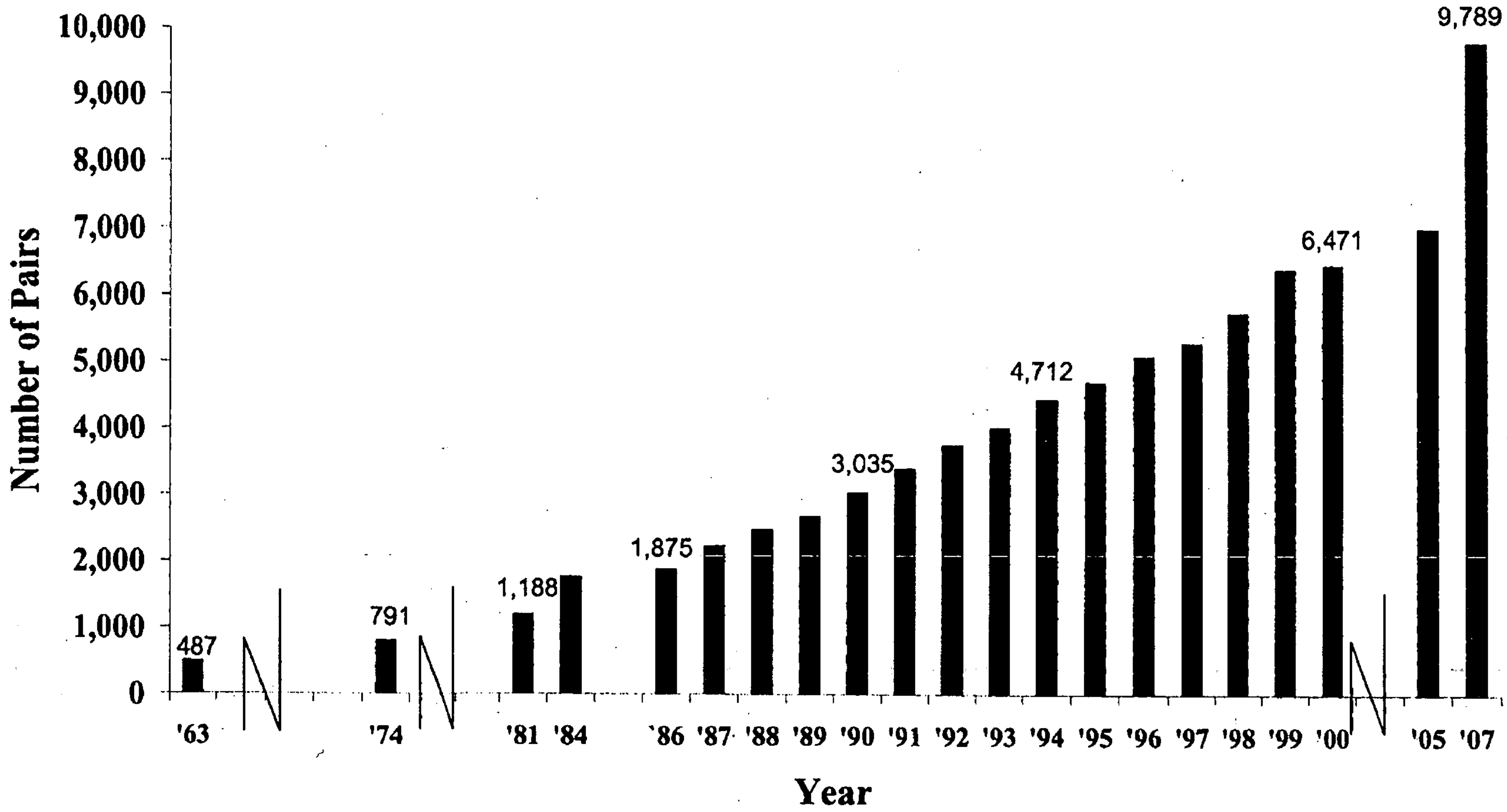
Recovery plans in general are not regulatory documents and are instead intended to provide a guide on how to achieve recovery. There are many paths to accomplishing recovery of a species in all or a significant portion of its range. The main goal is to remove the threats to a species, which may occur without meeting all recovery criteria contained in a recovery plan. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, the Service may judge that, overall, the threats have been reduced sufficiently, and the species is robust enough, to reclassify the species from endangered to threatened or perhaps to delist the species. In other cases, recovery opportunities may be recognized that were not known at the time the recovery plan was finalized. Achievement of these opportunities may be counted as progress toward recovery in lieu of methods identified in the recovery plan. Likewise, we may learn information about the species that was not known at the time the recovery plan was finalized. The new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery of species is a dynamic process requiring adaptive management, and judging the degree of recovery of a species is also an adaptive management process that may, or may not, fully follow the guidance provided in a recovery plan.

Recovery of the bald eagle has been a dynamic process. As new information became available, it was used during the recovery implementation process to help the Service determine whether recovery was on track. For instance, after the bald eagle was downlisted in 1995, the Southeastern Recovery Plan did not have specific delisting goals, and the Service used the recovery team to help determine the appropriate goal. This new delisting goal is considered the best available data in helping the Service determine whether the threats have been removed and to move forward with the delisting.

All of the bald eagle recovery plans established goals for the number of occupied breeding areas and the productivity of the populations in the individual recovery regions. By setting a goal to monitor population numbers and productivity, the Service could determine whether the threats that led to the bald eagle's endangerment were being removed. With the reduction in levels of persistent organochlorine pesticides (such as DDT) occurring in the environment and the habitat protection and management actions that have been put in place, the bald eagle population has shown a remarkable increase in numbers. Between 1990 and 2000, the bald eagle population had a national average productivity of at least one fledgling per nesting pair per year. As a result, the bald eagle's nesting population increased at a rate of about 8 percent per year during this time period. Since 1963, when the Audubon Society estimated that there were 487 nesting pairs, bald eagle breeding in the lower 48 States has expanded to more than 9,789 nesting pairs today (U.S. FWS 1995, p. 36001; U.S. FWS 1999, p. 36457.)

Some States have shown increases in their bald eagle pairs over the past several years. For example, Illinois had an estimated 36 pairs in 1999, but the State had an estimated 100 pairs in 2006 (Conlin 2006, p. 1). Iowa had an estimated 100 pairs in 1999, and their bald eagle population has doubled to an estimated 200 pairs in 2006 (Vonk 2006, p. 1). Minnesota had an estimated 681 pairs in 2001, and an estimated 1,312 pairs in 2005 (Moore 2006, p. 1). In recent decades, Vermont was the only State in the conterminous United States that did not have nesting bald eagles. In 2006, a pair of bald eagles nested in Vermont for the first time since the 1940s, and now Vermont has one nesting pair (Amaral 2006, p. 3). To date, the bald eagle's population growth has exceeded all the numeric goals established in the five recovery plans. In most of the recovery regions, the numeric goals for breeding pairs have been significantly exceeded. For example, the delisting goal in the Northern States Recovery Plan calls for 1,200 breeding pairs distributed over a minimum of 16 States. Today, there are an estimated 4,215 breeding pairs covering every State in that recovery region.

BILLING CODE 4310–55–P

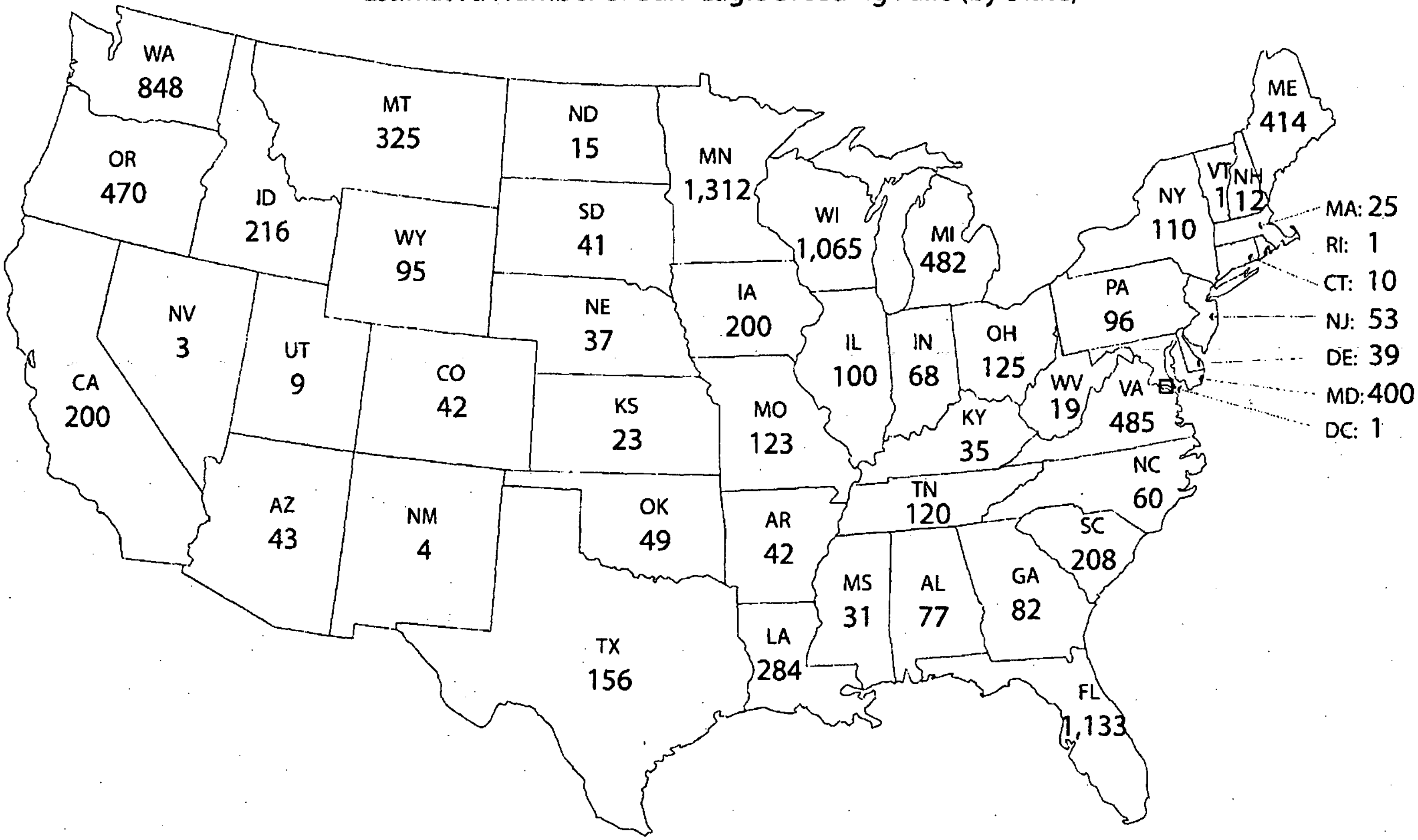


Estimated number of bald eagle pairs in lower 48 states from 1963 - 2007

BILLING CODE 4310-55-C

U.S. Fish & Wildlife Service

Final Rule to Delist the Bald Eagle in the Lower 48 States
Estimated Number of Bald Eagle Breeding Pairs (by State)*



* State information 2004, or later

Total Pairs: 9,789

April 2007

For more information on recovery of the bald eagle in general and specific recovery of the individual recovery areas, see the discussion on pages 8240–8243 of the February 16, 2006, reopening of the public comment period on the proposed rule to delist the species (71 FR 8238).

Summary of Comments and Recommendations

We requested written comments from the public on February 16, 2006 (71 FR 8238), when we reopened the public comment period on our July 6, 1999 (64 FR 36454), proposed rule to delist the bald eagle in the lower 48 States. In that reopening notice, we responded to comments previously received on the July 6, 1999 (64 FR 36454) proposed delisting rule. Therefore, the preamble to this final rule addresses only the comments we received on the February 16, 2006, notice. The comment period was reopened from February 16, 2006, to May 17, 2006. During that time, we received two requests to extend the public comment period. In response to those requests, on May 16, 2006 (71 FR 28293), we extended the public comment period to June 19, 2006. As part of the reopening of the public comment period, we also contacted the States and Tribes to solicit their comments.

In conformance with our policy on peer review, published on July 1, 1994 (59 FR 34270), we solicited opinions from three scientific experts who are familiar with this species to peer review the proposed rule. We received comments from two of the three peer reviewers, and those two peer reviewers convened panels of scientific experts to review the information provided. Their comments are included in the summary below. One peer reviewer generally supported the proposed delisting, and the other peer reviewer did not.

We reviewed all comments received from the peer reviewers, State and Tribal agencies, and the public for substantive issues and new information regarding the proposed delisting. We received a total of 387 new comments.

Section 4(b)(1)(A) of the Act requires that determinations as to whether any species is a threatened or endangered species shall be made "solely on the basis of the best scientific and commercial data available," including all information received during the public comment period. Comments merely stating support or opposition to the proposed delisting without providing supporting data, although noted, were not considered substantial and therefore were not considered in our determination. Substantial comments received during the comment period have either been addressed below or incorporated directly into this final rule.

Peer Review Comments

Issue: Several commenters, including one of the peer reviewers, stated that threat of habitat loss, including foraging, breeding, and wintering/roosting habitat (including communal roosting areas), due to development will continue because there are no adequate habitat protections (existing regulatory mechanisms) for bald eagles after delisting. One peer reviewer acknowledged that BGEPA and MBTA provide protection to birds, their nests, and eggs, but opined that those statutes offer no protection to habitat. In addition, the commenters believed that the proposed regulatory definition of "disturb" and the draft National Bald Eagle Management Guidelines will not be adequate to provide habitat protection. One peer reviewer expressed an opposite opinion stating that the proposed BGEPA definition and guidelines provide an adequate framework for protecting eagles and their habitat using BGEPA and MBTA.

Response: As discussed in detail under Factor A, the bald eagle population is continuing to increase in the lower 48 States, showing that reduced availability of habitat is not a current threat to the species. Nesting habitat is secure on many public and private locations throughout the lower 48 States. We acknowledge that some habitat threats continue to exist. However, this localized habitat loss will be limited by the operation of various Federal laws that will remain in effect after delisting (e.g., BGEPA, MBTA, and the Clean Water Act (CWA)).

The commenters are correct in that the BGEPA contains no provisions that directly protect habitat, except for nests. However, as further discussed under Factor A below, individual bald eagles are protected from certain effects that are likely to occur as the result of various human activities, including some habitat manipulation. Activities that disrupt eagles at nests, foraging areas, and important roosts can wound, kill, or disturb eagles, all of which are prohibited by the BGEPA. Through promulgation of the regulatory definition of disturb (72 FR 31132; June 5, 2007) and issuance of the National Bald Eagle Management Guidelines (72 FR 31156; June 5, 2007), we have clarified that eagle nests, important foraging areas, and communal roost sites are afforded protection under the BGEPA to the degree that adjacent habitat modification would disturb, injure, or kill eagles.

Issue: One of the peer reviewers stated that the final delisting rule should include a list of updated population data by State with references to the survey from which the data were obtained.

Response: We have included an updated national population estimate in this final rule along with a map with the estimated number of breeding pairs per State. To ensure that our determination on the status of the bald eagle was based "solely on the basis of the best scientific and commercial data available" as required by the Act, we used State population data provided to us directly by a State agency, the Pacific Flyway Council, or from a State Web site. Based on this information, there are an estimated 9,789 bald eagle pairs in the lower 48 States. We believe this is a conservative estimate based on the results of our pilot studies for the post-delisting monitoring plan (USFWS 2007). For example, in the pilot study conducted by Minnesota, 872 known nest sites were observed as occupied in 2005. Incorporating the use of area random plots for our pilot study, Minnesota's estimate of nesting bald eagle pairs increased to 1,312. Minnesota estimates that their known nest survey, which is similar to those conducted by each of the States and used to produce data for the delisting, may only count two-thirds of the breeding pairs in the State (Moore 2006, pp. 1–2).

Issue: Both peer reviewers expressed concern about using out-dated recovery plans and delisting criteria. One peer reviewer recommended that the delisting criteria in the recovery plan for Southeastern United States bald eagles should be peer reviewed before finalizing the delisting. One commenter thought the Service should seek more advice from the recovery team members.

Response: Recovery plans are not regulatory documents and are instead intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. There are many paths to accomplishing recovery of a species, and recovery may be achieved without fully meeting all criteria in a recovery plan. Overall, recovery of species is a dynamic process requiring adaptive management, and judging the degree of recovery of a species is also an adaptive management process that may, or may not, fully follow the guidance provided in a recovery plan.

Over the years, the Service sought advice from several recovery teams. In the Southeast, we used the advice of the recovery team to give us a population target that would indicate that the threats had been reduced. We believe this is the best available information at this time.

Issue: One peer reviewer and several commenters noted concern over the viability of the Southwest population of bald eagles based on low numbers of breeding pairs, relatively low productivity, relatively high adult mortality, and threats of habitat alteration and human disturbance. Based on this information, the peer reviewer recommended designating the population as a DPS and deferring the delisting.

Response: As further discussed in the Summary of Factors Affecting the Species section, the Service does not believe the bald eagle population in the Southwest meets the criteria stated in our DPS policy (61 FR 4722; February 7, 1996), nor is this population a significant portion of the range of the lower 48 States population of bald eagles. Therefore, consideration of the viability of, or threats to, the Southwestern population, standing alone, is not relevant to the delisting determination for the lower 48 States bald eagle population.

Issue: Several commenters, including peer reviewers, commented that a post-delisting monitoring (PDM) plan should be in place when delisting occurs and should remain in effect longer than 5 years. In addition, the plan should be comprehensive and scientifically based to monitor changes in population, productivity, wintering populations, habitat, and contaminants.

Response: Based on comments from the 1999 proposed delisting rule, we have been working steadily on the development of a revised national post-delisting monitoring plan, including conducting several pilot studies in cooperation with the States, to produce a monitoring plan that will be more scientifically robust than previously proposed in the 1999 proposed delisting rule. We have modified the draft post-delisting monitoring plan to take into account the life cycle of the bald eagle.

We are making the revised draft of the monitoring plan is available for public comment simultaneously with this rule elsewhere in today's **Federal Register.** We agree that a plan should ideally be in place at the time of delisting; however, given the proposed 20-year monitoring effort, we believe the plan will be finalized in a sufficient amount of time to adequately monitor the status of the species after delisting. Given the continued increase in the population, we do not expect a precipitous decline over the short term, prior to our completion of the final monitoring plan.

Other Comments

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Issue: One commenter stated that the delisting criteria have not been met for habitat protection in the Chesapeake Bay region. Another commenter stated that while lands have been protected in the Chesapeake Bay Recovery Region to sustain the targeted levels of breeding pairs, the proposed delisting does not address protection of summer and winter concentration areas. The commenter noted that neither the Service's National Wildlife Refuges nor State management areas provide enough land to provide the necessary concentration areas. Another commenter stated that habitat loss and development are not limiting factors in Maryland, and are not likely to cause endangerment in the future. The commenter believes that the Chesapeake Bay Critical Area Program will continue to conserve forested shoreline habitat, and that it is not necessary for us to fully meet the habitat preservation goals in the Chesapeake Bay Recovery Plan.

Response: The Chesapeake Bay bald eagle population has experienced significant growth over the past 30 years. Within the Chesapeake Bay Bald Eagle Recovery Region, approximately 280 nests occur on Federal or State lands (48 nests from Koppie 2007b and 230 nests from Otto 2007). In addition to the long term habitat protection afforded on these lands, nearly 200 other nests occur within areas regulated by the Maryland Critical Areas Act (Koppie 2007b), which is discussed below. Together, these areas will continue to play active roles in providing additional protection of nests, nest buffers, forest blocks, and roosting habitat for bald eagles in the foreseeable future.

Habitat loss is still likely to occur in this region in the foreseeable future through incremental land clearing. It is projected that between 1978 and 2020, the developed area of the Chesapeake Bay watershed will increase by 74 percent in Maryland and 80 percent in Virginia (Gray *et al.* 1988). The Service acknowledges ongoing shoreline development will continue for the foreseeable future, which will likely set limits on the rate of future expansion and overall population growth of the bald eagle in the Chesapeake Bay region. Bald eagle nesting pairs currently continue to increase despite the increased construction of new homes, business parks, boat marinas, and other infrastructure within habitats sustaining bald eagles. Therefore, it appears that unoccupied forested habitat currently still remains available, leading to the conclusion that the species has not yet reached the carrying capacity limits for nesting eagle pairs in the Chesapeake Bay region. The Service anticipates a continued upward population growth at least through the next decade based on the availability of habitat and behavioral adaptation. In addition, bald eagles have been able to adapt to higher densities of birds by decreasing the size of nesting territories in certain areas of the region where birds are starting to saturate the habitat. At some point, the Service expects the growth rate to decrease and level off, establishing a population that is stable over the long term.

A study published in 1996 used modeling to predict that the population of bald eagles in the Chesapeake Bay region would increase until reaching carrying capacity, after which there would be a rapid decline of the population (Fraser *et al.* 1996, p. 185). However, we find that model to be unpersuasive for a number of reasons. First, it predicts that a decline might have begun by about 2005, but bald eagle numbers continue to increase in the Chesapeake Bay area. In Maryland, the population has increased from 338 breeding pairs to 400 between 2003 and 2004, and in Virginia bald eagle pairs increased from 371 to 485 between 2003 and 2006.

Second, the predictive model showing a decline in the Chesapeake Bay bald eagle population does not take into account nest protection measures or refugia such as State and Federal wildlife refuges (Fraser *et al.* 1996, p. 185). In Virginia, the Eastern Virginia Rivers National Wildlife Refuge Complex was established to protect bald eagle nesting sites and communal roost sites that are part of concentration areas along the Rappahannock and James rivers. These refuges are within the Rappahannock River Watershed and the James River Watershed, which hold approximately half of Virginia's nesting population of bald eagles. In addition, the first "eagle refuge," Mason Neck National Wildlife Refuge, was established to protect bald eagles along the Potomac River in 1967. In Maryland, communal roost sites and nesting areas are protected at the U.S. Army Aberdeen Proving Ground, Blackwater National Wildlife Refuge, Naval Surface Warfare Center at Indian Head, and an area below the Conowingo Dam along the Susquehanna River. All these areas (excluding the Conowingo Dam) are located within forested habitats on federal lands and therefore have long term protection, as explained under Factor A (Koppie 2007a).

Third, the model does not take into account the increase in bald eagle tolerance to human disturbance. The Service has documented several cases in which bald eagles around the Chesapeake Bay have continued to nest and successfully produce young within distances that were previously considered too close to human activity (Koppie 2007a). In addition, in both Virginia and Maryland, compression of nesting territories (i.e., eagles nesting in closer proximity to each other than in recent decades) has been observed, suggesting that the density of nesting pairs can be higher than once documented (Koppie 2007a).

In addition, certain State authorities and programs may afford additional, unquantifiable habitat protection. For example, in Maryland the Critical Area Act covering the Chesapeake Bay and Atlantic Coastal Bays enables the State and local governments to jointly address the impacts of land development on habitat and aquatic resources. This program can indirectly protect bald eagle habitat by, among other things, categorizing predominant land uses, focusing new development towards existing developed areas, and designating natural resource areas, habitat protection areas and buffers. These measures may reduce the rate of bald eagle habitat alteration depending on how they are employed across the landscape. To the extent that the Critical Areas program is maintained, it has the potential to contribute to forested shoreline preservation within 1,000 feet of the Chesapeake and Atlantic Coastal Bays where upwards of 70 percent of Maryland's eagles nest (Koppie 2007b).

There are currently an estimated 1,093 breeding pairs in the Chesapeake Bay Recovery Region. Habitat loss is still likely to occur in the Chesapeake Bay region in the foreseeable future. However, based on the number of nests and associated habitat found on protected lands, the existence of refuges and other lands specifically to conserve concentration and foraging areas, the availability of additional unoccupied habitat, behavioral adaptation, potentially increased compression of nesting territories, and the continuation of protection under BGEPA (as discussed under Factor A), we do not expect the bald eagle population in the Chesapeake Bay area to decline below the recovery target of 300–400 nesting pairs in the foreseeable future. Similarly, we do not anticipate that habitat loss will have a significant negative impact on important concentration areas.

Issue: Eagles have not recovered in the Southwestern United States. They are threatened with oil and gas development. The Bureau of Land Management is allowing gas wells and pipelines to be constructed in prime eagle habitat, and it will only get worse after delisting. For example, the Bureau of Land Management is allowing gas wells and pipelines to be constructed in prime bald eagle habitat around Navajo Reservoir.

Response: We do not have any data to indicate that oil and gas development is currently threatening the future security of the bald eagle or its habitat in the Southwest. The Bureau of Reclamation manages the land around the Navajo Reservoir, and the Resource Management Plan includes areas specifically designated to protect bald eagles (U.S. BR 2005, p. 2–2, map 2–1). We believe the measures described in the Resource Management Plan will provide adequate protections for bald eagles and their habitat around the Navajo Reservoir after delisting.

Issue: One commenter stated that the final rule needs to include a discussion on the declines in some fisheries as a past and present concern. For example, the demise of a kokanee salmon run in Glacier National Park ended a large autumn aggregation of bald eagles in that area. Declines in alewives and herring in Maine have also restricted eagle aggregations.

Response: Bald eagle populations have increased despite isolated declines in local fish populations. As opportunistic feeders, bald eagles will move to alternative food sources, particularly during the non-nesting season. Therefore, we do not believe this is a threat that would limit the population of bald eagles in the lower 48 States, or a significant portion of its range in the foreseeable future such that continued protection under the Act would be warranted.

Issue: One commenter felt that a State-level management plan for bald eagles in the Southwest Recovery Region was needed because the Arizona Bald Eagle Nestwatch Program will likely disappear after delisting.

Response: The Conservation Assessment and Strategy for the Bald Eagle in Arizona has been developed by the Arizona Game and Fish Department, cooperating agencies, and Tribes to continue management practices for the bald eagle after delisting, including the Bald Eagle Nestwatch Program (Driscoll *et al.* 2006, pp. 1, 33). As we stated in our August 30, 2006, petition finding, the Arizona Bald Eagle Nestwatch Program will likely remain in place because the funding comes from a variety of sources, including State wildlife grants, donations, Arizona Game and Fish Department's Heritage Funds (State lottery), and matching funds for Federal grants. In any case, there is no specific requirement under the Act for a State management plan.

Issue: BGEPA does not require landowners or developers to provide notification of their projects that may affect eagle nests. BGEPA and MBTA only come into effect after discovery of an infringement. There currently is no mechanism under BGEPA to allow for lawful activities (such as transportation construction and maintenance) to proceed. Left without options, landowners will be very tempted to cut down nest trees rather than lose the use of their property.

Response: Actions that result in take as defined under BGEPA or MBTA are prohibited unless permitted by the Service. Thus, such notification is not required under either statute, but an action resulting in take is prohibited nonetheless. As currently occurs under the Act, providing such notification may be in the interest of a project proponent as it can help them avoid potential legal liabilities from enforcement of BGEPA or MBTA. We believe that working cooperatively with landowners to avoid or minimize adverse impacts to bald eagles is likely to achieve more positive conservation than reliance on regulatory enforcement. In addition, we have proposed a program that would allow us to authorize limited take associated with otherwise lawful activities under BGEPA (72 FR 31141; June 5, 2007), similar to the incidental take authorizations that we have made under sections 7 and 10 of the Act.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Issue: Poaching and illegal trade of bald eagle parts is still a threat that will increase if the bald eagle is delisted.

Response: There is no legal commercial or recreational use of bald eagles, and such uses of bald eagles will remain illegal under various statutes, as described under Factor B below. We consider current laws and enforcement measures apart from the Act sufficient to protect the bald eagle from illegal activities, including poaching and illegal trade.

Issue: Eagle parts and feathers should continue to be available for Native American religious and cultural needs. If the bald eagle is delisted, Native Americans should be given priority for eagle parts and feathers.

Response: To respond to the religious needs of Native Americans, in the early 1970s, we established the National Eagle Repository in Commerce City, Colorado, which serves as a collection point for dead raptors, including bald eagles. As a matter of policy, all Service units transfer salvaged bald eagle parts and carcasses to this repository. Federal and State conservation agencies, zoological parks, rehabilitators, and others who may legally possess and transport dead bald and golden eagles are encouraged to send the dead birds, and their parts, to the repository so they can be utilized by federally recognized Native American Tribes (16 U.S.C. 668a and 50 CFR 22.22).

Native Americans are given priority for eagle parts and feathers, and only members of Federally recognized tribes can obtain a permit from us authorizing them to receive and possess whole eagles, parts, or feathers from the repository for religious purposes. This policy is authorized by the provisions of BGEPA and will continue after delisting.

Issue: One commenter did not want the bald eagle delisted due to the importance of the bald eagle to Native American religious and spiritual practices and ceremonies. Another commenter recommended continuing the Act's protections until recovery had been achieved such that Native Americans no longer need a permit for Indian religious activities. Several commenters stated that Native Americans should not be allowed to sacrifice eagles, even if doing so is for religious ceremonies.

Response: As required by the Act, we are delisting the bald eagle because it no longer meets the definition of a threatened species; the bald eagle will continue to be protected under the BGEPA and MBTA once it is delisted. These statutes prohibit unauthorized take and require permits for limited designated uses of eagles, their parts, and related items. The BGEPA expressly authorizes issuance of permits to take bald eagles for the religious purposes of Indian tribes. We will continue to issue only permits that we determine are consistent with the preservation of the bald eagle.

Factor C. Disease or Predation

Issue: One commenter stated that avian influenza is a threat to the bald eagle and that it should be thoroughly discussed in the delisting rule. Another commenter was concerned about the threats to bald eagles from other diseases such as avian vacuolar myelinopathy, West Nile virus, and raptor beak overgrowth syndrome.

Response: The Department of the Interior is currently testing migratory birds for the presence of H5N1 high path avian influenza. At this time, there are no confirmed cases of migratory birds, including bald eagles, testing positive for avian influenza in the United States (USGS 2007a). At least 80 bald eagles and possibly thousands of American coots have died from avian vacuolar myelinopathy since it was discovered in 1994 at DeGray Lake in Arkansas. Studies on avian vacuolar myelinopathy are continuing, but the cause is still unknown (USGS 2007b). These and other diseases may affect individual bald eagles at the local level, but as discussed below under Factor C, are not considered to be a significant threat to the overall bald eagle population.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Issue: Several commenters were concerned that many States and local jurisdictions will remove the protections for the bald eagle after delisting. One commenter stated that Memoranda of Agreement should be in place between the Service and the States to provide protection for the bald eagle after delisting. One commenter wanted to make sure that States with small bald eagle populations will still provide protection after delisting. One State government commented that State laws provide little habitat protection. Several States indicated that they will play a large role in bald eagle conservation after delisting.

Response: Some States will likely maintain the sensitive status of the bald eagle under individual State laws; however, such protection is not needed to assure that the bald eagle population in the lower 48 States will continue to be a viable population after delisting. As described in the discussions of Factors A and B below, the Service believes that BGEPA and other Federal laws that will remain in place after delisting provide the necessary protections in the future for a recovered bald eagle population. Many States have developed State-specific management plans, regulations, and/or guidance for landowners and land managers to protect and enhance bald eagle habitat, and we encourage the continued development and use of these planning tools to benefit bald eagles. Such measures can only offer more protection for bald eagles than is already offered by BGEPA and MBTA. The States will play a key role in continuing to monitor bald eagles in the lower 48 States to make sure that the species continues to maintain its recovered status.

Issue: One commenter asserts that BGEPA and MBTA will continue to protect bald eagles after delisting, and, because of these protections, bald eagles will likely become overpopulated in some areas of the country.

Response: The bald eagle has not yet reached carrying capacity in many parts of its range, and we anticipate that the population will continue to increase in these areas following delisting. In prime congregation areas, numbers of nesting pairs will level off as the nesting habitat reaches carrying capacity. Many of the bald eagles displaced from saturated habitats will be able to relocate to other suitable habitats. However, territorial competition between eagles will likely maintain a naturally fluctuating population once carrying capacity has been reached.

Issue: Several commenters were concerned that the Service will not maintain adequate funding for staff to provide technical assistance or enforce BGEPA after delisting.

Response: The Service is committed to maintaining adequate staff to respond to requests for technical assistance. The ultimate mechanisms for delivering that assistance will be determined prior to making a decision on the proposed BGEPA permit program (72 FR 31141; June 5, 2007).

Issue: Several commenters expressed concern that the proposed delisting did not include grandfathering of existing take authorizations/permits under sections 7 and 10 of the Act.

Response: After delisting of the bald eagle, the Service will honor existing Act authorizations until the Service completes a final rulemaking for permits under the BGEPA. We do not intend to refer for prosecution the incidental take of any bald eagle under the MBTA, as amended (16 U.S.C. 703–712), or the BGEPA, as amended (16 U.S.C. 668–668d), if such take is in full compliance with the terms and conditions of an incidental take statement issued to the action agency or applicant under the authority of section 7(b)(4) of the Act or the terms and conditions of a permit issued under the authority of section 10(a)(1)(B) of the Act. The Service has proposed a rulemaking to establish criteria for issuance of a permit to authorize activities that would "take" bald eagles under the BGEPA. The Service has addressed the existing Act authorizations in that rulemaking, which if finalized, might extend comparable authorizations under the BGEPA (72 FR 31141; June 5, 2007).

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Issue: Several commenters were concerned about ongoing impacts of contaminants. One commenter noted that mercury is still a threat to bald eagles in the Northeast United States. Another commenter noted that PCBs and DDE were still an ongoing threat to the Great Lakes population of bald eagles. Another commenter noted that the upper Midwest population of bald eagles is experiencing a heavy metal contaminant problem that affects the ratio of immature eagles to adults. Another commenter stated that too many nests in northern Illinois have zero productivity due to contaminants.

Response: As we discuss further in Factor E below, we acknowledge that certain contaminants may pose a threat to individual bald eagles. We believe many of these instances are localized and that contaminants will not be a large enough threat to limit the population of bald eagles in the lower 48 States or any significant portions of its range in the foreseeable future such that the protection of the Act would be warranted. This is evidenced by the population increases that have occurred despite the presence of certain levels of contaminants, including mercury and PCBs, in the environment.

Issue: One commenter was concerned that climate change may be an issue, and we should, therefore, keep the bald eagle listed until we can guarantee that habitats are safe.

Response: Section 4(b)(1)(A) of the Act directs that determinations as to whether any species is a threatened or endangered species shall be made "solely on the basis of the best scientific and commercial data available." We did not receive any data during the public comment period to indicate that climate change is currently threatening the future security of the bald eagle or its habitat. Since the bald eagle is currently successful in a wide range of climate conditions throughout North America, climate change will not likely be a factor threatening the species in the foreseeable future.

General Comments

Issue: The Service may take too long to re-list the bald eagle if it is warranted.

Response: If data from the post-delisting monitoring plan show that the bald eagle population is decreasing below a trigger threshold specified in the plan, we will investigate the cause of the decline and take the necessary measures to address the decline. If the population decline is severe, then we will promptly evaluate whether re-listing under the Act is warranted, including the Act's provision for emergency listing, as appropriate.

Issue: The Service used an out-of-date, non-scientific population productivity value of 0.7 young/pair.

Response: Our information indicates that a productivity value of 0.7 young/pair for a stable population is still the best available data (see Sprunt *et al.* 1973, p. 104; Buehler 2000, p. 20).

Issue: The delisting is too reliant on current eagle numbers. Research on survivorship, sex ratios, and population recruitment are all important parameters of recovery, not just productivity. Delisting criteria should be based on numbers of active nests, not breeding pairs.

Response: The recovery criteria and goals were established by recovery teams composed of experts in each geographic region. The purpose of the criteria was to allow the Service to monitor the status of the recovery efforts. By setting a goal to monitor population numbers and productivity, the Service, in conjunction with the recovery teams, could determine whether the threats that led to the bald eagle's endangerment had been removed. Monitoring the additional parameters would have been more costly and would not provide any more data that would enable the Service to monitor recovery. Given the increase in the population parameters, the threats have been shown to have decreased to the point where the bald eagle no longer meets the definition of threatened or endangered under the Act.

Issue: The population data presented are estimates and not supported by field work. Data provided by the commenter indicate that the percentage of immature eagles to adults is dropping, which may influence reproduction or survival in the bald eagle population.

Response: The data discussed by the commenter are midwinter counts collected on one day in a 2-hour period from northern Minnesota to Reelfoot, Tennessee. These data, on their face, did show a fluctuation in the number of immature bald eagles throughout the time period from 1961 to 2006, with some years having a higher number than others. However, these data also indicated a trend of increasing adults from 470 in 1961 to 1,299 in 2006. Throughout this time period, the number of adults also fluctuated. Because surveys of wintering bald eagles, such as the midwinter counts described above, are weather dependent (mild winters cause fewer birds to move south) and can include birds migrating down from Canada, the Service has relied on nesting data as the stronger indicator of bald eagle population trends in the lower 48 States. We plan to continue monitoring population trends with implementation of our post-delisting monitoring plan. However, we support the public involvement related to midwinter counts, and such data have highlighted the importance of wintering habitats used by these eagles.

Distinct Vertebrate Population Segment

Section 4 of the Act and its implementing regulations (50 CFR part 424) set forth the procedures for listing species, reclassifying species, or removing species from listed status. "Species" is defined by the Act as including any species or subspecies of fish or wildlife or plants, and any distinct vertebrate population segment of fish or wildlife that interbreeds when mature (16 U.S.C. 1532(16)). We, along with the National Marine Fisheries Service (now the National Oceanic and Atmospheric Administration—Fisheries), developed the Policy Regarding the Recognition of Distinct Vertebrate Population Segments (DPS policy) (61 FR 4722; February 7, 1996), to help us in determining what constitutes a Distinct Population Segment (DPS). The policy identifies three elements that are to be considered in a decision regarding the status of a possible DPS. These elements are: (1) The discreteness of the population in relation to the remainder of the species to which it belongs; (2) the significance of the population segment to the species to which it belongs; and (3) the population segment's conservation status in relation to the Act's standards for listing. Our policy further recognizes it may be appropriate to assign different classifications (i.e., threatened or endangered) to different DPSs of the same vertebrate taxon (61 FR 4725; February 7, 1996).

Sonoran Desert Distinct Population Segment

As discussed above, the Service made a negative 90-day finding on a petition to list the Sonoran Desert bald eagle population as an endangered DPS (71 FR 51549; August 30, 2006). In this final determination on the proposed delisting of the entire bald eagle population in the lower 48 states, we also consider, as a final determination, whether the Sonoran Desert population of the bald eagle constitutes a DPS, and should remain listed as either an endangered or threatened species. The main bald eagle population center of the Sonoran Desert currently consists of 42 breeding pairs (AZ Game and Fish Dept. 2006, p. 6) that are found in the southern half of Arizona, west of the New Mexico state boundary. One breeding pair in Arizona is found outside the Sonoran Desert.

Discreteness

The DPS policy states that a population segment of a vertebrate species may be considered discrete if it satisfies either one of the following two conditions: It must be markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors; or it must be delimited by international boundaries within which significant differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act. The second criterion, international boundaries, is easily addressed because the Sonoran Desert population of bald eagles is not delimited by international boundaries that could be the basis of a review of management of habitat, conservation status or regulatory mechanisms. Therefore, the Sonoran Desert population of bald eagles is not discrete based on this criterion. As discussed below, under the first criterion, we find that the Sonoran Desert population is markedly separated from other populations as a consequence of behavioral factors. Therefore, we do not address separation by physical, physiological, or ecological factors.

In looking at whether Sonoran Desert bald eagle are markedly separated from other populations it is helpful to evaluate whether there is a level of interchange between this population and adjacent populations. Biologists in Arizona made a concerted effort to band all nestlings in Arizona since 1987. Of those birds that were sighted with bands between 1987 and 2005, 41.8 percent hatched in Arizona, 18.8 percent likely hatched in Arizona before 1987 (due to a different band type), less than one percent were from another State, and 38.8 percent were from unknown origin (unbanded) (Driscoll *et al.* 2006, p. 26). One adult breeding in Arizona is known to have originated from another State (banded as a nestling in 1988 in southeast Texas). Only one nestling with a band was identified as subsequently nesting outside the recovery region (Temecula, California) (Driscoll *et al.* 2006, p. 27). Roughly 20 percent of the population does not receive a band for a variety of reasons (*e.g.*, logistics of reaching the nestlings), and therefore 38 percent of the population without bands would not be unusual.

In addition, because of the clinal variation in these birds, bald eagle populations from around the same latitude would likely be the supplier of birds that would immigrate into the population. Currently, we do not have any populations surrounding the Sonoran Desert that are large enough that juveniles would likely start to disperse into the Sonoran Desert. Within the last 30 years, these adjacent populations have not increased in size to the same degree as we have seen with the populations in other parts of the bald eagle's range. Given that we do not have large bald eagle population centers surrounding the Sonoran Desert, and given the limited habitat found between currently known populations, it is likely that interchange between the Sonoran Desert and other populations will be minimal in the foreseeable future.

These data indicate that immigration to and emigration from the Sonoran Desert population is very limited. Reproductive isolation of the bald eagles nesting in the Sonoran Desert region of Arizona, although probably not absolute, appears to be substantial. Our DPS Policy does not require that populations experience total reproductive isolation in order to meet the discreteness criterion; rather, they need only to be "markedly separated." We believe the documented low levels of immigration and emigration indicate that this population is currently markedly separated from other bald eagles in the United States.

On the basis of the immigration by the southeast Texas eagle, in 1995, the Service determined as part of the Service's final rule reclassifying the bald eagle from endangered to threatened (60 FR 36000; July 12, 1995) that eagles in the Southwestern Recovery Region were not reproductively isolated. The banded bald eagle from Texas, although located within the Southwestern Recovery Region, occupies an area outside the Sonoran Desert. Furthermore, no additional banded bald eagles from outside the Sonoran Desert have been discovered immigrating into the Sonoran Desert since 1995. In addition, the analysis during the 1995 rule was conducted prior to implementation of the DPS policy in 1996. Therefore, now reviewing the same question in the context of the DPS policy, combined with more data on immigration and emigration, leads us to a conclusion that this population is discrete.

Significance

If we determine that a population segment is discrete under one or more of the discreteness conditions, then we evaluate its significance based on "the available scientific evidence of the discrete population segment's importance to the taxon to which it belongs" (61 FR 4725). We make this evaluation in light of congressional guidance that the Service's authority to list DPSs be used "sparingly" while encouraging the conservation of genetic diversity (61 FR 4722; February 7, 1996). This consideration may include, but is not limited to the following elements: (1) Evidence of the persistence of the population segment in an ecological setting that is unusual or unique for the taxon; (2) evidence that loss of the population segment would result in a significant gap in the range of the taxon; (3) evidence that the population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside of its historic range; and (4) evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

(1) Evidence of the persistence of the population segment in an ecological setting that is unusual or unique for the taxon.

As stated in the DPS policy, the Service believes that occurrence in an unusual ecological setting is potentially an indication that a population segment represents a significant resource warranting conservation under the Act (61 FR 4724). In considering whether the population occupies an ecological setting that is unusual or unique for the taxon, we evaluate whether the habitat shares many features common to the habitats of other populations. The Sonoran Desert bald eagle population inhabits a desert ecosystem characterized by hot and dry summers that, on its face, seems to represent an ecological setting that is highly unusual or unique for the species. However, bald eagles in the Sonoran Desert population essentially use the same ecological niche as those in other parts of the lower 48 States population. Bald eagles in the Sonoran Desert feed primarily on fish, consistent with bald eagles in other parts of the range. Habitat structure and proximity to a sufficient food source are usually the primary factors that determine suitability of an area for nesting (Grier and Guinn 2003, p. 44). Nationwide, bald eagles are known to nest primarily along seacoasts and lakeshores, as well as along banks of rivers and streams (Stalmaster 1987, p. 120). Similar to the remainder of the population, bald eagle breeding areas (eagle nesting sites and the area where eagles forage) in the Sonoran Desert are located in close proximity to a variety of aquatic sites, including reservoirs, regulated river systems, and free-flowing rivers and creeks.

We considered whether cliff nesting is an adaptation to the conditions in the Sonoran Desert that indicates the Southwest is a unusual or unique ecological setting for bald eagles. While Stalmaster (1987) noted that cliff nesting is common in Arizona, he also noted that exceptions to tree nests in other areas do occur. Gerrard and Bortolotti (1988, p. 41) note that bald eagles in other areas may nest on cliffs if suitable trees are not available. For instance, bald eagles are known to nest on cliffs on the Channel Islands off California (NOAA 2006). Bald eagles in Alaska also are known to nest on cliffs, sea stacks, hillsides, and rock promontories where there are no suitable nest trees (Sherrod *et al.* 1976, p. 153). It is likely that up to 10 percent of the bald eagles in Alaska nest on the ground (Schempf 2007). Ground nesting has been documented in northwestern Minnesota and Florida but is the exception rather than the rule (Hines, P. and H. Lipke 1991; Shea, R.E. and Robertson W.B. Jr. 1979). Eagles also nest in a variety of odd situations, such as utility poles, abandoned heavy equipment, mangroves, and root wads washed up on sandbars. Cliff nesting in the Sonoran Desert bald eagles does not seem to be an indication of a behavioral adaptation unique to the Sonoran Desert. Bald eagles will use whatever high nest sites are available near riparian areas they inhabit: in the Sonoran Desert these sites often happen to be cliffs. In fact, although bald eagles utilize cliffs, ledges, and pinnacles for nesting in the Sonoran Desert, they have also nested in cottonwood, willow, sycamore, pinyon pine, and ponderosa pine trees. Many Sonoran Desert eagle pairs have built and used both tree and cliff nests within their territories. This behavior demonstrates the flexibility in nest site selection that bald eagles have throughout the eagles' entire geographic range.

Bald eagles in the Sonoran Desert are smaller in size and breed earlier in the season than most other bald eagles, which could indicate behavioral adaptations to a unique setting. However, examination by latitude reveals differences between birds in the northern regions and birds in the southern regions. For instance, Stalmaster (1987, pp. 16–17) notes northern eagles are much larger and heavier than their southern counterparts. This is consistent with Bergmann's Rule, which holds that animal size increases with increasing latitude due to changes in environmental temperature. Consistent with this rule, Hunt *et al.* (1992) reports that bald eagles in Arizona are smaller than those in Alaska, California, and the Greater Yellowstone Region. Gerrard and Bortolotti (1988, p. 14) note that bald eagles in Florida, which is farther south than Arizona, are the smallest, with a gradation of small to large from south to north. Timing of various breeding events in bald eagles is also tied to latitude of the nesting area, with eagles at more northern latitudes breeding at later dates (Stalmaster 1987, p. 63). Stalmaster (1987, p. 63) notes that bald eagles in Florida initiate breeding activities in October, even earlier than Sonoran Desert bald eagles. Bald eagles in Florida also lay eggs earlier (Stalmaster 1987, p. 63; Gerrard and Bortolotti 1988, p. 76). Accordingly, Florida bald eagles hatch and fledge earlier than those in the Sonoran Desert.

In summary, Stalmaster's (1987) and Gerrard and Bortolotti's (1988) studies indicate that bald eagles in other parts of the lower 48 States are known to nest on cliffs if suitable trees are not available. Hunt *et al.* (1992) notes that Florida bald eagles are the smallest bald eagles, and that eagle size increases as the nest sites are located farther north. Stalmaster (1987) notes that bald eagles in Florida initiate breeding activities in October, even earlier than Sonoran Desert bald eagles. The best available scientific information indicates that the Sonoran Desert bald eagles are not unique in these behavioral aspects. Instead, bald eagle behavior and morphology gradually changes at different latitudes from north to south within the lower 48 States. In fact, even though bald eagles do persist in the Southwest desert setting, they remain consistently associated with riparian ecosystems. Bald eagles use whatever high nest sites are available near riparian areas they inhabit in the Sonoran Desert; these sites often happen to be cliffs. Therefore, because these riparian areas are common to eagle habitats throughout the species' range, the best available data indicate that the Sonoran Desert population of eagles does not occupy an ecological setting that is unusual or unique for the taxon or that has resulted in any adaptations that are unusual or unique for the taxon.

Many biological opinions prepared by the Service in connection with section 7 consultations in the Sonoran Desert and other Service documents issued over the last 30 years stated that Arizona bald eagles live in a unique ecological setting and demonstrate unique behavioral characteristics, including the use of cliffs instead of trees as nest sites, breeding at earlier times of the year, and development of smaller body sizes. Many of these biological opinions and other documents were issued prior to the Stallmaster (1987) and Gerrard and Bortolotti (1988) studies. Furthermore, these Service documents were prepared prior to the issuance of the DPS policy in 1996, or abstracted from such earlier biological opinions without re-analyzing their relevance. The term "unique ecological setting" was not used in these documents in the context of its meaning within the DPS policy, which requires that the unique ecological setting be important to the taxon as a whole. While the climate conditions differ in the Southwest compared to other parts of the lower 48 States where bald eagles are found, this attribute alone does not complete the requirements of the DPS policy. A unique ecological setting must also provide some element that makes the members of the population important to the taxon as a whole, such as an evolutionary advantage (61 FR 4724–4725). The factual statements in the biological opinions and other documents concerning the location of the population within the desert and the description of their behaviors did not include consideration of the population's importance to the taxon as a whole because these documents were either issued prior to the promulgation of the DPS Policy or were issued for other purposes than evaluation of the population under the DPS Policy.

The biological opinions and other documents, prior to 1995, also stated that the Arizona bald eagles had been considered a distinct population for the purposes of section 7 consultation and recovery efforts under the Act. The practice of dividing species distributed across the large areas within the United States into separate recovery regions was employed for management convenience (71 FR 51555). For the bald eagle, we created five different recovery plans for these regions. The Service's current practice, however, is to create one plan for the listed entity because the previous practice led to confusion regarding the status of the recovery plan entity under section 4 of the Act. In addition, "recovery units" have been, and continue to be, identified as part of the recovery planning process for listed species as a management convenience. In the past, for the purposes of section 7 consultation, the Service may have only evaluated whether the impact of a proposed action was jeopardizing the management unit, either the recovery plan entity or the recovery unit. However, this process was discontinued based on the consultation handbook that was finalized in March 1998 (USFWS and NMFS 1998, p. 4–36). As previously discussed, separating the listed entity into smaller management pieces may be useful in addressing the conservation needs of the species. However, it is important to note that the establishment of separate recovery plans or "recovery units" within a plan does not create a new listed entity under section 4 of the Act. The Service has since acknowledged that for both recovery planning and consultation, the listed entity is the appropriate level of analysis.

The Sonoran Desert can experience periods in the summer that are hot, with low humidity, but it is not a unique ecological setting for bald eagles for the purpose of the significance prong of the DPS policy. The best available scientific data suggest that the ecological setting is essentially the same as used by bald eagles elsewhere—riparian habitat. Although the Sonoran Desert obviously differs in some ways from other habitats that the bald eagle inhabits, every area differs somewhat from other occupied areas and the mere existence of difference does not settle this question. To the degree that the Sonoran Desert differs from other ecological settings used by the bald eagle, we conclude that it does not differ in a way that is dispositive under the DPS policy, because the adaptations exhibited by bald eagles in the Sonoran Desert are not unique to this setting. Rather, the variability in bald eagle nest site selection, breeding phenology, and size are noted elsewhere in the range where the species confronts similar limitations, such as the absence of nesting trees or high temperatures.

The question under the DPS policy is whether persistence of a species in an unusual or unique ecological setting supports a conclusion that the discrete population segment is important to the taxon to which it belongs (See *National Association of Home Builders* v. *Norton*, 340 F.3d 835, 849 (9th Cir. 2003) emphasizing that under the DPS policy significance must be to the taxon as a whole). The mere fact that a species persists in an ecological setting that differs to some degree from other ecological settings in which it is found does not mandate a finding that a population is significant. Here, we find that the species' persistence in the Sonoran Desert does not support such a conclusion because there is no evidence that these particular eagles have adapted in response to these conditions in any way that benefits the taxon as a whole because similar adaptations are found in other settings. Without evidence of such an adaptation, there is likewise no evidence that the bald eagle's persistence in the Sonoran Desert is important to the bald eagle as a whole.

Therefore, we conclude that the discrete population of bald eagles in the Sonoran Desert is not "significant" within the meaning of the DPS policy as a result of persistence in a unique or unusual ecological setting.

(2) Evidence that loss of the population segment would result in a significant gap in the range of the taxon.

As "[t]he plain language of the second significance factor does not limit how a gap could be important," *National Ass'n of Home Builders* v. *Norton*, 340 F.3d 835, 846 (9th Cir. 2003), we considered a variety of ways in which the loss of the Sonoran Desert population might result in a significant gap in the range of the bald eagle in the lower 48 States, much less the broader taxon. There has been much speculation about the loss of the Sonoran Desert population given that repopulation of this area would have to occur from northern Mexico or adjacent States, and available evidence indicates that little immigration has occurred in this population. We agree that the low number of eagles in neighboring States would likely require a large amount of time to repopulate the Sonoran Desert region, if they ever did. The small number of bald eagles and large distances between neighboring populations currently limit immigration and emigration between them, and bald eagles in the neighboring populations would have to increase their population size and expand their distribution to occupy the gaps.

Given repopulation through immigration is unlikely in the foreseeable future, we have to evaluate whether this would represent a significant gap to the taxon. The current range of the Sonoran Desert bald eagle could be significant if the population in the Sonoran Desert is numerous and constitutes a significant percentage of the total number of bald eagles, the loss of which would be a significant gap in the population. Bald eagles in the Sonoran Desert are neither numerous nor constitute a significant percentage of the total bald eagles within the lower 48 States. Currently, 43 pairs are found in Arizona, which represents less than 1% of the current estimated number of breeding pairs of bald eagles in the lower 48 states. In addition, this area did not support a large proportion of the bald eagle population historically. A small number, estimated at 15–20 breeding pairs, historically bred in this area (Tilt 1976, p. 15). Given the historical and current population number of bald eagles in the lower 48 States, the Sonoran Desert population of bald eagles represents a relatively small number of breeding pairs in comparison to other areas within the lower 48 States. Also, significant numbers of bald eagles that breed elsewhere do not winter in the Sonoran Desert.

In addition, as discussed in the first and fourth significance factors, we have no evidence that loss of the Sonoran Desert population would represent a significant gap due to a loss of biologically distinctive traits or adaptations or genetic variability of the taxon. In addition, as discussed in the discreteness section, loss of the Sonoran Desert population would not create a significant gap by impeding gene flow within the taxon, as the Sonoran Desert population does not connect otherwise unconnected populations. Finally, loss of the Sonoran Desert population would not result in a significant gap in the range of the taxon due to the sheer reduction of existing or potential geographical range. The actual amount of suitable bald eagle habitat in the Sonoran Desert, limited to a few riparian corridors, is a tiny fraction of the total suitable habitat available for bald eagles in the lower 48 States, much less their entire range. The limited size of the current and historical bald eagle population in the Sonoran Desert directly reflects that fact.

(3) Evidence that the population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside of its historic range.

The Sonoran Desert population does not represent the only surviving natural occurrence of the bald eagles in the lower 48 States.

(4) Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

Hunt *et al.* (1992, pp. E–96 to E–110) contains the genetic work completed to date on the Arizona bald eagle population. Vyse (1992, p. E–100, E–101) notes the data are inconclusive, as evidenced by such statements as: "These findings must be assumed to be preliminary (and treated with due caution), because of a lack of information concerning sampling procedures. The results we have obtained could easily be explained by sampling procedures"; and "At present these data (HinfI/M–13) are too incomplete to be considered further." In addition, Zegers *et al.* 1992, p. E–106 to E–109): "Question 4 * * * is difficult to answer with precision because of the different sample sizes between 1985 and 1990 * * *. [T]his difference is possibly an artifact of the many fewer samples in 1985"; "six loci may not be enough to give a reliable estimate of the true genetic distance"; and "We feel caution should be exercised when interpreting these results due to the low numbers of individuals sampled from most states but especially because of the few loci examined."

Although Hunt *et al.* (1992) suggested that the desert Arizona population may be reproductively isolated, neither enzyme electrophoresis nor DNA fingerprinting resolved any specific genetic markers with which Arizona eagles could be differentiated from other populations. The available genetic studies on bald eagles are dated, the sample size was small, and researchers conducting the studies found the results to be inconclusive. As discussed above, the Sonoran Desert population does not display any biologically distinctive traits that could signal any unique genetic characteristics. Therefore, given the assumptions and cautions in using the data, we have determined that the best available data do not support a conclusion that the Sonoran Desert bald eagle population has genetic characteristics that are markedly different from other bald eagles.

Conclusion

We have reviewed the best scientific and commercial data available and have evaluated the data in accordance with 50 CFR 424.14(b). On the basis of our review, we find that although the Sonoran Desert bald eagle population is discrete, it is not significant in relation to the remainder of the taxon. Sonoran Desert bald eagles lack any biologically or ecologically distinguishing factors. Although they do persist in an arid region, Sonoran Desert bald eagles do not have any adaptations that are not found in bald eagles elsewhere. The adaptability of the species allows its distribution to be widespread throughout the North American continent. Therefore, we conclude that the Sonoran Desert population of the bald eagle in the lower 48 States is not a listable entity under section 3(16) of the Act.

Summary of Factors Affecting the Species

Section 4 of the Act and its implementing regulations (50 CFR part 424) set forth the procedures for listing species, reclassifying species, or removing species from listed status. "Species" is defined by the Act as including any species or subspecies of fish or wildlife or plants, and any distinct vertebrate population segment of fish or wildlife that interbreeds when mature (16 U.S.C. 1532(16)). Once the "species" is determined we then evaluate whether that species may be endangered or threatened because of one or more of the five factors described in section 4(a)(1) of the Act. We must consider these same five factors in delisting a species. We may delist a species according to 50 CFR 424.11(d) if the best available scientific and commercial data indicate that the species is neither endangered nor threatened for the following reasons: (1) The species is extinct; (2) the species has recovered and is no longer endangered or threatened (as is the case with the bald eagle); and/or (3) the original scientific data used at the time the species was classified were in error.

A recovered species is one that no longer meets the Act's definition of threatened or endangered. Determining whether a species is recovered requires consideration of the same five categories of threats specified in section 4(a)(1) of the Act. For species that are already listed as threatened or endangered, this analysis of threats is an evaluation of both the threats currently facing the species and the threats that are reasonably likely to affect the species in the foreseeable future following the delisting or downlisting and the removal or reduction of the Act's protections.

A species is "endangered" for purposes of the Act if it is in danger of extinction throughout all or a "significant portion of its range" and is "threatened" if it is likely to become endangered within the foreseeable future throughout all or a "significant portion of its range." The word "range" in the significant portion of its range (SPR) phrase refers to the range in which the species currently exists. For the purposes of this analysis, we will evaluate whether the currently listed species, the bald eagle in the lower 48 States, should be considered threatened or endangered. Then we will consider whether there are any portions of bald eagle's range in danger of extinction or likely to become endangered within the foreseeable future.

For the purposes of this final rule, we consider "foreseeable future" for the bald eagle to be 30 years. Bald eagles fully mature at 4 to 5 years of age (Buehler 2000, p. 19). Gerrard and Bortolotti (1988) observed that successful breeding may not occur for 2 years or more after reaching maturity. Thus, a life cycle from birth to breeding is about 6 years (Gerrard and Bortolotti 1988, p. 57). We used 5 bald eagle generations (30 years) to represent a reasonable biological timeframe to determine if threats could depress the population size and therefore would be significant. We have roughly 30 years of detailed information on how bald eagle populations have responded to the threats identified when the species was listed. Based on this body of information and the combination of bald eagle biology and the threats of greatest consequence (contaminant exposure, shooting, and habitat modification), we conclude that 30 years is a reasonable timeframe over which we can extrapolate the likely extent of the threats and their impact on the species.

The following analysis examines all five factors currently affecting, or that are likely to affect, the bald eagle in the lower 48 States within the foreseeable future.

A. *The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range.* This section will first describe the habitat needs of the bald eagle. It will then discuss the potential threats to that habitat, and the degree to which those threats are ameliorated by various factors. Our analysis concludes that: (1) The habitat threats to such a wide-ranging species, while not readily quantifiable, are much less significant than once feared given the strong recovery of the eagle over the last 30 years; (2) the threats that do exist vary considerably across the landscape, based in part on the ownership of the land in question and the fact that many lands have significant protection independent of the Act; (3) nesting habitat on protected lands is likely sufficient to maintain the recovered population in the foreseeable future; (4) several regulatory mechanisms will limit the degree to which habitat loss will occur on other lands; and (5) recent anecdotal data suggest that even when habitat loss occurs, the impact on bald eagles may be less than previously anticipated.

Throughout their life cycle, bald eagles are associated with a variety of aquatic habitats. Beyond this generalized need for aquatic habitat, bald eagles are not particularly specialized in their habitat needs, thriving near a variety of different environments, including reservoirs, lakes, rivers, estuaries, and coastal areas throughout North America. Within the aquatic habitats, bald eagles feed primarily on fish, but may also consume waterfowl, gulls, cormorants, and a variety of carrion.

Bald eagles usually nest in trees near water, but may use cliffs in the southwestern United States and Alaska. Ground nests have also been reported from Alaska. Nests are usually built in large trees along shorelines, but may be up to one-half mile or more from the shoreline. Adults use the same breeding territory, and often the same nest, year after year. They may also use one or more alternate nests within their breeding territory.

The habitat needs of bald eagles vary somewhat outside of the breeding cycle, although bald eagles are still strongly dependent on aquatic habitats as their primary food source. The timing and distance of dispersal from the breeding territory varies. Some bald eagles stay in the general vicinity of their breeding territory while some migrate up to hundreds of miles to their wintering grounds and remain there for several months. Young eagles may wander randomly for several years before returning to nest in their natal areas. Eagles seek wintering (non-nesting) areas offering an abundant and readily available food supply with suitable night roosts. Night roosts typically offer isolation and thermal protection from winds. Bald eagles generally concentrate in large numbers in suitable habitat areas in the winter. Important breeding and wintering areas have generally been located in areas at distances from human activity. As discussed below, however, recent data have begun to challenge long-held assumptions that bald eagles require significant isolation from all human activity.

The eagle's decline was largely due to chemicals now known to impair reproductive success (see discussion of this threat under Factor E). Through the recovery planning process, however, various threats to habitat were noted, such as loss of nesting, roosting, and perching habitat through recreational shoreline development, forestry, and urban and suburban expansion. In addition, habitat can be degraded through human disturbance, especially during breeding season. However, as discussed in detail below, in the context of the eagle's dramatic recovery (and continuing population increases), the threat posed by future destruction or modification of habitat is minor compared to what would be required for the bald eagle to be likely to become in danger of extinction throughout all or a significant portion of its range within the foreseeable future.

Currently, habitat availability is not preventing the growth of the bald eagle population in the lower 48 States. Areas that were unoccupied have been repopulated, and the eagle population continues to increase, indicating that carrying capacity has not been reached in many parts of their range. Based on the most recent data, the population in a few States with relatively limited habitat may have started to stabilize; Colorado has shown a slight decline in the numbers of pairs between survey years of 2001 and 2005 (Ver Steeg 2006, p. 2). Other States continue to experience rapid population growth: the number of pairs in Illinois and Iowa doubled between 1999 and 2006 (Conlin 2006, p. 1; Vonk 2006, p. 1). Most States are continuing to show a slight increase in the number of breeding pairs. The population in the lower 48 States as a whole will likely continue to increase in the foreseeable future but at a gradually declining rate that is much slower than has been documented during the past 30 years of the recovery period. Once the carrying capacity has been reached in different parts of the range, we expect the population to naturally stabilize and then fluctuate.

When the recovery planning started, the bald eagle population was at a precarious stage and any threat to the remaining birds was identified, given the uncertainty of its continued survival, much less recovery. At that time, any significant habitat loss (particularly if it affected the remaining pairs) was of grave concern. However, with the eagle population increasing by well over an order of magnitude since that time, the immediate concern posed by habitat loss has dissipated. The only remaining concern related to habitat is whether, over the long term, development or other factors might cause habitat loss sufficient to limit the eagle population to a point that the viability of the population is threatened.

In the future, available habitat will almost certainly limit the population of bald eagles in the lower 48 States. Furthermore, we acknowledge that habitat loss will likely eventually result in slow declines of bald eagle populations in some areas. Through comments and information in our files, we are aware that heavy development pressures and important eagle habitat overlap in parts of Florida and the Chesapeake Bay region. According to the U.S. Census Bureau, Florida is the third fastest growing State in the nation, and the State's human population is projected to increase by 79 percent by 2030 (compared to 2000). The Chesapeake Bay region States (Maryland, Delaware, and Virginia) all have varying degrees of projected increase that average around 32 percent over the same time period. Moreover, the population of bald eagles in Florida has started to stabilize, not showing an increase or decrease between 2003 and 2005. Thus, it is likely that the number of breeding pairs in Florida will begin to decline within the foreseeable future, and possible that the same result could occur in the Chesapeake Bay region.

The relevant question under section 4 of the Act, however, is whether such a decline will occur in the foreseeable future to a degree that the bald eagle is likely to become in danger of extinction again throughout all or a significant portion of its range. In analyzing this question, we considered the fact that the habitat threats that do exist vary considerably across the landscape. This is in part based on the ownership of the land in question—some lands have significant protection independent of the Act. Because the threats do vary across the range, we discuss in greater detail at the end of this section those portions of the range that have come to our attention based on comments or information in our files.

One of the biological factors that will ensure the bald eagle is not now endangered or likely to become so in the foreseeable future is that bald eagles are not particularly specialized in the type of aquatic habitat they use, but instead thrive near a variety of different environments including reservoirs, lakes, rivers, estuaries, and the marine environment. Currently, bald eagles occupy one or more of these environments in each of the lower 48 States, and have large breeding populations in those geographic areas that historically supported significant breeding populations. This tremendous distribution of bald eagles throughout the lower 48 States, combined with the species' ability to exploit such a wide range of geographic habitat settings, provides an important buffer against any potential threats to any of the significant portions of the range and to the species as a whole.

High quality habitat has been characterized as those areas in which human development and disturbance are absent (McGarigal *et al.* 1991). However, recent data suggest that eagles across many parts of their range are demonstrating a growing tolerance of human activities in proximity to nesting and foraging habitats. Eagles in these situations continue to successfully reproduce in settings previously considered unsuitable. For example, where our Southeastern nesting management guidelines have been followed in Florida, some bald eagle pairs have shown a remarkable adaptation to human presence by nesting in residential subdivisions and commercial and industrial parks, and on cell phone towers and electric distribution poles. A common thread throughout these urban and suburban landscapes is the availability of ample food sources such as natural lakes, rivers, and ponds; artificial stormwater retention ponds; and public landfills (Millsap *et al.* 2002, p. 10). A study of bald eagle nesting patterns in western Florida detected no differences in nest-site occupancy, nest success, or number of young fledged between bald eagles occupying suburban or rural nest sites, except bald eagles in suburban sites nested earlier (Millsap *et al.* 2002, pp. 14, 25). In western Washington, breeding bald eagles responded less to pedestrian activity than had been documented in other studies in the United States, possibly reflecting a higher degree of habituation to human activities by eagles in this area (Watson 2004, p. 301). The Service has documented several cases in which bald eagles around the Chesapeake Bay have continued to nest and successfully produce young within distances that were previously considered too close to human activity (Koppie 2007a). In addition, in both Virginia and Maryland, compression of nesting territories has been observed, suggesting that the density of nesting pairs can be higher than once documented (Koppie 2007a). This evidence suggests that as eagles begin to reach the carrying capacity in local areas and face development or other encroachments, some eagles will successfully adapt to these circumstances. To the extent that this is true, degradation of habitat due to human disturbance is not as large a threat as once believed.

To understand the potential for nesting habitat loss due to development in the foreseeable future, we used a GIS (Geographic Information Systems) analysis to estimate the number of known bald eagle nests throughout the lower 48 States that occur on "protected land." The "protected" land category includes Federal, State, Tribal, and other areas designated as privately protected, such as lands owned by The Nature Conservancy or similar non-governmental entities. To identify such lands, we used the Conservation Biology Institute Protected Areas Database, the National Atlas Federal Lands data layer, and the State GAP Analysis data (Otto 2007). Included in another data layer are the bald eagle nests in the lower 48 States that are identified as a result of a compilation of data we received from individual States.

The resolution and quality of this information was not at a highly detailed scale, so there may be nests assigned to the wrong type of land use. For instance, the data from the National Atlas Federal lands data layer only includes Federal lands of 640 acres or more. However, given that our analysis was done at a broad scale, the resolution and quality of this data can generally give us an indication of the percentage of nests over the entire 48 States on protected land. Our intent in this analysis was only to gain perspective on those lands on which eagle nesting habitat is not likely to be lost in the foreseeable future due to the particular land category status. These areas may not all be managed specifically for bald eagles; however, as discussed below, a variety of legal and practical considerations will act to minimize negative impacts to bald eagle habitat once the protections of the Act are removed.

Through the GIS analyses, we have identified more than 6,000 bald eagle nests in the lower 48 States on lands that provide protection for bald eagles. Of these, more than 3,400 occur on Federal lands managed by the Departments of Agriculture or the Interior, and an additional 275 occur on lands managed by the Department of Defense, including approximately 170 on lands managed by the U.S. Army Corps of Engineers. The remaining roughly 2,700 nests included within the 6,000 bald eagle nest figure are found on lands in either State or private ownership. Based on many years of conducting consultations under section 7 of the Act, reviewing habitat conservation plans under section 10 of the Act, reviewing National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq.*) documentation for Federal actions, and other interactions with Federal and State agencies, we have found that management activities on public lands usually provide for maintaining some vegetation buffers of varying widths along riparian corridors and coastal areas. These were sometimes required by the Service as reasonable and prudent measures to address impacts to eagles, but often these buffers were incorporated into project planning because they were required to satisfy another of the action agencies' governing environmental or management laws, or because maintaining such buffers represents a good management practice even in the absence of a legal requirement. The practice of maintaining vegetative buffers is particularly relevant to (and generally supportive of) bald eagle conservation, because of the need of the species to have nesting and roosting sites (generally in trees) in close proximity to water.

As mentioned in the Effects of This Rule section, we intend to honor the existing incidental take statements associated with existing section 7 consultations, as long as the action agency and other covered entities comply with all their terms and conditions. We therefore anticipate that habitat that would be either protected or conserved as a result of these Act authorizations remaining in place. Looking to the foreseeable future, each land management agency has its own authorizing statutes and implementing regulations that may either directly or indirectly conserve habitat for bald eagles, such as by means of buffers (as discussed above). The following paragraphs discuss some of the relevant authorities for the Federal agencies managing land with substantial numbers of eagle nests.

The U.S. Forest Service reports that bald eagles occur on 142 National Forests in the lower 48 States (Bosch 2006). More than 2,000 known bald eagle nests are found within these areas. The Forest Service manages most of its lands for multiple uses, including management for timber production, recreation, and the needs of wildlife, fish, and sensitive plants. Under the National Forest Management Act of 1976 (16 U.S.C. 1600 et seq.), it is the policy of Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans. Particular habitat protection for bald eagle is afforded through the protection of streams, stream-banks, shorelines, lakes, wetlands, and other bodies of water from detrimental in changes in water temperature, blockages of water courses and deposits of sediment (16 U.S.C 1604(g)(3)(E)(iii)). In developing, maintaining, and revising management plans for units of the National Forest System, the Secretary of Agriculture is required to provide for multiple-use and sustained-yield of the products and services obtained from the System in accordance with the Multiple-Use, Sustained-Yield Act of 1960, including coordination of outdoor recreation, range, timber, watershed, wildlife and fish, and wilderness (16 U.S.C. 1604(e)(1)).

The number of nests on Forest Service lands has grown substantially over the last 30+ years, and there is no indication that we have achieved the carrying capacity of the National Forest System. Even at some point in the future when the system's carrying capacity is reached, the multiple-use, sustained yield policies of the U.S. Forest Service are generally consistent with the conservation needs of the bald eagle because they will maintain a large-scale, shifting mosaic that should provide generally stable habitat conditions and a stable number of breeding pairs throughout the National Forest System.

The Service's National Wildlife Refuge (NWR) System contains more than 160 national wildlife refuges that provide important nesting grounds for bald eagles (U.S. FWS 2006c, p. 1). These refuges host more than 600 bald eagle nests. The Service established four refuges specifically to provide management for the bald eagle: the Bear Valley NWR in Oregon was established in 1978 to protect a major night roost site for wintering bald eagles; the Karl E. Mundt NWR in South Dakota/Nebraska protects one of the important bald eagle winter roosting areas and provides important habitat for 100–300 individual bald eagles; the Mason Neck NWR in Virginia protects essential nesting, feeding, and roosting habitat; and the James River NWR in Virginia protects one of the largest summer roosting areas for juvenile bald eagles east of the Mississippi River.

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (16 U.S.C. 668dd). Refuges may be opened for public access and limited uses, with priority afforded to wildlife-dependent recreation. Evaluation of proposed uses typically requires an examination of the appropriateness and compatibility with the System mission and the purposes for which a particular refuge has been established, among other considerations.

The System regulations at 50 CFR part 27 contain a number of prohibitions regarding wildlife that are applicable to bald eagles, including taking, disturbing, or injuring them on refuge lands without a permit. In administering the System, the Secretary of the Interior shall provide for the conservation of fish, wildlife, and plants and their habitats within the System and ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans. The Service applies those requirements through its Administrative Manual Chapter on Biological Integrity, Diversity, and Environmental Health (601 FW 3). Key underlying principles of the policy are that wildlife conservation comes first; each refuge is managed to ensure its biological integrity, diversity, and environmental health; and biological integrity, diversity, and environmental health is considered in a landscape context.

The number of nests on refuges has also grown substantially over the last 30+ years, and there is no indication that we have achieved the carrying capacity of the NWR system. When carrying capacity is reached at some point in the future, the policies and management practices of the Service, with their emphasis on wildlife conservation and the requirement that all uses of System lands meet the test of being compatible with the purposes for which a particular unit of the System was established, are consistent with the conservation needs of the bald eagle because they will provide generally stable habitat conditions and numbers of breeding pairs throughout the system. Therefore, we expect that units of the National Wildlife Refuge System will continue to be managed in ways that contribute substantially to the conservation of bald eagles and meet their habitat needs.

Approximately 130 National Park units have bald eagles located within their boundaries, according to the National Park Service Endangered Species database (U.S. NPS 2006), with more than 300 bald eagle nests on the lands managed by the National Park Service (NPS). These lands include National Parks, National Seashores, National Monuments, and National Wild and Scenic Rivers. Lands managed by the National Park Service are subject to the NPS Organic Act of 1916, which provides that the "fundamental purpose" of those lands "is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 U.S.C. 1). Most units of the National Park System also have their own specific enabling legislation, but the 1970 General Authorities Act makes it clear that all units are united into a single National Park System. Furthermore, no activities shall be allowed "in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 U.S.C. 1a–1).

NPS regulations specifically protect wildlife, including nests, by prohibiting disturbing wildlife or nests from their natural state and by prohibiting take of wildlife and the intentional disturbance of nesting or breeding activities (36 CFR 2.1(a), 2.2(a)). The basic policy document applied to the NPS is Management Policies 2006 ("MP"). Those policies provide that NPS will manage natural resources "to preserve fundamental physical and biological processes, as well as individual species, features, and plant and animal communities," and "will try to maintain all the components and processes of naturally evolving park ecosystems" (MP 4.1). With respect to wildlife, NPS "will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems" by "preserving and restoring the natural abundances, diversities, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur"; "restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions"; and "minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them" (MP 4.4.1).

NPS relies on natural processes whenever possible to maintain native species, but "may intervene to manage individuals or populations of native species" if the intervention will not cause unacceptable impacts to the population of the species or to the ecosystem, and if it is necessary for one of several reasons, such as an unnaturally high or low population due to human influences or to protect a rare species (MP 4.4.2). Based on these requirements, management of NPS lands has and will continue to support the conservation needs of bald eagles, and there is little likelihood that eagles on NPS lands will suffer habitat-based disturbance.

The Bureau of Land Management (BLM) manages lands with more than 200 bald eagle nests. Similar to the U.S. Forest Service, BLM lands are generally managed for multiple-use purposes, under the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 *et seq.*), which includes a declaration of policy that "the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use" (43 U.S.C. 1701(a)(8). For mining activities, BLM provides specific protections for eagle nests and concentration areas (43 CFR 3461.5(k) and (l)). As with lands of the National Forest System, such multiple-use practices are generally consistent with the conservation needs of bald eagles because on a system-wide basis they provide for a generally stable amount and distribution of bald eagle habitat.

The Department of Defense and the U.S. Army Corps of Engineers collectively manage lands that host more than 440 bald eagle nests.

Department of Defense facilities that support at least 275 of these nests include some 43 Army, 17 Navy, 7 Air Force, and 3 Marine Corps installations with nesting or regular eagle use. Under the Sikes Act, the Secretary of Defense must provide for the conservation of natural resources on each installation (16 U.S.C. 670a), with an Integrated Natural Resources Management Plan. Each plan is prepared in cooperation with the Service and the State wildlife agency. As appropriate to the installation, the plan includes provisions for wildlife management (with respect to all wildlife, not just species listed under the Act), habitat enhancement, and wetland protection. As applicable, such plan's primary management goals typically seek to maintain and improve forested habitat for eagles, minimize human disturbance in eagle nesting and wintering areas, improve food supplies, and minimize hazards to eagles. Nests are protected by special management areas. To maintain effective protections, installations have a priority to monitor their nesting and wintering eagles.

In addition, two other authorities specific to management of migratory birds (including bald eagles) on Department of Defense installations are relevant. First, the Armed Forces are authorized by regulation under the Migratory Bird Treaty Act to take migratory birds incidental to military readiness activities (50 CFR 21.15). However, this authorization is contingent upon the Armed Forces conferring and cooperating with the Service to develop and implement appropriate conservation measures to minimize and mitigate any significant adverse effects on a population of a migratory bird species that the Armed Forces determine may result from those activities. Second, on July 31, 2006, the Department of Defense entered into a Memorandum of Understanding (MOU) with the Service under Executive Order 13186, discussed below.

The remainder of the nests on Defense and Corps lands, at least 65 nests, are on lands managed by the Army Corps of Engineers. These lands include major riparian corridors, such as the Mississippi and Missouri Rivers, associated with large civil works projects maintained for navigation and flood control. The projects, with their aquatic suitable habitat for eagles, are likely to remain in place in the foreseeable future. To the extent further work on these projects is proposed, established policies require the Corps to consider opportunities to enhance habitat for wildlife (33 CFR 236.4(b)), including bald eagles. The Corps must also consult with the Service under a provision of the Fish and Wildlife Coordination Act (16 U.S.C. 662) to determine how the Corps can protect wildlife, again including bald eagles. While Defense and Corps lands are managed primarily for military readiness and civil projects, they have historically made significant, positive contributions to eagle conservation. Eagles have also adapted to many of the military, training, and operational activities on these lands. Because of the management plans and conservation measures in place on the Defense and Corps lands, the Service believes that these lands will continue to contribute to eagle recovery for the foreseeable future.

According to the GIS analysis described above, approximately 40 percent of the total of approximately 15,000 known bald eagle nests occur within the "protected lands" category where long-term adverse habitat modification is unlikely to occur. Note that there are more known nests than known breeding pairs. This is because some breeding pairs have more than one nest and because some known nests are abandoned (not currently maintained by any breeding pair). The underlying data used in this analysis is with respect to all known nests, and is without any indication of whether a particular nest is currently active, serves as an alternate nest, or has been abandoned. On the other hand, there are certainly additional nests on protected lands (and elsewhere) currently used by breeding pairs that are not in our data set. The pilot study conducted for the bald eagle post-delisting monitoring plan indicates that the State data for number of nests only accounts for 42 to 81 percent of actual nests (Otto 2007).

Although there is not a scientifically established quantitative correlation between nests and breeding pairs, and therefore we cannot state precisely how many breeding pairs in fact nest on protected lands in a given year, these data give us an indication of the amount of nesting habitat that is protected. Moreover, the 40 percent of nests on protected lands are distributed throughout all areas that are significant for breeding and wintering. These areas therefore will provide protections to significant areas of bald eagle nesting, roosting, perching, and feeding habitat and will continue to provide strongholds throughout the range of the species in the foreseeable future.

Combining the five recovery plans' goals for the bald eagle breeding population leads to a total delisting goal of about 4,000 breeding pairs in the lower 48 States. This level, coincidentally, represents about 40 percent of the 9,789 currently known breeding pairs. While the numbers of recorded nests to breeding pairs are not exact comparisons and, as indicated above, the protection on protected lands is not absolute, our analysis does indicate that it is highly likely that the number of breeding pairs necessary to maintain the species' recovery can be accommodated for the foreseeable future on the protected lands.

In addition to the habitat protection afforded on account of management related to ownership, several other factors will limit the degree to which habitat loss will occur on any lands in the foreseeable future. First, eagle habitat in some areas, because of its remoteness, faces little threat associated with human population expansion. For example, northern Minnesota, Wisconsin, and Michigan have 2,859 breeding pairs and development pressures are negligible within the northern portions of these States.

Second, a number of applicable laws will at least indirectly protect bald eagle habitat. The most important of these is the BGEPA, a Federal statute that applies throughout the United States regardless of land ownership status. The BGEPA (16 U.S.C. 668–668d), enacted in 1940 and since amended, was then intended to be the primary vehicle to protect and preserve bald eagles. The statute prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs (16 U.S.C 668(a)). The BGEPA further defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" (16 U.S.C. 668c).

Even after the bald eagle was added to the List of Threatened and Endangered Wildlife under the Act, BGEPA's prohibition against disturbance continued to be an important component in protecting eagles from human interference. For instance, the Service, in conjunction with various States, developed guidelines based upon BGEPA that have been an essential component of our technical assistance to the public and have helped people avoid harmful impacts to eagles.

But given that the BGEPA will now be the primary law preserving bald eagles, and recognizing the need for predictability in implementing it in the foreseeable future, we further clarified our interpretation of the BGEPA's take prohibition. On June 5, 2007, we published a final rule (72 FR 31132, effective on July 5, 2007) defining the term "disturb" under 50 CFR 22.3 as meaning:

to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior (72 FR 31139).

This definition largely reflects how "disturb" has been interpreted in the past by the Service and other Federal and State wildlife and land management agencies. The final definition of "disturb" encompasses impacts that, based on the best scientific information available, are likely to cause injury to an eagle, or a decrease in its capacity to reproduce. This may include effects from disturbance caused by habitat manipulation.

Although the BGEPA is not a land management law (it contains no provisions that directly protect habitat except for nests), it does protect eagles in their habitat. Activities that disrupt eagles at nests, foraging areas, and important roosts can illegally disturb eagles. Therefore, areas adjacent to eagle nests, important foraging areas, and communal roost sites are indirectly accorded protection under the BGEPA to the degree that their loss would disturb or kill eagles. Those losses may result from habitat alteration. For instance, in our final rule defining "disturb" we noted:

Removal of trees is not in itself a violation of the Eagle Act. The impacts of such action can be a violation, however, if the loss of the trees kills an eagle, or agitates or bothers a bald or golden eagle to the degree that results in injury or interferes with breeding, feeding, or sheltering habits substantially enough to cause a decrease in productivity or nest abandonment, or create the likelihood of such outcomes (72 FR 31137).

We also intend the definition to apply to a situation where eagles, as part of their normal nesting behavior, return to the vicinity of the nest, but the habitat alterations are so vast in scale that the eagles become agitated as a result, alter their behavior, and never return to the nest itself (72 FR 31136).

We have also finalized after public notice and comment National Bald Eagle Management Guidelines (72 FR 31156; June 5, 2007) that are to be used in conjunction with this new definition of the term "disturb." The Guidelines are intended to: (1) Publicize the provisions of the BGEPA that continue to protect bald eagles, in order to reduce the possibility that people will violate the law; (2) advise landowners, land managers, and the general public of the potential for various human activities to disturb bald eagles; and (3) encourage additional nonbinding land management practices that benefit bald eagles. The Guidelines themselves are not law. Rather, they are recommendations based on several decades of behavioral observations, science, and conservation measures to avoid or minimize adverse impacts to bald eagles. The document is intended primarily as a tool for landowners and planners who seek information and recommendations regarding how to avoid disturbing bald eagles.

It is important to note that the Guidelines contain numerous recommendations that relate to bald eagle habitat. For instance, to avoid disturbing nesting bald eagles, we recommend: (1) Keeping a distance between the activity and the nest (distance buffers), (2) maintaining preferably forested (or natural) areas between the activity and around nest trees (landscape buffers), and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees. Again, the primary purpose of these Guidelines is to provide information that will minimize or prevent violations of only Federal laws governing bald eagles.

When this rule becomes effective, the Act's protections and prohibitions will no longer apply to the bald eagle. We recognize that the above-described BGEPA habitat protections that will remain are not identical to those afforded under the Act, nor are they intended to be. There is, however, considerable overlap in the statutory definitions of "take" under both statutes (16 U.S.C. 1532(19) and 668c). Moreover, the regulatory definitions of "harm" and "harass" (50 CFR 17.3) that further define the term "take" under the Act are similar to the newly promulgated "disturb" definition under BGEPA.

As described, we have interpreted "disturb" to include certain biological or behavioral effects caused by activities, including some habitat manipulation. This view is supported by the only court to have addressed the relationship between the prohibitions of the Act and the BGEPA:

Both the Act and the Eagle Protection Act prohibit the take of bald eagles, and the respective definitions of "take" do not suggest that the ESA provides more protection for bald eagles than the Eagle Protection Act* * *. The plain meaning of the term "disturb" is at least as broad as the term "harm," and both terms are broad enough to include adverse habitat modification.

(*Contoski* v. *Scarlett*, Civ No. 05–2528 (JRT/RLE), slip op. at 5–6 (D. Minn. Aug 10, 2006).

Unlike the Act, the BGEPA does not include a private right of action, meaning a third party cannot bring legal action to enforce the statute, but the BGEPA provides criminal and civil penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle * * * or any golden eagle, alive or dead, or any part, nest, or egg thereof" (16 U.S.C. 668 (b)). A violation of the Act can result in a criminal fine of $100,000 ($200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation of this Act is a felony. We anticipate that traditional governmental enforcement of the BGEPA prohibitions will continue to have a deterrent effect despite the absence of a private right of action.

Finally, the Act provides broad substantive and procedural protections for listed species but at the same time allows significant flexibility to permit activities that affect listed species. In particular, the Act provides that we may exempt or authorize the incidental take of listed wildlife in the course of otherwise lawful activities (sections 7(b)(4) and 10(a)(1)(B), respectively). Nationwide, since 2002, the Service has issued an average of 52 incidental take statements per year that covered anticipated take of bald eagles under section 7 of the Act. During that same 5-year period, we also issued about two (1.8) incidental take permits per year under section 10(a)(1)(B) of the Act for bald eagles. The requirements, including minimization, mitigation, or other conservation measures, of those authorizations were designed to ensure that those actions did not jeopardize the continued existence of the bald eagle. It is also apparent that these limited authorizations did not impede the recovery of the bald eagle. The number of section 7 informal consultations concluding that the bald eagle would not likely be adversely affected by a particular action is also notable. For example, in 2006, although we issued 57 section 7 incidental take statements, we engaged in 5,184 informal consultations where take was either not anticipated, or averted through early coordination, incorporation of management recommendations, or project modification.

The regulations at 50 CFR part 22 govern the issuance of bald eagle permits for certain types of take, transportation, and possession, such as for Indian religious purposes, scientific research and exhibition, and depredation. The BGEPA regulation does not presently contain take mechanisms similar to that of the Act with respect to incidental take coverage. On June 5, 2007, however, we published a proposed rule to create such a permitting scheme under the BGEPA (72 FR 31141). The public comment period closes on September 4, 2007. The regulations we have proposed would (1) establish a take permit under the BGEPA, (2) provide BGEPA authorizations comparable to the authorizations granted under the Act to entities who continue to operate in full compliance with the terms and conditions of permits issued under section 10 of the Act and incidental take statements issued under section 7 of the Act, and (3) authorize take of eagle nests in limited circumstances that pose a risk to human safety or to the eagles themselves.

We anticipate that, if that proposal is adopted through the final rule, the majority of permits would be issued to cover activities that cause disturbance in proximity to eagle nests, important foraging sites, and communal roosts. However, by adhering to the National Bald Eagle Management Guidelines, landowners and project proponents will be able to avoid bald eagle disturbance under the BGEPA most of the time. We anticipate only rarely issuing permits for take associated with activities that adhere to the Guidelines because the great majority of such activities will not take bald eagles. In this capacity, the Guidelines and technical advice that we will provide will function much like our informal consultations under section 7 of the Act, but will be available to all landowners. If when applying the Guidelines, avoiding disturbance is not practicable, the project proponent may apply for a take permit. Additionally, in some limited cases, where other forms of take besides disturbance are unavoidable, we anticipate that a permit may be issued for such other form of take.

For reasons enumerated in our proposal, we cautiously estimate the number of eagle take permits would increase if the proposal is adopted from an average of 54 authorizations currently issued under the Act to 300 BGEPA permits, annually. But we may only issue these authorizations if they are "compatible with the preservation" of bald eagles (16 U.S.C. 668a). Like the Act, this BGEPA standard acknowledges that limited take of eagles is not inconsistent with the protection of the species.

As suggested in our proposed rule, we believe the demand for permits, and the effects of issuing those permits, both individually and cumulatively, including minimization and mitigation measures, would not be significant enough to cause a decline in eagle populations from current levels. Our proposal identifies a recognized threshold for determining the level of decline that would be incompatible with the BGEPA standard, which we regularly employ to assess other species we manage under the MBTA. We recognize that external factors could arise that negatively affect eagle populations. Whatever the cause, if data suggest population declines are approaching a level where additional take would be incompatible with the preservation of the eagle, we would refrain from issuing permits until such time that we determine the take would be compatible with the preservation of the bald eagle. For a fuller explanation of the proposed threshold and safeguards, see the proposed rule at 72 FR 31143–31144.

In summary, the BGEPA will remain in force following delisting. The BGEPA prohibits the take of bald eagles, including disturbance, which we have identified and interpreted to occur in some circumstances as a result of habitat alteration. Adherence to the Guidelines, as appropriate in a given situation, may provide for buffers or other measures that protect bald eagle habitat on both private and public lands. Although a take permitting scheme has been proposed, it should not significantly diminish these habitat protections. The proposed permitting mechanism should not reduce the bald eagle population to a level that might necessitate re-listing. Rather, based on the current proposal, we conclude that the number of anticipated permits, coupled with BGEPA's protective "preservation" standard, should ensure that the population will not decline below current levels. Therefore, we expect BGEPA to contribute to the availability of habitat for the recovered bald eagle population in the foreseeable future.

To a much lesser extent, the MBTA also provides indirect protection to bald eagle habitat. The MBTA makes it unlawful to at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or eggs of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof (16 U.S.C 703(a)). Bald eagles are among the migratory birds protected by the MBTA. Therefore, a modification to eagle habitat that directly takes or kills a bald eagle (such as cutting down a nest tree with chicks present) would constitute a violation of the MBTA, as well as the BGEPA.

The Clean Water Act (CWA) (33 U.S.C. 1251 *et seq.*) is the cornerstone of surface water quality protection in the United States. It will continue to protect aquatic habitats upon which the bald eagle depends following delisting. The CWA employs a variety of regulatory and non-regulatory tools to sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and * * * recreation in and on the water" (33 U.S.C. 1251(a)(2)).

The first step in achieving these goals is the establishment of water quality standards (WQS), either by States or the Environmental Protection Agency (EPA) (33 U.S.C. 1313). Necessary reductions in pollutant loading are achieved by implementing the following: (1) The Section 402 National Pollution Discharge Elimination System permit program, covering point sources of pollution; (2) the Section 404 permitting program, regulating the placement of dredged or fill materials into wetlands and other waters of the United States; and (3) Section 401, which requires federal agencies to obtain certification from the State, territory, or Indian tribes before issuing permits that would result in increased pollutant loads to a waterbody. Surface waters are monitored to determine whether the WQS are met. If they are, then anti-degradation policies and programs are employed to keep the water quality at acceptable levels. If waterbodies are not meeting WQS, they must be identified and a strategy for meeting the standards developed. The most common type of strategy is the development of a Total

Maximum Daily Load (TMDL). TMDLs determine what level of pollutant load would be consistent with meeting WQS. TMDLs also allocate acceptable loads among sources of the relevant pollutants. These regulatory programs, coupled with the CWA's protective goals, will continue to help protect the aquatic habitats and prey species of the bald eagle in the foreseeable future.

In 2001, the President signed Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," requiring Federal agencies to incorporate migratory bird conservation measures into their agency activities. Under this Executive Order, each Federal agency whose activities may adversely affect migratory birds was required to enter into a Memorandum of Understanding (MOU) with the Service, outlining how the agency will promote conservation of migratory birds. The Executive Order has a number of provisions that specifically relate to habitat, including the requirements that agencies, as practicable, (1) restore and enhance habitat, (2) prevent or abate the pollution or detrimental alteration of the environment, (3) design habitat conservation principles, measures, and practices into agency plans and planning processes, (4) ensure that NEPA analyses evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern, and (5) identify where unintentional take reasonably attributable to agency actions is having, or is likely to have, a measurable negative effect on migratory bird populations, focusing first on species of concern, priority habitats, and key risk factors.

The Executive Order also encourages an agency to implement those criteria immediately even if it has not yet completed its MOU. Two MOUs have been approved to date with the Department of Defense (U.S. FWS 2006d) and the Department of Energy (U.S. FWS 2006e) that emphasize a collaborative approach to conservation of migratory birds, including minimizing disturbance to breeding, migration, and wintering habitats. While these MOUs are non-binding and therefore are not considered here as existing regulatory mechanisms, they provide an opportunity for us to continue to reduce the threat of habitat loss to bald eagles after delisting by working with our Federal partners.

In addition, the Fish and Wildlife Coordination Act (16 U.S.C. 661–667d) (FWCA) requires that agencies sponsoring, funding, or permitting activities related to water resource development projects request review by the Service and the State natural resources management agency. The Service's review is non-binding, and therefore the Coordination Act is not considered here as an existing regulatory mechanism. However, given that bald eagles reside in aquatic habitats, FWCA will allow the Service to continue to make recommendations on minimizing and offsetting impacts that might occur from these types of activities on bald eagles.

In conclusion, the bald eagle population is continuing to increase in the lower 48 States, showing that reduced availability of habitat is not a current threat to the species. Nesting habitat is secure on many public and private locations throughout the lower 48 States. Although localized habitat loss due to development may be a threat to individual bald eagles in the foreseeable future, particularly on private lands, we expect these threats will be reduced by the Federal laws that will remain in effect after delisting (e.g., BGEPA, MBTA, and CWA) and will not be of sufficient magnitude or intensity to threaten or endanger the species throughout all or a significant portion of its range. In addition, bald eagles have demonstrated increasing levels of tolerance to human disturbance that will allow bald eagles to use habitats previously thought to be unavailable due to disturbance.

Even in the areas where the threat of development is the greatest, we find that the bald eagle is secure for the foreseeable future. In the Chesapeake Bay region, as discussed in our response to comments above, at least 482 breeding pairs nest on federal lands, and we do not anticipate that number to drop in the foreseeable future, even if the numbers of breeding pairs eventually begin to decrease on some other lands (particularly private lands). Even in Florida, where the development pressure outside of protected lands is likely to be greatest, the current population of over 1,133 breeding pairs could suffer a substantial decrease (which we think unlikely within the foreseeable future, for all of the reasons discussed above) without the bald eagle being or likely to become in danger of extinction. The recovery goal for the southeastern region, as updated by the recovery team, is for 1,500 breeding pairs. The southeastern region includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and eastern Texas. Florida's current bald eagle estimate alone is 76 percent of what would be needed for the entire 11-State region. Florida would have to reverse its upward trend and lose nearly two-thirds of its current breeding pairs to get back down to the southeastern recovery goal. We have no data suggesting that a change of this magnitude is reasonably foreseeable. Finally, although the limited habitat available in Arizona makes the bald eagles there particularly vulnerable to habitat threats, as discussed elsewhere, Arizona is not a significant portion of the range of the bald eagle, and what threats do exist there will not affect the conservation of the species throughout all of the lower 48 States, much less its entire range. Therefore, threats of present or future destruction, modification, or curtailment of the bald eagle's habitat or range do not rise to the level where the bald eagle population in the lower 48 States meets the definition of either threatened or endangered throughout all or a significant portion of its range.

B. *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes.* The bald eagle population's first major threat was large-scale mortality from unregulated shooting that occurred early in the last century. The threat was significantly reduced when the shooting of bald eagles was prohibited in 1940 with the Bald Eagle Protection Act, which is now the BGEPA. Shooting of bald eagles was prohibited by an additional law when bald eagles were added to the list of birds protected by the MBTA in 1972.

The Madison National Wildlife Health Center monitored causes of wildlife mortality, between 1963 and 1993, including bald eagle mortality. Out of the 4,300 bald and golden eagles rangewide (including Alaska) that were known to be killed, 15 percent of the bald eagles were killed due to shooting (La Roe *et al.* 1995, p. 68). Even if all of the 4,300 eagle deaths that were investigated were bald eagles, the deaths from shooting would be around 645 deaths spread across a 30-year timeframe. In 1997, Alaska alone had 8,250 breeding pairs (Buehler 2000, p. 37), and the Service estimated the lower 48 States population as 5,295 breeding pairs. In addition, during this same timeframe, the bald eagle population continued to increase, suggesting that this level of mortality was not a serious threat to the bald eagle in the lower 48 States. Since this threat is not centered in any specific geographic area, there are no significant portions of the range that might be threatened for this reason with extinction in the foreseeable future.

There is no legal commercial or recreational use of bald eagles, and such uses of bald eagles will remain illegal into the foreseeable future under BGEPA and MBTA. We consider current laws and enforcement measures sufficient to protect the bald eagle from illegal activities, including trade. The BGEPA prohibits the taking or possession of, and commerce in, bald and golden eagles, with limited exceptions. The law provides significant protections for bald eagles by prohibiting, without specific authorization, take, possession, sale, purchase, barter, offering to sell or purchase or barter, transport, export or import any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. Take under the BGEPA is defined as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" (16 U.S.C. 668c).

The Service will continue to enforce the take prohibitions in the BGEPA. Over the past 5 years, the Service has seen an increase in the investigation of suspected BGEPA violations. In 2006, 324 cases under BGEPA were investigated, a portion of which were bald eagles (Garlick 2007). Legal imports and exports of bald eagle parts, feathers, and live birds have increased over the past 5 years. In 2006, there were 142 bald eagle imports and exports of which the Service is aware (Garlick 2007). These numbers are still relatively low compared to the bald eagle population in the lower 48 States of 9,789 breeding pairs, particularly given that many of these circumstances did not involve taking of live birds from the wild. As the population of bald eagles continues to increase, we would expect a corresponding increase in the number of investigations. We expect that even if this same low level of illegal take, and import and export of eagle feathers and parts, to continue in the foreseeable future, it will be without any significant effects to the species.

The bald eagle is a designated migratory bird that benefits from protections under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703–712), which implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Unless permitted by regulations, the MBTA provides that it is unlawful to pursue, hunt, take, capture, or kill; attempt to take, capture or kill; possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not.

We exercise very strict control over the use of bald eagles or their parts for scientific, education, and Native American religious activities (50 CFR 22.21, 22.22). To respond to the religious needs of Native Americans, we established the National Eagle Repository in Commerce City, Colorado, which serves as a collection point for dead eagles (see 50 CFR 21.31(e)(4)(vi)(C)). As a matter of policy, all Service units (as well as many other Federal and State agencies) transfer salvaged bald eagle parts and carcasses to this repository. Members of Federally recognized tribes can obtain a permit from us authorizing them to receive and possess whole eagles, parts, or feathers from the repository for religious purposes. After removal from protection under the Act, we will still have the ability to issue permits under BGEPA for limited exhibition and education purposes, selected research work, and other special purposes, including Native American religious use, consistent with Federal regulations implementing the BGEPA (50 CFR part 22). We will not issue these permits if they are incompatible with the preservation of the bald eagle under the BGEPA or the terms of the conventions underlying the MBTA (16 U.S.C. 668a and 16 U.S.C. 704(a), respectively), and therefore, these permits are not a threat to the bald eagle population in the lower 48 States.

In summary, there is no current overutilization of the bald eagle for commercial, recreational, scientific, or educational purposes, and the protections afforded by BGEPA and MBTA will continue to reduce this threat to prevent the likelihood of endangerment for the bald eagle in the lower 48 States or a significant portion of its range into the foreseeable future.

C. *Disease or Predation.* Predation has been documented, but it does not constitute a significant problem for bald eagle populations. Eggs, nestlings, and fledglings are the most vulnerable to predators. Eggs in tree nests have been reportedly predated by black-billed magpies (*Pica pica*), gulls, ravens and crows, black bears (*Ursus americanus*), and raccoons (*Procyon lotor*). Nestlings have been reportedly killed by black bears, raccoons, hawks and owls, crows and ravens, bobcat (*Felis rufus*), and wolverine (*Gulo gulo*), although there is little actual documentation. Nestling mortality is more likely due to the effects of starvation and sibling attack. Few nonhuman species are capable or likely to prey on immature or adult bald eagles. The exception to this is at the time of nest departure; fledglings on the ground are vulnerable to mammalian predators.

Immatures and adults in poor condition from starvation, injury, or disease may also be vulnerable to mammalian predators. Bald eagles will defend their nest against other avian species, especially ravens and other raptor species (Buehler 2000, p. 14).

Diseases such as avian cholera, avian pox, aspergillosis, tuberculosis, and botulism may affect individual bald eagles, as do parasites such as the Mexican chicken bug, but are not considered to be a significant threat to overall bald eagle numbers. According to the National Wildlife Health Center (NWHC) in Madison, Wisconsin, only a small percentage of bald eagles submitted to the NWHC between 1985 and 2003 died of infectious disease. The widespread distribution of the species generally helps to protect the bald eagle from catastrophic losses due to disease. Recently, H5N1 high path avian influenza may affect eagles. Currently the Department of the Interior is testing migratory birds for the presence of H5N1 high path avian influenza. At this time, there are no confirmed cases of migratory birds, including bald eagles, testing positive for avian influenza in the United States (USGS 2007a).

Based on data compiled from the National Wildlife Health Center, 99 bald eagles died of avian vacuolar myelinopathy (AVM) between 1994 and 2003. Confirmed cases of bald eagle deaths due to AVM are recorded in Arkansas, North Carolina, South Carolina, and Georgia. Studies on avian vacuolar myelinopathy are continuing, but the cause is still unknown. Natural or manmade toxins are suspected as the most likely cause of AVM based on histopathological findings. A sentinel study demonstrated that exposure to the agent that causes AVM is site-specific, seasonal, and relatively short in duration (USGS 2007b). These States' bald eagle populations have increased between 1994 and 2005, and, based on the most recent population estimates, have a total of 392 breeding pairs. Based on the increase in the population levels, these localized mortalities are not having a significant impact on the bald eagle in the lower 48 States or these portions of the range. We do not expect this disease to be a threat in the foreseeable future because there has been no increase in the number of mortalities throughout the 9 years of monitoring and the number of mortalities is extremely small in relation to the total population. The mortalities are also small in relation to the population in these portions of the range, such that these portions will not become threatened in the foreseeable future.

In more recent years, the West Nile Virus (WNV) has affected some individual bald eagles. According to

NWHC, between January 2002 and January 2004, 81 bald eagles were tested for WNV at the Center, and four tested positive. Individual States have also conducted tests on dead bald eagles with an overall small percentage testing positive. For example, the State of New York annually counts the number of bald eagles residing in the State, which has averaged more than 300 individual bald eagles each year since 2000. Within the State of New York, only two confirmed cases of WNV have been present. Given the small percentage of bald eagle mortality due to WNV, we expect this threat will not significantly affect the bald eagle population in the lower 48 States or any significant portion of its range in the foreseeable future.

During several years in the 1990s, bald eagles wintering along the lower Wisconsin River experienced an unusual rate of mortality. Beginning in 2000–2001, after a gap of 5 years, similar bald eagle mortality has reoccurred each winter, with less than 30 confirmed cases as of 2004. Many of the eagles exhibit signs of neurologic impairment. One hypothesis is that the syndrome is caused by a severe thiamine deficiency as a result of feeding largely on gizzard shad, but that hypothesis remains to be adequately tested (Wisconsin Department of Natural Resources 2005). This syndrome is very localized, and is not having a significant impact on the Statewide bald eagle population given that Wisconsin's eagle population has been rising each year since the mid-1980s, with 1,065 nesting pairs counted in 2006 (Eckstein 2007, p. 3). Given the small percentage of Wisconsin bald eagles affected by this disease, this threat will not affect the lower 48 States' bald eagle population in all or a significant portion of its range in the foreseeable future.

In summary, like all wildlife populations, the bald eagle is affected by numerous natural and environmentally related diseases, as well as predation. While these diseases and predation may have measurable impacts on small, local populations, no known natural or environmentally related disease threats currently have, or are anticipated to have, widespread impacts on the bald eagle population in the lower 48 States. While these impacts are measurable, they are not affecting those small areas given the increase in the population levels of bald eagles in those areas. We do not expect an increase in this threat in the foreseeable future, and, therefore, this is not a threat to any significant portion of the bald eagle's range. Therefore, neither predation nor disease is likely to constitute a significant threat to the bald eagle currently or in the foreseeable future throughout all or any significant portion of its range.

D. *The Inadequacy of Existing Regulatory Mechanisms.* As with all of the five factors, we have to determine whether any particular factor is a threat to the species. The main threats to the bald eagle at the time of listing were threats to reproductive success from contaminants and habitat loss or degradation. Regulatory mechanisms, in and of themselves, were never identified as a threat for bald eagles. Indirectly, regulatory mechanisms were needed to assure that the threats identified in the other factors were removed or reduced. Because we address these regulatory mechanisms in the other factors, we will only mention them briefly in this section.

The BGEPA explicitly protects individuals and nests (16 U.S.C. 668); it will also minimize threats to bald eagle habitat because acts that disturb bald eagles, their nests, or their eggs violate the prohibitions of the BGEPA. The MBTA also provides protection by making it unlawful to pursue, hunt, take, capture, or kill; attempt to take, capture or kill; possess, sell, barter, purchase, deliver; or cause to be shipped, exported, imported, transported, carried or received any migratory bird (which bald eagles are considered), part, nest, egg or product, manufactured or not. In addition to these laws that provide direct protection to the bald eagle, the Clean Water Act and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA; 7 U.S.C. 136 *et seq.*) provide regulations indirectly contributing to the reduction of various manmade threats. Given the level of threats identified in the discussion of the other factors, these protections, taken together, provide adequate regulatory mechanisms for the bald eagle in the lower 48 States in the foreseeable future, and, therefore, factor D is not a threat throughout all or any significant portion of the range.

E. *Other Natural or Manmade Factors Affecting Its Continued Existence.* Bald eagles have been subjected to direct and indirect mortality from a variety of human-related activities such as poisoning (including indirect lead poisoning), electrocution, collisions (such as impacts with vehicles, power lines, or other structures), and death and reproductive failure resulting from exposure to pesticides.

The first major decline in the bald eagle population probably began in the mid to late 1800s. Widespread shooting for feathers and trophies led to extirpation of eagles in some areas. Shooting also reduced part of the bald eagle's prey base (waterfowl and shorebirds). Carrion treated with strychnine, thallium sulfate, and other poisons was used as bait to kill livestock predators and indirectly killed many eagles as well. These were the major factors that contributed to a reduction in bald eagle numbers through the 1940s. Shooting and poisoning of bald eagles and other migratory birds is now prohibited by BGEPA and MBTA, as discussed in Factor B.

In the late 1940s, shortly after World War II, the use of dichloro-diphenyl-trichloroethane (DDT) and other organochlorine pesticide compounds became widespread. Initially, DDT was sprayed extensively along coastal and other wetland areas to control mosquitoes (Carson 1962, p. 122). Later, it was widely used as a general crop insecticide. Dichlorophenyl-dichloroethylene (DDE), the principal metabolic breakdown product of DDT, devastated eagle productivity from the 1950s through the mid-1970s. DDE accumulated in the fatty tissue of adult female bald eagles, and impaired calcium metabolism necessary for normal eggshell formation, causing eggshell thinning. Many eggs broke during incubation, while others suffered embryonic mortality resulting in massive reproductive failure. On December 31, 1972, the U.S. Environmental Protection Agency, under the authority of FIFRA, canceled and suspended registration of DDT in the United States.

The threat of death and reproductive failure was dramatically reduced in 1972 when DDT was banned from use in the United States. An additional step to halt the bald eagle's decline was taken in 1976, when FIFRA registrations of dieldrin, heptachlor, chlordane, and other toxic persistent pesticides were cancelled for all but the most restricted uses in the United States. The residual effects of DDT are now highly localized and have a negligible impact on the bald eagle population in the lower 48 States.

The organochlorine compound concentrations are continuing to decline even in the localized areas in which high levels have persisted through time. For instance, the Channel Islands area of southern coastal California has historically had severe problems related to DDE impacts to bald eagle productivity because this was a DDT manufacturing site (64 FR 35460). On March 16, 2006, biologists with the Montrose Settlements Restoration Program announced that a bald eagle egg successfully hatched on Santa Cruz Island in the Northern Channel Islands (NOAA 2007, p. 1). This bald eagle successfully fledged and took its first flight on July 14, 2006 (NOAA 2007, p. 1). This is the first successful bald eagle fledging on the Northern Channel Islands since 1949 when they nested on Anacapa Island (NOAA 2007, p. 1). Given the recent success in this area, other areas that had high levels of organocholorine concentrations will likely show similar success in the foreseeable future.

The threat of pesticide-related impacts on bald eagles will continue to decline after delisting due to the requirement that pesticides be registered with the Environmental Protection Agency (EPA). Under the authority of FIFRA, the EPA requires environmental testing of new pesticides. It specifically requires testing the effects of pesticides on representative wildlife species before a pesticide is registered. The registration process provides a safeguard to avoid the type of environmental catastrophe that occurred from organochlorine pesticides, such as DDT, that led to the listing of this species as endangered. In addition, the Food Quality Protection Act (1996) has resulted in a similar EPA review of existing pesticides already on the market. This protection from effects of pesticides afforded under the FIFRA will continue into the future even after delisting the bald eagle under the Act.

Polychorinated biphenyls (PCBs) have been demonstrated to cause a variety of adverse health effects including effects on the immune system, reproductive system, nervous system, and endocrine system. In 1976, manufacturing, processing, and distribution in commerce of PCBs were prohibited by Section 6(e) of the Toxic Substances Control Act (15 U.S.C 2601, 2605(e)). Some industrial and commercial applications where PCBs were used include: Electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; and in pigments, dyes, and carbonless copy paper. More than 1.5 billion pounds of PCBs were manufactured in the United States prior to 1977 (U.S. EPA 2007, p. 1). PCBs do not readily break down and may persist in the environment for decades. Individual bald eagles may consume prey that has accumulated high levels of PCBs, leading to a risk of reproductive failure (Bowerman 1993). Given the prohibitions in the use of PCBs, we expect impaired reproductive success because of PCBs to be relatively low and localized to those areas in the range where concentrations remain relatively high. Monitoring of concentrations of PCBs throughout each of the Great Lakes has shown concentrations of PCBs in lake trout that are stable or decreasing (Environment Canada and the U.S. EPA 2005, pp. 122–131). Although there are areas around the Great Lakes that have not yet recovered to the level present before persistent organic pollutants were used, the reproductive rates in the shoreline populations of Great Lakes bald eagles as a whole have increased. This population increase indicates that widespread effects of persistent organic pollutants have decreased (Environment Canada and U.S. EPA, 2005 p. 272). Given that PCB use is prohibited and monitoring data show the levels of PCBs decreasing, we expect the effects of PCBs to continue to decrease in the foreseeable future and not to affect the bald eagle population in the lower 48 States or any significant portion of its range.

Mercury occurs naturally in the earth's crust and cycles in the environment as part of both natural and human-induced activities. The amount of mercury mobilized and released into the biosphere has increased since the beginning of the industrial age. Mercury has long been known to have toxic effects on humans and wildlife. Mercury is a toxic, persistent, bioaccumulative pollutant that affects the nervous system.

Mercury is emitted into the atmosphere by industrial activities like coal-fired power generation. It can travel long distances in the atmosphere and can be deposited on the surface of the earth in remote areas far from the industry emitting the atmospheric mercury. Mercury that accumulates in soil can be transported to waterways in runoff and subsurface water flow. Once in the water, mercury begins to accumulate in the aquatic organisms, with concentrations highest at the top of the food chain. Methylmercury is the form of mercury that bioaccumulates in fish. Mercury contamination is the most frequent basis for fish advisories, represented in 60 percent of all water bodies with advisories. Forty-one States have advisories for mercury in one or more water bodies, and 11 States have issued Statewide mercury advisories.

Consumption of prey with elevated levels of mercury can cause adverse effects on growth, development, reproduction, metabolism and behavior in birds (Eisler 1987, p. 36). Elevated levels of mercury have been reported in bald eagles in the Northeast, Great Lakes region, Northwest, Florida, and recently Montana. An ongoing study of the exposure and impacts of mercury on bald eagles in Maine and New Hampshire indicates that concentration levels are suggestive of reproductive or behavioral impacts (DeSorbo and Evers 2006, p. 5). However, bald eagle population levels in these areas have continued to increase even with the increasing mercury concentration levels. While potentially high levels of mercury may be present in localized areas, there currently are no data suggesting that the bald eagle populations in these localized areas are adversely affected. If the mercury concentration did increase in these isolated small areas, only a few bald eagle pairs would be affected around these particular lakes. These lakes would likely be too small to meaningfully contribute to the resilience, redundancy, or representation of the bald eagle in the lower 48 States. Therefore, mercury exposure currently is having a negligible impact on the bald eagle population in the lower 48 States and any significant portions of its range.

EPA has recognized the need for regulations for water-quality criteria and in 2001 announced a new water quality-criterion for methylmercury that is protective of human health. On August 9, 2006, EPA announced draft guidance for implementing the water quality criterion (71 FR 45560). Given that high mercury concentrations affect a variety of different species, including humans, we expect that under the current laws mercury levels will continue to be monitored and managed to a point that mercury will not have significant adverse effects on the bald eagle population in the lower 48 States or a significant portion of its range in the foreseeable future.

Lead poisoning has caused death and suffering in birds and other wildlife for many years. Bald eagles died from lead poisoning as a result of feeding on waterfowl that were killed or crippled by hunters using lead shot. Bald eagles also died from feeding on waterfowl prey that had inadvertently ingested lead shot in the environment as they fed. Since 1991, the Service has recommended phasing out of lead shot for waterfowl hunting (U.S. FWS, 2006b, p. 2). However, the use of lead shot continues in most States for hunting upland game birds. Another contributor to possible lead poisoning is use of lead fishing sinkers. Such use remains legal in every State except New Hampshire, and could potentially pose a threat to the bald eagle. However, according to a report in 1995, after 30 years of study, lead poisoning was diagnosed in only 338 eagles, including both bald and golden, from 34 States. Even if a majority of these deaths were bald eagles over the 30-year period, this represents a relatively small number of bald eagles given the large increase we have seen in the population during that same timeframe (LaRoe *et al.* 1995. p.

68). Lead poisoning is a threat to a very few individual bald eagles each year and we do not expect the numbers of bald eagles affected by lead to increase given the increased public awareness of the threats posed by using lead shot.

Other causes of injury and mortality to individual bald eagles continue to exist. Of the 4,300 bald and golden eagle deaths investigated between the early 1960s and 1990s, accidental death and impacts with vehicles, power lines, or other such structures accounted for 23 percent of the bald eagle deaths rangewide (including Alaska) (LaRoe *et al.* 1995. p. 68). Low numbers of these types of impacts can be found scattered throughout the population, and are not concentrated in any specific geographic region of the lower 48 States. Because these threats are found in low levels throughout the population, the population as a whole can absorb these impacts. Considering the increase in the population size of bald eagles in the lower 48 States during the time period studied, these impacts were not a significant threat to the population as a whole. Given the 30-year time period studied and the continued increase in the population size during that time period, this threat will likely not increase in the foreseeable future to the point where the bald eagle in the lower 48 States or a significant portion of its range will meet the definition of threatened or endangered under the Act.

Raptor electrocution has been a concern since the early 1970s and accounted for 12 percent of the causes of bald eagle mortality in the 4,300 bald and golden eagle deaths studied since the 1960s (LaRoe *et al.* 1995. p. 68). Generally, electrocutions are more prevalent in sites where a susceptible species' prey base is present and where suitable perches, other than power structures, are lacking. Birds can be electrocuted during any season, but there can be seasonal fluctuations in electrocution frequency that are related to weather conditions or bird behavior (USGS 1999, p. 358). Raptor electrocutions generally can be reduced by adopting safe electrical-pole-and-line configurations or managing raptor perching. With the increase in the bald eagle population, electrocution mortality has likely increased (Koppie 2007a). However, given the continued increase in the population, the effects of such deaths are negligible on the population as a whole and there are no particular areas within the range where this threat is concentrated. The Service and the Edison Electric Institute's Avian Power Line Interaction Committee (APLIC) have worked together to develop guidelines to minimize the incidence of bird electrocutions on power lines. Their "Avian Protection Plan Guidelines" provide detailed guidance to utility company employees for minimizing and avoiding the incidence of bird electrocutions, including the bald eagle. They are used in conjunction with APLIC's "Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 2006" to reduce the number of avian electrocutions on existing and new utility poles. Although this is only guidance, it illustrates the collaborative working relationship to minimize bird electrocution. Given the small number of individual birds that are killed by electrocution and the continued increase in the population size, this is not a significant threat to the bald eagle in the lower 48 States or a significant portion of its range currently or in the foreseeable future.

Development of wind energy production facilities is increasing in localized areas of the lower 48 States, especially in the Atlantic coast flyway area. National projections by the U.S. Department of Energy for U.S. onshore installed wind-energy capacity show an increase from 11.9 GW in 2005 to 72.2 GW in 2020 (National Academy of Sciences 2007). Some wind power facilities have caused mortality to birds of prey and other avian species. There is no evidence, however, indicating that bald eagles have been taken to date. But post-construction studies at existing wind power facilities have been limited in scope and duration, and facilities are now being proposed in areas where bald eagles are more likely to occur. Bald eagles may still be susceptible to mortality, injury, or disturbance in the future if wind energy facilities are not carefully sited to avoid breeding, foraging, or migratory areas. But BGEPA and MBTA prohibitions on the take of bald eagles will still apply after delisting, thereby creating an incentive for thoughtful siting and design of future wind facilities. If wind power development is not carefully planned, bald eagle take may occur in the foreseeable future. But we currently do not have any data indicating that this threat would rise to the level of causing the bald eagle population to be threatened or endangered, especially given the protections afforded by BGEPA and the MBTA.

The main cause of bald eagle endangerment in the lower 48 States, the use of pesticides, has been reduced by cancellation or limitations placed on use of key pesticides under FIFRA. Some contaminants are still prevalent in certain local areas of the lower 48 States that cause death or reduced productivity in a small number of eagles within the population. In addition, several other minor threats remain for individual bald eagles, including electrocution and vehicle strikes. However, due to the large geographic range of the bald eagle and its widespread recovery, these localized negative impacts appear to have a negligible effect on regional or national populations and, therefore, are not threats to the bald eagle population in the lower 48 States. We have determined that these other natural or manmade factors affecting the bald eagle are not likely to cause the bald eagle to become endangered or threatened in the foreseeable future throughout all or any significant portion of its range.

Conclusion of the 5-Factor Analysis

As required by the Act, we considered the five potential threat factors to assess whether the bald eagle is threatened or endangered throughout all or a significant portion of its range in the lower 48 States. When considering the listing status of the species, the first step in the analysis is to determine whether the species is in danger of extinction throughout all of its range. If this is the case, then the species is listed in its entirety. For instance, if the threats on a species are acting only on a portion of its range, but they are at such a large scale that they place the entire species in danger of extinction, we would list the entire species.

The wide distribution of bald eagles throughout the lower 48 States, combined with the eagles' ability to exploit a wide range of geographic aquatic habitat settings, provides an important buffer against any potential threats to any of the significant portions of the range and to the species as a whole. Bald eagles have demonstrated increasing levels of tolerance of human activities that will allow bald eagles to use habitats previously thought to be unavailable due to the proximity of human activities. Several regulatory mechanisms will remain after delisting that will continue to protect bald eagles and their nests. Approximately 40 percent of the bald eagle nests occur on areas where long-term adverse habitat modification is unlikely to occur, including National Wildlife Refuges, National Parks, and National Forests. The BGEPA, MBTA, and CWA will continue to limit threats to habitat.

Large-scale mortality from unregulated shooting, like that which occurred early in the last century, has been eliminated and is prohibited by both the BGEPA and the MBTA. Like all wildlife populations, the bald eagle is affected by numerous natural and environmentally related diseases.

However, these localized effects on individuals are not significantly affecting the bald eagle population in the lower 48 States or a significant portion of its range, nor are they likely to do so within the foreseeable future.

The main cause of bald eagle endangerment in the lower 48 States, the use of certain organochlorine pesticides, has been banned or reduced. While some contaminants are still prevalent in certain local areas of the lower 48 States, these localized impacts are not having a significant effect on the population levels of bald eagles in the lower 48 States. Regulatory mechanisms such as FIFRA will continue to regulate levels of contaminants such that the bald eagle in the lower 48 States will likely not become endangered in the foreseeable future. Moreover, the existing regulatory mechanisms summarized here have been proven adequate to control all of the potentially significant human-caused threats identified for the species.

Bald eagle recovery goals have been met or exceeded for the species on a rangewide basis. There is no recovery region in the lower 48 States where we have not seen substantial increases in eagle numbers. We believe the surpassing of recovery targets over broad areas and on a regional basis, and the continued increase in eagle numbers since the 1995 reclassification from endangered to threatened, demonstrates that threats have been reduced or eliminated such that the bald eagle population in the lower 48 States no longer meets the definition of threatened or endangered.

Having determined that the bald eagle in the lower 48 States does not meet the definition of threatened or endangered, we must next consider whether there are any significant portions of its range that are in danger of extinction or are likely to become endangered in the foreseeable future. On March 16, 2007, a formal opinion was issued by the Solicitor of the Department of the Interior, "The Meaning of 'In Danger of Extinction Throughout All or a Significant Portion of Its Range'" (U.S. DOI 2007). We have summarized our interpretation of that opinion and the underlying statutory language below. A portion of a species' range is significant if it is part of the current range of the species and is important to the conservation of the species because it contributes meaningfully to the representation, resiliency, or redundancy of the species. The contribution must be at a level such that its loss would result in a decrease in the ability to conserve the species.

The first step in determining whether a species is threatened or endangered in a significant portion of its range is to identify any portions of the range of the species that warrant further consideration. The range of a species can theoretically be divided into portions in an infinite number of ways. However, there is no purpose to analyzing portions of the range that are not reasonably likely to be significant and threatened or endangered. To identify only those portions that warrant further consideration, we determine whether there is substantial information indicating that (i) the portions may be significant and (ii) the species may be in danger of extinction there or likely to become so within the foreseeable future. In practice, a key part of this analysis is whether the threats are geographically concentrated in some way. If the threats to the species are essentially uniform throughout its range, no portion is likely to warrant further consideration. Moreover, if any concentration of threats applies only to portions of the range that are unimportant to the conservation of the species, such portions will not warrant further consideration.

If we identify any portions that warrant further consideration, we then determine whether in fact the species is threatened or endangered in any significant portion of its range. Depending on the biology of the species, its range, and the threats it faces, it may be more efficient in some cases for the Service to address the significance question first, and in others the status question first. Thus, if the Service determines that a portion of the range is not significant, the Service need not determine whether the species is threatened or endangered there; conversely, if the Service determines that the species is not threatened or endangered in a portion of its range, the Service need not determine if that portion is significant.

The terms "resiliency," "redundancy," and "representation" are intended to be indicators of the conservation value of portions of the range. Resiliency of a species allows the species to recover from periodic disturbance. A species will likely be more resilient if large populations exist in high-quality habitat that is distributed throughout the range of the species in such a way as to capture the environmental variability within the range of the species. It is likely that the larger size of a population will help contribute to the viability of the species. Thus, a portion of the range of a species may make a meaningful contribution to the resiliency of the species if the area is relatively large and contains particularly high-quality habitat or if its location or characteristics make it less susceptible to certain threats than other portions of the range. When evaluating whether or how a portion of the range contributes to resiliency of the species, it may help to evaluate the historical value of the portion and how frequently the portion is used by the species. In addition, the portion may contribute to resiliency for other reasons—for instance, it may contain an important concentration of certain types of habitat that are necessary for the species to carry out its life-history functions, such as breeding, feeding, migration, dispersal, or wintering.

Redundancy of populations may be needed to provide a margin of safety for the species to withstand catastrophic events. This does not mean that any portion that provides redundancy is a significant portion of the range of a species. The idea is to conserve enough areas of the range such that random perturbations in the system act on only a few populations. Therefore, each area must be examined based on whether that area provides an increment of redundancy that is important to the conservation of the species.

Adequate representation ensures that the species' adaptive capabilities are conserved. Specifically, the portion should be evaluated to see how it contributes to the genetic diversity of the species. The loss of genetically based diversity may substantially reduce the ability of the species to respond and adapt to future environmental changes. A peripheral population may contribute meaningfully to representation if there is evidence that it provides genetic diversity due to its location on the margin of the species' habitat requirements.

To determine whether the bald eagle is threatened in any significant portion of its range, we first considered how the concepts of resiliency, representation, and redundancy apply to the conservation of this particular species. The recovery of the bald eagle in the lower 48 States provides important perspective. The species has demonstrated that it had sufficient resiliency and redundancy to recover from a severe population crash. That recovery was due in large part to the widespread distribution of the species: once the threats (most significantly the use of DDT) were removed, the population began to expand back into the main breeding and wintering areas that we currently see today housing a majority of the population. These breeding and wintering areas are distributed in such a fashion as to capture a majority of the latitudinal and environmental conditions that vary throughout the range. Approximately 75 percent of the breeding population occurs in these key core areas that are distributed throughout the northern, southern, eastern, and northwestern portions of the lower 48 States. In general, the large breeding areas have large expanses of aquatic habitat such as Florida, the Chesapeake Bay region, Maine, the Great Lakes, and the Pacific Northwest (Buehler 2000, p. 1). Winter habitat can also be characterized by having roost sites that are open and close to water with good food availability (Buehler 2000, pp. 3, 7). Bald eagles tend to congregate in large population centers during the winter such that large populations are present in a few areas that have good habitat characteristics. In the lower 48 States, these wintering concentration areas are found mainly along rivers in the Pacific Northwest, including the Puget Sound and the lower Klamath Basin; and along major inland river systems in the Midwest and the Chesapeake Bay.

The main breeding and wintering areas again provide adequate resiliency and redundancy for the bald eagles in the lower 48 States. Although there is little data on the genetic diversity within the species, these same areas appear to provide for adequate representation. A variation in body size in bald eagle individuals is present that is likely due to environmental temperature changes in latitude, as discussed in the significance discussion in the DPS section of this rule. Bald eagles in the southern States tend to be smaller and lighter than eagles found in the northern States (Stalmaster 1987, pp. 16–17). However, we do not have any data currently suggesting this morphological difference is heritable. Even if this trait was heritable, the current distribution of the main breeding and wintering areas discussed above does capture this environmental variation.

Applying the process described above for determining whether a species is threatened in a significant portion of its range, we next addressed whether any portions of the range of the bald eagle in the lower 48 States warranted further consideration. We noted that, as discussed in Factor E, there are several small geographic areas where localized contaminant threats still exist. However, we concluded that these did not warrant further consideration because (1) they are very small (in the context of the range of this species) and affect only a few bald eagles, and thus there was no substantial information that they were a significant portion of the range, or (2) the contaminant levels are decreasing and eagle populations increasing, and thus there was no substantial information that the bald eagles in these areas were likely to become in danger of extinction in the foreseeable future.

In contrast, the threat of habitat loss discussed in Factor A found in Florida and the Chesapeake Bay region is distributed over relatively larger geographic areas of obvious importance to bald eagle conservation. Therefore, we determined that these areas warranted further consideration as portions of the range that may be both significant and threatened. However, as discussed separately in the Factor A analysis, we conclude that the threat of habitat loss in Florida and the Chesapeake Bay region does not rise to the level that the bald eagle is likely to become in danger of extinction in these portions of the range in the foreseeable future. Therefore, we need not determine whether Florida or the Chesapeake Bay region constitute a significant portion of the bald eagle's range.

Finally, we decided to assume that the Sonoran Desert population, as well as the population in the broader area of the Southwest (Arizona, New Mexico, Utah, and Nevada), of which the Sonoran Desert population is the major component, warranted additional consideration out of an abundance of caution and based on the controversy concerning the status of the bald eagles in this region. The following provides our analysis of whether these portions of the range are significant.

Turning first to the question of whether the Sonoran Desert portion of the range makes a meaningful contribution to the representation of the bald eagle, we note that the Sonoran Desert population is a peripheral population, and, as such, requires special consideration, as differing environmental conditions at the periphery of a species' range may give rise to genetic adaptations valuable to the long-term conservation of the species. However, as discussed immediately above and in detail in the DPS analysis, there is no evidence that the morphological and behavioral characteristics of bald eagles in the Sonoran Desert are genetically based (and, therefore, heritable). Even if they were genetically based, the best available data suggest that those characteristics are sufficiently represented in other portions of the species' range. Therefore, we conclude that the Sonoran Desert population does not make a meaningful contribution to the representation of the bald eagle. We reach the same conclusion for the broader population in the Southwest because there is no evidence that the breeding pairs in the broader area have adaptations that are not sufficiently represented in other portions of the range.

Next, we conclude that the Sonoran Desert and broader southwest portions of the range do not make a meaningful contribution to the resiliency of the bald eagle. As discussed previously, habitat suitability determines the density and distribution of bald eagle populations. The Southwest, for example, does not contain particularly high-quality habitat: it does not support large expanses of the bald eagle's preferred breeding habitat type of forested areas adjacent to large bodies of water (Buehler 2000, p. 6). Therefore, this geographic area, both historically and currently, supports a small number of breeding pairs that are more widespread and fewer in number compared to other regions with abundant prey and nest substrate (Jacobsen *et al.* 2006, p. 27). Several accounts suggest that the breeding areas may have been more widespread prior to European development; however, these accounts do not suggest a large breeding population ever occurred in this region of the United States.

The isolation of the Sonoran Desert population and the fact that the ecological setting in the Southwest differs somewhat from other portions of the bald eagle range might provide some insulation from threats that in the future may affect other portions of the range. Therefore, these portions of the range might make some contribution to the resiliency of the species. However, we find that any such contribution is minor, and, therefore, not meaningful because of the small number of pairs that are present in this area. Nor does the southwestern portion of the range include any important concentration of habitat necessary to carry out the life-history functions of the bald eagle.

Finally, we conclude that the Sonoran Desert and broader southwestern portions of the range do not make a meaningful contribution to the redundancy of the bald eagle. As discussed above, even the broader southwestern portion of the range contains only a small number of bald eagles and a tiny portion of the suitable habitat in the lower 48 States. Given the overall numbers of eagles and their broad distribution in the lower 48 States, the southwestern portion of the range provides almost no redundancy to the species.

In light of the above, we conclude that neither the Sonoran Desert nor the Southwest constitute a significant portion of the range of the bald eagle in the lower 48 States, and its loss would not result in a decrease in the ability to conserve the bald eagle. Therefore, we do not need to determine whether either of these portions of the range are in fact threatened. We note that although we have determined that these portions of the range are not significant for the purposes of section 4 of the Act, we recognize that the bald eagles in the Southwest have great importance to people in this region, particularly Native Americans, and will continue to be protected under the BGEPA. We will continue to work with the States, tribes, and conservation organizations in this region continue to conserve the bald eagle in the southwestern United States.

In summary, the bald eagle has made a dramatic resurgence from the brink of extinction. The banning of DDT, coupled with the cooperative conservation efforts of the Service, States, other Federal agencies, non-government organizations, and individuals, have all contributed to the recovery of our National symbol. We have determined that none of the existing or potential threats, either alone or in combination with others, are likely to cause the bald eagle to become in danger of extinction within the foreseeable future throughout all or any significant portion of its range. The bald eagle no longer requires the protection of the Act, and, therefore, we are removing it from the Federal List of Endangered and Threatened Wildlife.

Effects of This Rule

This final rule revises 50 CFR 17.11(h) to remove the bald eagle in the lower 48 States from the Federal List of Endangered and Threatened Wildlife, and also removes the special rule for the bald eagle at 50 CFR 17.41(a). The prohibitions and conservation measures provided by the Act, particularly sections 7, 9, and 10 no longer apply to this species. Federal agencies will no longer be required to consult with us under section 7 of the Act in the event that activities they authorize, fund, or carry out may affect the bald eagle. Critical habitat was not designated for the bald eagle, so the delisting will not affect critical habitat provisions of the Act.

The provisions of the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (including prohibitions on the taking of bald eagles) will remain in place. This rule will not affect the bald eagle's status as a threatened or endangered species under State laws or suspend any other legal protections provided by State law. This rule will not affect the bald eagle's Appendix II status under CITES.

For existing section 7 and 10 authorizations under the Act that cover bald eagles, the Service will honor existing Act exemptions and authorizations of incidental take until such time as the Service completes a final rulemaking for permits under the Bald and Golden Eagle Protection Act. We do not intend to refer for prosecution the incidental take of any bald eagle under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703–712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. 668–668d), if such take is in full compliance with the terms and conditions of an incidental take statement issued to the action agency or applicant under the authority of section 7(b)(4) of the Act or the terms and conditions of a permit issued under the authority of section 10(a)(1)(B) of the Act. The Service has proposed a rulemaking to establish criteria for issuance of a permit to authorize activities that would "take" bald eagles under the Bald and Golden Eagle Protection Act (72 FR 31141, June 5, 2007). The comment period for the proposed rulemaking will close on September 4, 2007. Applying the preservation standard of the BGEPA, we do not anticipate that the proposed permitting program would reduce the bald eagle population below its current level.

Post-Delisting Monitoring

Section 4(g)(1) of the Act requires us, in cooperation with the States, to implement a monitoring program for not less than 5 years for all species that have been recovered and delisted. The purpose of this requirement is to develop a program that detects the failure of any delisted species to sustain itself without the protective measures provided by the Act. If, at any time during the monitoring period, data indicate that protective status under the Act should be reinstated, we can initiate listing procedures, including, if appropriate, emergency listing. We have proposed a draft post-delisting monitoring plan in a separate part of today's **Federal Register** and expect to finalize that post-delisting monitoring plan within a year.

Paperwork Reduction Act

This rule does not contain any new collections of information other than those already approved under the Paperwork Reduction Act (44 U.S.C. 3501 *et seq.*). An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

National Environmental Policy Act

We have determined that Environmental Assessments and Environmental Impact Statements, as defined under the authority of the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited herein is available upon request from the Headquarters Office (see **FOR FURTHER INFORMATION CONTACT** section).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, and Transportation.

Regulation Promulgation

■ Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

§ 17.11 [Amended].

■ 2. Section 17.11(h) is amended by removing the entry for "Eagle, bald" under "BIRDS" from the List of Endangered and Threatened Wildlife.

§ 17.41 [Amended].

■ 3. Section 17.41 is amended by removing and reserving paragraph (a).

Dated: June 28, 2007.

Dirk Kempthorne,

Secretary of the Interior.

H. Dale Hall,

Director, Fish and Wildlife Service.

[FR Doc. 07–4302 Filed 7–6–07; 8:45 am]

BILLING CODE 4310–55–P

Sec. 2.4 Ref 49

U.S. Fish & Wildlife Service

USFWS Threatened and Endangered Species System (TESS)

TESS

Contact ECOS

278 Records

- Listing Status: Candidates for Listing

Species Report

Inverted Common Name	Scientific Name	Where Listed	Listing Status
Alani	*Melicope christophersenii*	-	C
Alani	*Melicope degeneri*	-	C
Alani	*Melicope hiiakae*	-	C
Alani	*Melicope makahae*	-	C
Alani	*Melicope paniculata*	-	C
Alani	*Melicope puberula*	-	C
Amphipod, diminutive	*Gammarus hyalelloides*	-	C
sphodel, bog	*Narthecium americanum*	-	C
Aster, Georgia	*Symphyotrichum georgianum*	-	C
A`e	*Zanthoxylum oahuense*	-	C
Bat, Pacific sheath-tailed	*Emballonura semicaudata rotensis*	entire	C
Bat, Pacific sheath-tailed	*Emballonura semicaudata semicaudata*	American Samoa	C
Bean, Choctaw	*Villosa choctawensis*	-	C
Bean, rayed	*Villosa fabalis*	-	C
Beardtongue, Parachute	*Penstemon debilis*	-	C
Beardtongue, White River	*Penstemon scariosus albifluvis*	-	C
Beetle, Warm Springs Zaitzevian riffle	*Zaitzevia thermae*	-	C
Bladderpod, Short's	*Lesquerella globosa*	-	C
Bladderpod, White Bluffs	*Physaria (= Lesquerella) tuplashensis*	-	C
Brickell-bush, Florida	*Brickellia mosieri*	-	C
Buckwheat, Churchill Narrows	*Eriogonum diatomaceum*	-	C
Buckwheat, Red Mountain	*Eriogonum kelloggii*	-	C

Buckwheat, Umtanum Desert	*Eriogonum codium*	-	C
[illegible]g, Wekiu	*Nysius wekiuicola*	-	C
Bully, Everglades	*Sideroxylon reclinatum ssp. austrofloridense*	-	C
Butterfly, Mariana eight-spot	*Hypolimnas octucula mariannensis*	-	C
butterfly, Mariana wandering	*Vagrans egistina*	-	C
Butterfly, Miami Blue	*Cyclargus (=Hemiargus) thomasi bethunebakeri*	-	C
Cactus, Acuna	*Echinomastus erectocentrus var. acunensis*	-	C
Cactus, Fickeisen plains	*Pediocactus peeblesianus fickeiseniae*	-	C
Cactus, Florida semaphore	*Consolea corallicola*	-	C
Caddisfly, Sequatchie	*Glyphopsyche sequatchie*	-	C
Cave beetle, Baker Station	*Pseudanophthalmus insularis*	-	C
Cave beetle, Clifton	*Pseudanophthalmus caecus*	-	C
[illegible]e beetle, coleman	*Pseudanophthalmus colemanensis*	-	C
Cave beetle, Fowler's	*Pseudanophthalmus fowlerae*	-	C
Cave beetle, icebox	*Pseudanophthalmus frigidus*	-	C
Cave beetle, Indian Grave Point (=Soothsayer)	*Pseudanophthalmus tiresias*	-	C
Cave beetle, inquirer	*Pseudanophthalmus inquisitor*	-	C
Cave beetle, Louisville	*Pseudanophthalmus troglodytes*	-	C
Cave beetle, Nobletts	*Pseudanophthalmus paulus*	-	C
Cave beetle, surprising	*Pseudanophthalmus inexpectatus*	-	C
Cave beetle, Tatum	*Pseudanophthalmus parvus*	-	C
Checkerspot, Taylor's (=whulge)	*Euphydryas editha taylori*	-	C
Chub, headwater	*Gila nigra*	-	C
Cinquefoil, Soldier Meadows	*Potentilla basaltica*	-	C
Crabgrass, Florida [illegible]land	*Digitaria pauciflora*	-	C
Crake, spotless	*Porzana tabuensis*	American Samoa pop	C
Creeper, Kauai	*Oreomystis bairdi*	-	C

Cress, Tahoe yellow	*Rorippa subumbellata*	-	C
Cuckoo, yellow-billed	*Coccyzus americanus*	Western U.S. DPS	C
Daisy, basalt	*Erigeron basalticus*	-	C
Damselfly, blackline Hawaiian	*Megalagrion nigrohamatum nigrolineatum*	-	C
Damselfly, crimson Hawaiian	*Megalagrion leptodemus*	-	C
Damselfly, flying earwig Hawaiian	*Megalagrion nesiotes*	-	C
Damselfly, oceanic Hawaiian	*Megalagrion oceanicum*	-	C
Damselfly, orangeblack Hawaiian	*Megalagrion xanthomelas*	-	C
Damselfly, Pacific Hawaiian	*Megalagrion pacificum*	-	C
Darter, Arkansas	*Etheostoma cragini*	-	C
Darter, Cumberland	*Etheostoma susanae*	-	C
Darter, Pearl	*Percina aurora*	-	C
Darter, rush	*Etheostoma phytophilum*	-	C
Darter, yellowcheek	*Etheostoma moorei*	-	C
Ebonyshell, round	*Fusconaia (=Obovaria) rotulata*	-	C
fern, Maui	*Microlepia (=Microlepia) strigosa (=mauiensis) var. mauiensis*	-	C
Fescue, Guadalupe	*Festuca ligulata*	-	C
Fisher	*Martes pennanti*	West coast DPS	C
Flax, Carter's small-flowered	*Linum carteri carteri*	-	C
Flax, sand	*Linum arenicola*	-	C
Fleabane, Lemmon	*Erigeron lemmonii*	-	C
Frog, Columbia spotted	*Rana luteiventris*	Great Basin DPS	C
Frog, mountain yellow-legged	*Rana muscosa*	U.S.A., all mountain yellow-legged frogs that occur north of the Tehachapi Mountains in the Sierra Nevada	C
Frog, Oregon spotted	*Rana pretiosa*	Entire	C
Frog, relict leopard	*Rana onca*	-	C
Gladecress, Texas golden	*Leavenworthia texana*	-	C
Gladecress, [unnamed]	*Leavenworthia crassa*	-	C
Goldenrod, Yadkin River	*Solidago plumosa*	-	C

Ground-Dove, Friendly	*Gallicolumba stairi*	American Samoa DPS	C
[illegible]se, greater sage	*Centrocercus urophasianus*	Columbia basin DPS, WA	C
Haha	*Cyanea asplenifolia*	-	C
Haha	*Cyanea calycina*	-	C
Haha	*Cyanea eleeleensis*	-	C
Haha	*Cyanea kuhihewa*	-	C
Haha	*Cyanea kunthiana*	-	C
Haha	*Cyanea lanceolata*	-	C
Haha	*Cyanea obtusa*	-	C
Hairstreak, Bartram's	*Strymon acis bartrami*	-	C
Hala pepe	*Pleomele fernaldii*	-	C
Hala pepe	*Pleomele forbesii*	-	C
Hazardia, Orcutt's	*Hazardia orcuttii*	-	C
Ha`iwale	*Cyrtandra filipes*	-	C
Ha`iwale	*Cyrtandra kaulantha*	-	C
Ha`iwale	*Cyrtandra oenobarba*	-	C
[illegible]wale	*Cyrtandra oxybapha*	-	C
Ha`iwale	*Cyrtandra sessilis*	-	C
Hellbender, Ozark	*Cryptobranchus alleganiensis bishopi*	-	C
Holei	*Ochrosia haleakalae*	-	C
Horned lark, streaked	*Eremophila alpestris strigata*	-	C
Hornshell, Texas	*Popenaias popei*	-	C
Hornsnail, rough	*Pleurocera foremani*	-	C
Ho`awa	*Pittosporum napaliense*	-	C
Hulumoa	*Korthalsella degeneri*	-	C
Indigo, Florida	*Indigofera mucronata keyensis*	-	C
Ivesia, Webber	*Ivesia webberi*	-	C
June Beetle, Caseys	*Dinacoma caseyi*	entire	C
Kamakahala	*Labordia helleri*	-	C
Kamakahala	*Labordia pumila*	-	C
Kampua`a	*Hedyotis fluviatilis*	-	C
[illegible]u	*Pteralyxia macrocarpa*	-	C
Kidneyshell, fluted	*Ptychobranchus subtentum*	-	C
Kidneyshell, southern	*Ptychobranchus jonesi*	-	C

Knot, red	*Calidris canutus rufa*	-	C
Kolea	*Myrsine fosbergii*	-	C
Kolea	*Myrsine mezii*	-	C
Kolea	*Myrsine vaccinioides*	-	C
Kopiko	*Psychotria grandiflora*	-	C
Kopiko	*Psychotria hobdyi*	-	C
Ko`oko`olau	*Bidens amplectens*	-	C
Ko`oko`olau	*Bidens campylotheca pentamera*	-	C
Ko`oko`olau	*Bidens campylotheca waihoiensis*	-	C
Ko`oko`olau	*Bidens conjuncta*	-	C
Ko`oko`olau	*Bidens micrantha ctenophylla*	-	C
Leafwing, Florida	*Anaea troglodyta floridalis*	-	C
lehua makanoe	*Lysimachia daphnoides*	-	C
Lizard, sand dune	*Sceloporus arenicolus*	-	C
Lo`ulu, (=Na`ena`e)	*Pritchardia hardyi*	-	C
Madtom, chucky	*Noturus crypticus*	Entire	C
maiden fern, Boyds	*Christella boydiae*	-	C
Makou	*Ranunculus hawaiensis*	-	C
Makou	*Ranunculus mauiensis*	-	C
Mariposa lily, Siskiyou	*Calochortus persistens*	-	C
Massasauga (=rattlesnake), eastern	*Sistrurus catenatus catenatus*	-	C
Ma`oli`oli	*Schiedea pubescens*	-	C
Meshweaver, Warton's cave	*Cicurina wartoni*	-	C
Milk-vetch, Sleeping Ute	*Astragalus tortipes*	-	C
Moonwort, slender	*Botrychium lineare*	-	C
Mountainsnail, Ogden	*Oreohelix peripherica wasatchensis*	-	C
Mucket, Neosho	*Lampsilis rafinesqueana*	-	C
Mudalia, black	*Elimia melanoides*	-	C
Murrelet, Kittlitz's	*Brachyramphus brevirostris*	-	C
Murrelet, Xantus's	*Synthliboramphus hypoleucus*	-	C
Mussel, sheepnose	*Plethobasus cyphyus*	-	C
Nanu	*Gardenia remyi*	-	C
Naucorid bug (=Furnace	*Ambrysus funebris*	-	C

Creek), Nevares Spring			
na`e	*Dubautia imbricata imbricata*	-	C
Na`ena`e	*Dubautia plantaginea magnifolia*	-	C
Na`ena`e	*Dubautia waialealae*	-	C
No common name	*Calliandra locoensis*	-	C
No common name	*Calyptranthes estremerae*	-	C
No common name	*Cordia rupicola*	-	C
No common name	*Doryopteris takeuchii*	-	C
No common name	*Festuca hawaiiensis*	-	C
No common name	*Gonocalyx concolor*	-	C
No common name	*Keysseria (=Lagenifera) erici*	-	C
No common name	*Keysseria (=Lagenifera) helenae*	-	C
No common name	*Phyllostegia bracteata*	-	C
No common name	*Phyllostegia floribunda*	-	C
No common name	*Phyllostegia hispida*	-	C
No common name	*Platydesma cornuta cornuta*	-	C
ommon name	*Platydesma cornuta decurrens*	-	C
No common name	*Platydesma remyi*	-	C
No common name	*Schiedea attenuata*	-	C
No common name	*Schiedea salicaria*	-	C
No common name	*Stenogyne cranwelliae*	-	C
No common name	*Stenogyne kealiae*	-	C
Nohoanu	*Geranium hanaense*	-	C
Nohoanu	*Geranium hillebrandii*	-	C
Nohoanu	*Geranium kauaiense*	-	C
Orchid, white fringeless	*Platanthera integrilabia*	-	C
Paintbrush, Christ's	*Castilleja christii*	-	C
Panic grass, Hirsts'	*Dichanthelium (=Panicum) hirstii*	-	C
Papala	*Charpentiera densiflora*	-	C
Pa`iniu	*Astelia waialealae*	-	C
Pea, Big Pine partridge	*Chamaecrista lineata keyensis*	-	C
rlshell, Alabama	*Margaritifera marrianae*	-	C
earlymussel, slabside	*Lexingtonia dolabelloides*	-	C
Phacelia, Brand's	*Phacelia stellaris*	-	C
Phacelia, DeBeque	*Phacelia submutica*	-	C

Pigtoe, fuzzy	*Pleurobema strodeanum*	-	C
Pigtoe, Georgia	*Pleurobema hanleyianum*	-	C
Pigtoe, narrow	*Fusconaia escambia*	-	C
Pigtoe, tapered	*Quincuncina burkei*	-	C
Pilo kea lau li`i	*Platydesma rostrata*	-	C
Pocket gopher, Louie's western	*Thomomys mazama louiei*	-	C
Pocket gopher, Olympia	*Thomomys mazama pugetensis*	-	C
Pocket gopher, Olympic	*Thomomys mazama melanops*	-	C
Pocket gopher, Roy Prairie	*Thomomys mazama glacialis*	-	C
Pocket gopher, Shelton	*Thomomys mazama ssp. couchi*	-	C
Pocket gopher, Tacoma western	*Thomomys mazama tacomensis*	-	C
Pocket gopher, Tenino	*Thomomys mazama tumuli*	-	C
Pocket gopher, Yelm	*Thomomys mazama yelmensis*	-	C
Pomace fly, [unnamed]	*Drosophila attigua*	-	C
Pomace fly, [unnamed]	*Drosophila digressa*	-	C
Pondsnail, Bonneville	*Stagnicola bonnevillensis*	-	C
Popolo	*Solanum nelsonii*	-	C
Prairie-chicken, lesser	*Tympanuchus pallidicinctus*	-	C
Prairie-clover, Florida	*Dalea carthagenensis floridana*	-	C
Prickly-apple, aboriginal	*Harrisia (=Cereus) aboriginum (=gracilis)*	-	C
Rabbit, New England cottontail	*Sylvilagus transitionalis*	-	C
Redhorse, Sicklefin	*Moxostoma*	-	C
Reedgrass, Hillegrand's	*Calamagrostis hillebrandii*	-	C
Reedgrass, Maui	*Calamagrostis expansa*	-	C
Riffle beetle, Stephan's	*Heterelmis stephani*	-	C
Rockcress, Georgia	*Arabis georgiana*	-	C
Rocksnail, interrupted (=Georgia)	*Leptoxis foremani*	-	C
Rose-mallow, Neches River	*Hibiscus dasycalyx*	-	C
Salamander, Austin blind	*Eurycea waterlooensis*	-	C
Salamander, Georgetown	*Eurycea naufragia*	-	C
Salamander, Salado	*Eurycea chisholmensis*	Entire	C

Sand-verbena, Ramshaw Meadows	*Abronia alpina*	-	C
Sandmat, pineland	*Chamaesyce deltoidea pinetorum*	-	C
sandshell, Southern	*Hamiota (=Lampsilis) australis*	-	C
Sculpin, grotto	*Cottus sp.*	-	C
Shiner, sharpnose	*Notropis oxyrhynchus*	-	C
Shiner, smalleye	*Notropis buccula*	-	C
Shrimp, anchialine pool	*Metabetaeus lohena*	-	C
Shrimp, anchialine pool	*Palaemonella burnsi*	-	C
Shrimp, anchialine pool	*Procaris hawaiana*	-	C
Shrimp, anchialine pool	*Vetericaris chaceorum*	-	C
Shrimp, troglobitic groundwater	*Typhlatya monae*	-	C
silverbush, Blodgett's	*Argythamnia blodgettii*	-	C
Sisi	*Ostodes strigatus*	-	C
Skipper, Dakota	*Hesperia dacotae*	-	C
Skipper, Mardon	*Polites mardon*	-	C
Skyrocket, Pagosa	*Ipomopsis polyantha*	-	C
Snail, Diamond Y Spring	*Pseudotryonia (=Tryonia) adamantina*	-	C
Snail, fragile tree	*Samoana fragilis*	-	C
Snail, Guam tree	*Partula radiolata*	-	C
Snail, Humped tree	*Partula gibba*	-	C
Snail, Lanai tree	*Partulina semicarinata*	-	C
Snail, Lanai tree	*Partulina variabilis*	-	C
Snail, Langford's tree	*Partula langfordi*	-	C
Snail, Phantom Cave	*Cochliopa texana*	-	C
Snail, Tutuila tree	*Eua zebrina*	-	C
Snake, black pine	*Pituophis melanoleucus lodingi*	-	C
Snake, Louisiana pine	*Pituophis ruthveni*	-	C
Spectaclecase	*Cumberlandia monodonta*	-	C
Spineflower, San Fernando Valley	*Chorizanthe parryi var. fernandina*	-	C
Spinymussel, Altamaha	*Elliptio spinosa*	-	C
Springsnail (=Tryonia), Phantom	*Tryonia cheatumi*	-	C
Springsnail, Chupadera	*Pyrgulopsis chupaderae*	-	C

Springsnail, elongate mud meadows	*Pyrgulopsis notidicola*	-	C
Springsnail, Gila	*Pyrgulopsis gilae*	-	C
Springsnail, Gonzales	*Tryonia circumstriata (=stocktonensis)*	-	C
Springsnail, Huachuca	*Pyrgulopsis thompsoni*	-	C
Springsnail, New Mexico	*Pyrgulopsis thermalis*	-	C
Springsnail, Page	*Pyrgulopsis morrisoni*	-	C
Springsnail, Three Forks	*Pyrgulopsis trivialis*	-	C
Spurge, wedge	*Chamaesyce deltoidea serpyllum*	-	C
Squirrel, Palm Springs round-tailed ground (=Coachella Valley)	*Spermophilus tereticaudus chlorus*	-	C
Squirrel, Southern Idaho ground	*Spermophilus brunneus endemicus*	-	C
Squirrel, Washington ground	*Spermophilus washingtoni*	-	C
Stonecrop, Red Mountain	*Sedum eastwoodiae*	-	C
Storm-petrel, band-rumped	*Oceanodroma castro*	Hawaii DPS	C
Sucker, Zuni bluehead	*Catostomus discobolus yarrowi*	-	C
Sunflower, whorled	*Helianthus verticillatus*	-	C
Thoroughwort, Cape Sable	*Chromolaena frustrata*	-	C
Tiger beetle, Coral Pink Sand Dunes	*Cicindela limbata albissima*	-	C
Tiger beetle, highlands	*Cicindela highlandensis*	-	C
Toad, Yosemite	*Bufo canorus*	-	C
Tree snail, Newcomb's	*Newcombia cumingi*	-	C
Turtle, Sonoyta mud	*Kinosternon sonoriense longifemorale*	-	C
Warbler, elfin woods	*Dendroica angelae*	-	C
Waterdog, black warrior (=Sipsey Fork)	*Necturus alabamensis*	-	C
Wawae`iole	*Huperzia (=Phlegmariurus) stemmermanniae*	-	C
wild coffee, Oahu (=kopiko)	*Psychotria hexandra ssp. oahuensis*	-	C
Wormwood, Northern	*Artemisia campestris var. wormskioldii*	-	C
`Aiea	*Nothocestrum latifolium*	-	C
`Akoko	*Chamaesyce eleanoriae*	-	C

`Akoko	*Chamaesyce remyi var. kauaiensis*	-	C
`Akoko	*Chamaesyce remyi var. remyi*	-	C
`aku `aku	*Cyanea tritomantha*	-	C
`Ala `ala wai nui	*Peperomia subpetiolata*	-	C
`Anunu	*Sicyos macrophyllus*	-	C
`Awikiwiki	*Canavalia napaliensis*	-	C
`Awikiwiki	*Canavalia pubescens*	-	C
`Ena`ena	*Pseudognaphalium (=Gnaphalium) sandwicensium var. molokaiense*	-	C
`Ohe	*Joinvillea ascendens ascendens*	-	C

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U.S. Fish & Wildlife Service

USFWS Threatened and Endangered Species System (TESS)

TESS Contact ECOS

89 Records

- Species Groups: Birds
- Listing Status: Endangered,Threatened,Emergency Listing (Threatened),Emergency Listing (Endangered),Similarity of Appearance (Endangered),Similarity of Appearance (Threatened)
- Listed in the US

Species Report

Inverted Common Name	Scientific Name	Where Listed	Listing Status
Akepa, Hawaii (honeycreeper)	*Loxops coccineus coccineus*	-	E
Akepa, Maui (honeycreeper)	*Loxops coccineus ochraceus*	-	E
Akialoa, Kauai (honeycreeper)	*Hemignathus procerus*	-	E
Akiapola`au (honeycreeper)	*Hemignathus munroi*	-	E
Albatross, short-tailed	*Phoebastria (=Diomedea) albatrus*	-	E
Blackbird, yellow-shouldered	*Agelaius xanthomus*	-	E
Bobwhite, masked (quail)	*Colinus virginianus ridgwayi*	-	E
Caracara, Audubon's crested	*Polyborus plancus audubonii*	U.S.A. (FL)	T
Condor, California	*Gymnogyps californianus*	U.S.A. only, except where listed as an experimental population below	E
Coot, Hawaiian	*Fulica americana alai*	-	E
Crane, Mississippi sandhill	*Grus canadensis pulla*	-	E
Crane, whooping	*Grus americana*	Entire, except where listed as an experimental population	E
Creeper, Hawaii	*Oreomystis mana*	-	E
Creeper, Molokai	*Paroreomyza flammea*	-	E
Creeper, Oahu	*Paroreomyza maculata*	-	E
Crow, Hawaiian	*Corvus hawaiiensis*	-	E

(=‘alala)			
[illegible]v, Mariana (=aga)	*Corvus kubaryi*	-	E
Crow, white-necked	*Corvus leucognaphalus*	-	E
Curlew, Eskimo	*Numenius borealis*	-	E
Duck, Hawaiian (=koloa)	*Anas wyvilliana*	-	E
Duck, Laysan	*Anas laysanensis*	-	E
Eider, spectacled	*Somateria fischeri*	-	T
Eider, Steller's	*Polysticta stelleri*	U.S.A. (AK breeding population only)	T
Elepaio, Oahu	*Chasiempis sandwichensis ibidis*	-	E
Falcon, northern aplomado	*Falco femoralis septentrionalis*	-	E
Finch, Laysan (honeycreeper)	*Telespyza cantans*	-	E
Finch, Nihoa (honeycreeper)	*Telespyza ultima*	-	E
Flycatcher, [illegible]thwestern willow	*Empidonax traillii extimus*	-	E
Gnatcatcher, coastal California	*Polioptila californica californica*	-	T
Goose, Hawaiian	*Branta (=Nesochen) sandvicensis*	-	E
Hawk, Hawaiian (='Io)	*Buteo solitarius*	-	E
Hawk, Puerto Rican broad-winged	*Buteo platypterus brunnescens*	-	E
Hawk, Puerto Rican sharp-shinned	*Accipiter striatus venator*	-	E
Honeycreeper, crested	*Palmeria dolei*	-	E
Jay, Florida scrub	*Aphelocoma coerulescens*	-	T
Kingfisher, Guam Micronesian	*Halcyon cinnamomina cinnamomina*	-	E
Kite, Everglade snail	*Rostrhamus sociabilis plumbeus*	U.S.A. (FL)	E
Megapode, Micronesian	*Megapodius laperouse*	-	E
[illegible]erbird, Nihoa (old [illegible]orld warbler)	*Acrocephalus familiaris kingi*	-	E
Moorhen, Hawaiian common	*Gallinula chloropus sandvicensis*	-	E

Moorhen, Mariana common	*Gallinula chloropus guami*	-	E
urrelet, marbled	*Brachyramphus marmoratus*	U.S.A. (CA, OR, WA)	T
Nightjar, Puerto Rican	*Caprimulgus noctitherus*	-	E
Nukupu`u (honeycreeper)	*Hemignathus lucidus*	-	E
Owl, Mexican spotted	*Strix occidentalis lucida*	-	T
Owl, northern spotted	*Strix occidentalis caurina*	-	T
Palila (honeycreeper)	*Loxioides bailleui*	-	E
Parrot, Puerto Rican	*Amazona vittata*	-	E
Parrotbill, Maui (honeycreeper)	*Pseudonestor xanthophrys*	-	E
Pelican, brown	*Pelecanus occidentalis*	Entire, except U.S. Atlantic coast, FL, AL	E
Petrel, Hawaiian dark-rumped	*Pterodroma phaeopygia sandwichensis*	-	E
igeon, Puerto Rican plain	*Columba inornata wetmorei*	-	E
Plover, piping	*Charadrius melodus*	Great Lakes watershed in States of IL, IN, MI, MN, NY, OH, PA, and WI and Canada (Ont.)	E
Plover, piping	*Charadrius melodus*	Entire, except those areas where listed as endangered above	T
Plover, western snowy	*Charadrius alexandrinus nivosus*	U.S.A. (CA, OR, WA), Mexico (within 50 miles of Pacific coast)	T
Po`ouli (honeycreeper)	*Melamprosops phaeosoma*	-	E
Prairie-chicken, Attwater's greater	*Tympanuchus cupido attwateri*	-	E
Rail, California clapper	*Rallus longirostris obsoletus*	-	E
Rail, Guam	*Rallus owstoni*	Entire, except Rota	E
Rail, light-footed clapper	*Rallus longirostris levipes*	U.S.A. only	E
Rail, Yuma clapper	*Rallus longirostris yumanensis*	U.S.A. only	E
Shearwater, Newell's Townsend's	*Puffinus auricularis newelli*	-	T
Shrike, San Clemente loggerhead	*Lanius ludovicianus mearnsi*	-	E

Sparrow, Cape Sable seaside	*Ammodramus maritimus mirabilis*	-	E
Sparrow, Florida grasshopper	*Ammodramus savannarum floridanus*	-	E
Sparrow, San Clemente sage	*Amphispiza belli clementeae*	-	T
Stilt, Hawaiian	*Himantopus mexicanus knudseni*	-	E
Stork, wood	*Mycteria americana*	U.S.A. (AL, FL, GA, SC)	E
Swiftlet, Mariana gray	*Aerodramus vanikorensis bartschi*	-	E
Tern, California least	*Sterna antillarum browni*	-	E
Tern, least	*Sterna antillarum*	U.S.A. (AR, CO, IA, IL, IN, KS, KY, LA_Miss. R. and tribs. N of Baton Rouge, MS_Miss. R., MO, MT, ND, NE, NM, OK, SD, TN, TX_except within 50 miles of coast)	E
Tern, roseate	*Sterna dougallii dougallii*	U.S.A. (Atlantic Coast south to NC), Canada (Newf., N.S, Que.), Bermuda	E
Tern, roseate	*Sterna dougallii dougallii*	Western Hemisphere and adjacent oceans, incl. U.S.A. (FL, PR, VI), where not listed as endangered	T
Thrush, large Kauai (=kamao)	*Myadestes myadestinus*	-	E
Thrush, Molokai	*Myadestes lanaiensis rutha*	-	E
Thrush, small Kauai (=puaiohi)	*Myadestes palmeri*	-	E
Towhee, Inyo California	*Pipilo crissalis eremophilus*	-	T
Vireo, black-capped	*Vireo atricapilla*	-	E
Vireo, least Bell's	*Vireo bellii pusillus*	-	E
Warbler (=wood), Bachman's	*Vermivora bachmanii*	-	E
Warbler (=wood), golden-cheeked	*Dendroica chrysoparia*	-	E
Warbler (=wood), Kirtland's	*Dendroica kirtlandii*	-	E
Warbler, nightingale reed (old world warbler)	*Acrocephalus luscinia*	-	E
White-eye, bridled	*Zosterops conspicillatus conspicillatus*	-	E
White-eye, Rota	*Zosterops rotensis*	-	E

bridled			
'oodpecker, ivory-..led	*Campephilus principalis*	entire	E
Woodpecker, red-cockaded	*Picoides borealis*	-	E
\`O\`o, Kauai (honeyeater)	*Moho braccatus*	-	E
\`O\`u (honeycreeper)	*Psittirostra psittacea*	-	E

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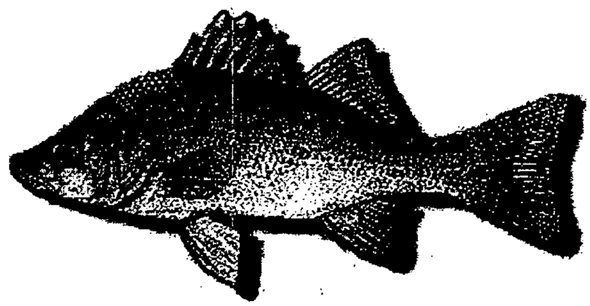
Text Only

Fish of the Great Lakes
Wisconsin Sea Grant

G-277



White Perch

Morone americana

- **Length:** Usually 5-7 inches (127-178mm)
- **Weight:** Average 8 ounces
- **Coloring:** variable, dark grayish-green, dark silvery green, or dark brown to almost black on back; pale olive or silvery green on sides; silvery white on belly
- **Common Names:** white perch, narrow-mouthed bass, silver perch, sea perch
- **Found in Lakes:** Michigan, Huron, Ontario, Erie and Superior

Native to Atlantic coastal regions, white perch invaded the Great Lakes through the Erie and Welland canals in 1950. Prolific competitors of native fish species, white perch are believed to have the potential to cause declines of Great Lakes walleye populations.

White perch have been found to eat the eggs of walleye (*Stizostedion vitreum*), white bass (*Morone chrysops*), other white perch and possibly other species as well. Fish eggs apparently are an important component of the diet of white perch in the spring months. At times, depending on which fish is spawning, the eggs of either walleye or white bass comprise 100% of the white perch's diet. During one three-year study, this diet was unique in that eggs were eaten for a comparatively long time; they were the only significant food item eaten by white perch adults during two of the study's three years; and large volumes were eaten per individual. White perch also feed heavily on minnows (*Notropis* spp.). The collapse of the walleye fishery in the Bay of Quinte on the north shore of Lake Ontario coincided with the increase

Sucker

Muskellunge

Northern Pike

Pink Salmon

Rainbow Smelt

Rainbow Trout

Round Goby

Round Whitefish

Ruffe

Sea Lamprey

Smallmouth Bass

Walleye

White Perch

White Sucker

Yellow Perch

in white perch population and may have been a result of egg predation and the resulting lack of recruitment.

Another concern is that white perch, actually a species of the bass genus (*Moronidae*), have hybridized with native white bass in western Lake Erie. These hybrids were first noted in western Lake Erie in the early 1980s, the same time when white perch were increasing in abundance in this area. Since these hybrids are capable of back-crossing with parent species as well as crossing among themselves, they could dilute the gene pool of both parent species. This is the first known natural occurring hybrid in this genus; all other *Morone* hybrids were artificially produced. This hybridization is probably also occurring in the other Great Lakes.

White perch were first found in the Great Lakes basin in Cross Lake in central New York in 1950. They apparently gained access to the lake via the Erie Barge Canal during the warm weather in the 1930s and 1950s. From the canal system, the species moved down the Oswego River to Lake Ontario. Once in Lake Ontario, they had moved into Lake Erie via the Welland Canal by 1953 and continued to spread to the upper Great Lakes. The first reports of its westward movement through the Great Lakes are as follows: Lake St. Clair, 1977; Lake Huron, 1987; Lake Michigan at Green Bay/Fox River in Wisconsin, May 1988; and Illinois waters of Lake Michigan off Chicago, September 1988. One oddity is that the first sighting of white perch in Lake Superior waters was in 1986 at Duluth Harbor - one year before it was found in Lake Huron and two years before it was seen in Lake Michigan. The Lake Superior population is still restricted to this harbor, possibly because it is the warmest part of that frigid lake. That population likely represents a separate introduction since it does not fit the pattern of western dispersal.

Established in all five Great Lakes and their surrounding states, white perch can also be found in Kentucky, Massachusetts, Missouri, Nebraska and New Hampshire. White perch have been stocked intentionally in other areas for sport fishing. Their native range is the Atlantic Slope drainages from St. Lawrence-Lake Ontario drainage in Quebec south to the Peedee River of South Carolina. A marine species, they run up coastal streams to spawn.

An excellent panfish highly regarded as a food fish in the Eastern United States, it is not often exploited as a game fish and generally is regarded as undesirable, especially when over-population in fresh waters causes the species to become stunted.

Sources:
Pam Fuller, Southeastern Biological Science Center, National Biological Service.
Fishes of Wisconsin by George C. Becker (University of Wisconsin Press, 1983).
Freshwater Fishes of Canada by W.B. Scott and E.J. Crossman (Fisheries Research Board of Canada, 1973).

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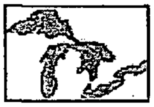


Alewife

Atlantic Salmon

Bloater

Brook Trout

Brown Trout

Burbot

Carp

Chinook Salmon

Coho Salmon

Freshwater Drum

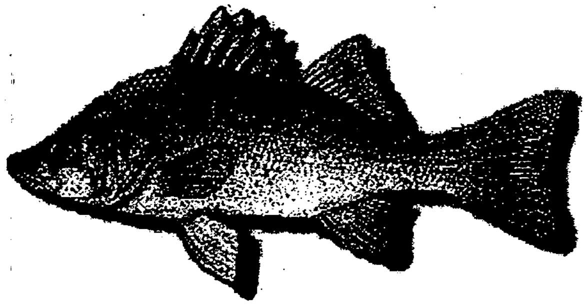
Lake Herring

Lake Sturgeon

Lake Trout

Lake Whitefish

Longnose



White Perch

Morone americana

- **Length:** Usually 5-7 inches (127-178mm)
- **Weight:** Average 8 ounces
- **Coloring:** variable, dark grayish-green, dark silvery green, or dark brown to almost black on back; pale olive or silvery green on sides; silvery white on belly
- **Common Names:** white perch, narrow-mouthed bass, silver perch, sea perch
- **Found in Lakes:** Michigan, Huron, Ontario, Erie and Superior

Native to Atlantic coastal regions, white perch invaded the Great Lakes through the Erie and Welland canals in 1950. Prolific competitors of native fish species, white perch are believed to have the potential to cause declines of Great Lakes walleye populations.

White perch have been found to eat the eggs of walleye (*Stizostedion vitreum*), white bass (*Morone chrysops*), other white perch and possibly other species as well. Fish eggs apparently are an important component of the diet of white perch in the spring months. At times, depending on which fish is spawning, the eggs of either walleye or white bass comprise 100% of the white perch's diet. During one three-year study, this diet was unique in that eggs were eaten for a comparatively long time; they were the only significant food item eaten by white perch adults during two of the study's three years; and large volumes were eaten per individual. White perch also feed heavily on minnows (*Notropis* spp.). The collapse of the walleye fishery in the Bay of Quinte on the north shore of Lake Ontario coincided with the increase

Sucker

Muskellunge

Northern Pike

Pink Salmon

Rainbow Smelt

Rainbow Trout

Round Goby

Round Whitefish

Ruffe

Sea Lamprey

Smallmouth Bass

Walleye

White Perch

White Sucker

Yellow Perch

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