GREEN INFRASTRUCTURE PLANNING GUIDELINES

For Coastal Georgia

Coastal Regional Commission of Georgia

GEORGIA Department of Natural Resources
Coastal Resources Division

NatureServe
A Network Connecting Science With Conservation

Georgia Department of Community Affairs

Heart of Georgia Altamaha Regional Commission

Context 4
Land Conservation- A Strategic Approach 7
Perspective on Green Infrastructure ...**Error! Bookmark not defined.**
DEFINING GREEN INFRASTRUCTURE 8
Benefits of Green Infrastructure 11
Urban Forestry 13
Social Benefits 14
Communal Benefits 15
Environmental Benefits 15
Economic Benefits 16
Trees Require an Investment 16
Forests and Fires 17
NETWORK DESIGN 19
Green Infrastructure at Multiple Scales 19
Ten Key Principles of Green Infrastructure 19
KEY DESIGN ELEMENTS (McMahon & Benedict, 2006) 21
HUBS 21
LINKS 21
Existing Plans 22
Green Infrastructure Planning Topics 23
Regional Planning 23
Patterns: Green Infrastructure 23
Preservation: Green Infrastructure 24
Passages: Green Infrastructure 24
Places: Green Infrastructure 25
Smart Growth 26
Smart Conservation 26
Transportation Planning and Green Infrastructure 27
Forestry Management 27
Sustainable Forest Management in Georgia 27
Georgia Statewide Forest Resources Strategy 2010 28
Georgia Land Conservation Partnership Plan 2004 29
Urban Forestry .....**Error! Bookmark not defined.**
GREENWAYS AND TRAILS 29
Coastal Georgia Greenway 30
Agencies and parties responsible for Land Conservation in Coastal Georgia 32
COMPREHENSIVE PLANNING 34
Project flow for Green Infrastructure Implementation 35
The Southeastern Ecological Framework (SEF) 36
CONTEXT 36
GOAL AND OBJECTIVES OF THE SOUTHEASTERN ECOLOGICAL ... 37
FRAMEWORK 37

Identification of Priority Ecological Areas (PEAs) and Significant Ecological Areas (SEAs) 38
Priority Ecological Area Exclusion 38
Delineation of Hubs 39
Identification of Landscape Linkages . **Error! Bookmark not defined.**
Integration and Optimization of Framework Components .....**Error! Bookmark not defined.**
USGS GAP Analysis Program- Protected Areas Database 39
MAPPING..... 41
Georgia Coast Green Infrastructure Technical Methods 42
Creating the Green Infrastructure Components..... 43
Creating Green Infrastructure Cores and Corridors..... 47
Evaluating the Green Infrastructure 48
Results and Discussion 49
APPENDIX A: CONSERVATION TOOLS AND STRATEGIES..... 51
Governmental Tool Box 51
Administrative Tools..... 51
Zoning Tools..... 51
Outright Purchase..... 52
Voluntary Programs 52
State of Georgia WHIP. 53
APPENDIX B: ECOSYSTEM SERVICES ANALYSIS 55
APPENDIX C: BEST MANAGEMENT, POLICIES AND PRACTICES FOR GREEN INFRASTRUCTURE 66
APPENDIX D: OUTREACH SUMMARY 76
APPENDIX E: WORKS CITED..... 81
APPENDIX F: MAP SERIES 83

Context

Georgia is one of top ten fastest growing states in the country (US Census Bureau). U.S Census Estimates for 2010 indicate that Georgia has more than nine and a half million residents (9,687,653). Outside of the Atlanta Metro Region, the Coastal Region of Georgia is the second fastest growing Region in the State. The Study Area for this project included Brantley, Bryan, Bulloch, Camden, Chatham, Charlton, Effingham, Glynn, Liberty, Long, McIntosh, Screven and Wayne counties. **See Map 1 & 2.**

Counties in Study Area	2000	2010	% Change
Brantley	14629	18411	25.9%
Bryan County	23417	30233	29.1%
Bulloch County	55983	70217	25.4%
Camden County	43664	50513	15.7%
Chatham County	232048	265128	14.3%
Charlton	10282	12171	18.4%
Effingham County	37535	52250	39.2%
Glynn County	67568	79626	17.8%
Liberty County	61610	63453	3.0%
Long County	10304	14464	40.4%
McIntosh County	10847	14333	32.1%
Screven County	15374	14593	-5.1%
Wayne	26565	30099	13.3%
Total	**609826**	**715491**	**17.3%**

Collectively, these counties have undergone a 17.3 percent population increase in the years between 2000 and 2010. While this increase is lower than the State's during the same time period (18.3%) population increases above the state rate can be seen in the counties of Long, Effingham, McIntosh, Bryan, Brantley, Bulloch and Charlton, respectively. With the exception of Bryan, these counties have historically been considered more rural and underdeveloped counties.

This underscores the fact that the region's forested lands, agricultural lands and wetlands are being developed rapidly, resulting in loss of critical habitat, biodiversity and other valuable ecosystem services.

The costs associated with urban sprawl have become obvious to the majority of Americans. Human modifications of the land have created fragmented development patterns that threaten native plant and wildlife communities and associated ecological functions and processes.

This has led to:

- LOSS OF NATURAL AREAS

Developing land for houses, roads and other human needs reduces the amount of natural areas. As natural areas diminish, so does habitat diversity. The result is both a decline in the number of species and fewer individuals of those species that survive.

- FRAGMENTATION OF NATURAL SPACES

As we convert land, we fragment it into smaller and more isolated patches of open space, which greatly alters the way in which natural systems function.
Fragmentation increases edge habitat and the isolation between patches while reducing the number and diversity of natural plant and animal species.

- DEGRADATION OF WATER RESOURCES

Developing wetlands and riparian zones reduces their capacity to control floods, trap sediments, filter out toxins and excess nutrients, and support wildlife and plant species, and it threatens the health of the environment.

- DECREASED ABILITY FOR NATURE TO RESPOND TO CHANGE

Development has hindered nature's ability to respond to climatic changes and has reduced population viability for wildlife by reducing genetic diversity and limiting wildlife movement.
In addition to the above ecological effects, there are also social and economic consequences of the consumption of open lands and the resulting loss of green space.

These include:

- LOSS OF "FREE" NATURAL SERVICES

Natural systems provide important services, such as flood control, stormwater management and the filtration of pollutants. The loss of natural systems increases the risk of flooding and natural disasters. This, in turn, costs communities billions in mitigation efforts and in disaster relief and recovery.

- INCREASED COSTS OF PUBLIC SERVICES

Haphazard development often increases the cost of public services by requiring huge investments in new roads, sewers, schools and other public infrastructure.
In addition, the loss of farm and forestlands affects a community's bottom line. Many studies show that farming and forestry generate considerably higher revenue than the amount of public services they require. Residential development has the opposite effect. Urban sprawl and the inefficient use of land and resources require communities to provide services across a larger geographic area. Because developments and buildings are spread further apart, sprawl stretches municipal services, resulting in scarcer services and higher taxes.

- INCREASED SUSCEPTIBILITY TO NATURAL HAZARDS

Development in many parts of Georgia—including growth adjacent to forests and wetlands—increases the risk of wildfire for people and property, raises the cost and risk of fighting fires, contributes to the spread of invasive species, increases conflicts among recreational users, reduces access to recreation lands, fragments fish and wildlife habitat.

Development within flood plains, wetlands and other flood prone areas also diminishes the natural capacity to mitigate flooding and high water events, including hurricanes.

Land Conservation- A Strategic Approach

Just as we must address haphazard development, we must also address haphazard conservation – conservation activities that are reactive, site-specific, narrowly focused, or not well integrated with other efforts. Just as we need smart growth to strategically direct and influence the patterns of land development, we need "smart conservation" to strategically direct conservation practices. Green infrastructure provides a solution that ensures environmental protection and a higher quality of life within communities as well as regulatory predictability for landowners and investors.

To have a green, sustainable community, both economic development and land conservation are necessary. Achieving conservation outcomes that are truly meaningful while allowing for balanced growth requires identification and protection of an integrated system or "green infrastructure network" for the region.

This guide identifies a regional green infrastructure network while providing a background and framework from which to launch a regional Green Infrastructure program in Coastal Georgia.

The guide seeks to:

- Inform and educate on Green Infrastructure and related principles.
- Identify key stakeholders and resources essential to a successful GI program
- Map essential, regional Green Infrastructure network elements
- Provide guidelines for planning and implementing region- wide green infrastructure initiatives.
- Provide a framework from which to build and expand on in the future via more detailed, local initiatives.

DEFINING GREEN INFRASTRUCTURE

Green Infrastructure has various definitions and applications. A discussion of these various definitions and applications is only briefly discussed in this document.

In the past, Green Infrastructure strategies and programs tended to focus on green space improvements with a more immediate public utility, rather than investment in wider ecosystem service enhancement. When this happened, the real value of the actual or potential benefits from Green Infrastructure could not be taken fully into account within the planning process or associated investment decisions. Instead, the incorporation of Green Infrastructure was viewed at best as 'cosmetic' or meeting some wider policy objective such as contributing to 'sustainability'

Fortunately, recent holistic approaches have evolved as understanding of the issues increase and practical ways to value the benefits of Green Infrastructure become more accepted, making it easier to make the case for investment. This transition to Integrated Regional Planning Strategies (see pg 24) helps, providing a platform for connecting public interventions and spatial planning, and encouraging strategic approaches to Green Infrastructure planning and investment. The definition of Green Infrastructure should therefore, remain broad enough to provide space for this new thinking and innovative approaches.

Green Infrastructure originated in thinking about ecological / ecosystem services, the life-support functions which the natural environment provides (clean water, fertile soils, clean air). It is rapidly being adopted into mainstream strategic planning. The emergence of policies on sustainable communities, with quality of place and quality of life as key drivers of regeneration and economic renewal, have provided fertile ground for the language of Green Infrastructure to take root and grow.

In recent years the term "green infrastructure" has been used to refer to everything from green roofs to more ecologically friendly stormwater management systems and large networks of natural areas (Wise 2008, Schwartz 2009). What these different usages have in common is a basic recognition that our built environment and our ecological environment are connected and interrelated. When the term is used at a landscape scale such as a watershed, municipality, or region, our definition of "green infrastructure" is an interconnected system of natural areas and open space that conserves ecosystem values, helps sustain clean air and water, and provides benefits to people and wildlife (Benedict and McMahon 2006).

Green Infrastructure (GI) is a term which has grown in use in recent years. Although definitions vary, most stakeholders agree that green infrastructure is a network of multi-functional open and green space in and around towns and cities – the gardens, trees, rivers, woodland, parkland, nature reserves and urban wildspace, and the access to and through them, which support wildlife and biodiversity, provide recreation, access and leisure opportunities and create a sense of place.

According to State of Georgia Department of Community Affairs, a 'Green Infrastructure Network' means *"a strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that benefits wildlife and people, supports native species, maintains natural ecological processes, sustains air and water resources, links urban settings to rural ones, and contributes to the health and quality of life for the communities and citizens sharing this network. The network should encompasses a wide range of elements, including: natural areas - such as wetlands, woodlands, waterways, and wildlife habitat; public and private conservation lands - such as nature preserves, wildlife corridors, greenways, and parks; and public and private working lands of conservation value – such as forests, farms, and ranches. It should also incorporate outdoor recreation and trail networks".*

Source: DCA Rules Chapter 110-12-4-.03(1)(g)

Coastal Georgia's Green Infrastructure network as currently defined in the Regional Plan of Coastal Georgia follows the landscape scale definition of green infrastructure by defining the network as *"a natural life support system of parks and preserves, woodlands and wildlife areas, wetlands and waterways, greenways and other natural areas all with conservation value".*

The Concept of Green Infrastructure

1. Elevates air, land, and water to an equal footing with built infrastructure.
2. Transforms open space from "nice to have" to "must have."
3. Helps frame the most efficient location for development and growth -and related gray infrastructure.

Source: The Conservation Fund

It further states, *"A potential impact as a result of premature or poorly planned conversion of land to other uses is the failure to adequately protect and conserve natural resources such as wetlands, flood plains, native vegetation, lakes, streams, rivers, natural groundwater aquifer recharge areas, and other significant natural systems. The river corridors, floodplains and tributary streams are considered to be critical green*

infrastructure components, as they supply key social, economic and environmental benefits for local communities and provide important habitats for wildlife".

Green Infrastructure is therefore a concept that highlights the importance of the natural environment in decisions about land-use planning. In particular there is an emphasis on the "life support" functions provided by a network of natural ecosystems, with an emphasis on interconnectivity to support long-term sustainability.

The United States Environmental Protection Agency (EPA) has extended the concept to apply to the management of stormwater at the local level through the use of natural systems, or engineered systems that mimic natural systems, to treat polluted runoff. This use of the term "green infrastructure" to refer to urban "green" best management practices (BMPs), although not central to the larger concept, does contribute to the overall health of natural ecosystems.

The EPA definition is closely related with Low Impact Development strategies such as the Green Growth Guidelines developed by Georgia DNR. The Green Growth Guidelines define Green Infrastructure as both a process and a product, consistent with Benedict and McMahons' opinions. Both uses of the term have in common a basic recognition that our built environment and our ecological environment are connected and interrelated.

http://www.coastalgadnr.org/cm/green/guide

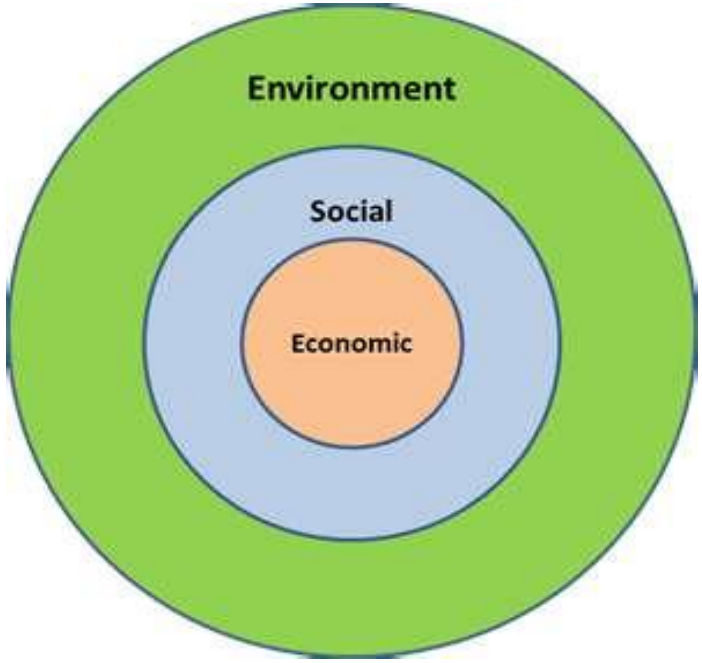
.

Benefits of Green Infrastructure

A comprehensive, proactive, green infrastructure approach to land conservation and development provides numerous, immediate benefits to communities within a region. Green Infrastructure networks can protect critical habitats and the necessary connections between them, thus conserving biodiversity. Green infrastructure helps sustain forests, farms and working lands and allows natural systems to remain functioning; this in turn saves millions of dollars in flood mitigation, water purification, and a host of other savings resulting from avoiding expensive, man- made solutions.

Green infrastructure provides the populous with mental and physical health benefits derived from simply living near and surrounded by healthy natural areas. Green infrastructure provides opportunities for outdoor recreation and protects valuable amenities that attract tourist dollars to the area. Green Infrastructure also helps to direct growth away from areas prone to forest fires, floods and other natural hazards, saving lives, as well as millions of dollars associated with recovery and rebuilding. Finally, by providing a predictable level of certainty about growth and the pattern of development, green infrastructure helps reduce opposition to development and mediate opposing viewpoints of 'developers' and 'conservationists'. Communities that want more housing, more jobs and more open space can use green infrastructure to achieve all these goals.

Green infrastructure has its roots in such wide ranging disciplines and studies as ecology, conservation biology, biogeography, landscape ecology, conservation geographic information systems, urban and regional planning and landscape architecture to name a few. Because of its diverse foundations, green infrastructure provides an equally diverse set of public and private functions and values that address both natural and human needs that benefit the environment



and communities. Green infrastructure systems help protect and restore naturally functioning ecosystems and provide a framework for future development. In doing so, it provides a diversity of ecological, social, and economic functions and benefits that promote the triple bottom line inherent in any discussion of sustainability.

The sustainability pyramid illustrates how viable ecosystems preserved as green infrastructure serve a society's foundation by providing the natural resources that support our human systems and man-made surroundings. A variety of natural processes interact to create a healthy environment and allow us to harvest the food we eat and obtain the raw materials to build our communities.

Well planned green infrastructure has also been shown to increase property values and decrease the costs of public infrastructure and public services, including the costs for stormwater management and water treatment systems.

A focus on permanent protection of green infrastructure provides multiple, additional benefits:

- It provides a balance to protecting land for recreation and agriculture with protection of ecological services;
- It ensures the continuation of natural services that help clean the air and water;
- It supports Georgia's economy, especially the forest products industry, seafood industry, nature tourism, and outdoor recreation.
- It reduces the need for expensive stormwater management, flood control, and restoration projects by protecting water resources including streams, wetlands, and riparian corridors.

Figure 2- Sustainability Pyramid: illustrating the inherent dependability upon the environment and ecosystem services.

Why Is Green Infrastructure Planning Important?

- Supports working lands (farms and forest) and the landscapes for tourism
- Prioritizes limited financial resources wisely
- Helps a community or region visualize its future
- Provides more information to decision makers to improve outcomes
- May help with compliance with regulatory review and requirements
- Provides predictability and a level playing field for both developers and conservationists
- Supports ecosystem services that provide benefits to communities without additional financial investment
- Makes communities more disaster resistant by using the landscape to protect communities from flooding and focusing development in appropriate areas
- Supports biodiversity and facilitates ecotourism
- Supports a high quality of life, attracting businesses and retirees.

The protection of green infrastructure also builds upon existing conservation programs by:

- Conserving and connecting large contiguous areas of natural land, containing important natural resources;
- Providing a focal point to coordinate existing conservation programs and increase their overall effectiveness; and
- Guiding and coordinating land conservation and preservation efforts.

Developers, private landowners and others benefit from having a clear understanding of where the most ecologically valuable lands are located, and where targeted conservation activities will be directed. Citizens interested in increased stewardship activities will know where their efforts are most needed. Land planners, policy makers and developers can use the green infrastructure maps as a reference in the development of site plans and management objectives.

Using green infrastructure maps and data, local governments can enhance their efforts to provide open space, recreation lands, and natural areas that retain the unique character of their communities and rural landscapes. This can complement their efforts to direct growth to specified areas.

Private land trusts can also benefit. Conservation groups, and their members, will find that focusing on green infrastructure will give them a greater overall impact. It not only identifies large blocks of habitat and linkages, it gives a sense of how each given place fits into the larger landscape.

Urban Forestry

Urban forests provide enormous environmental, social, and economic benefits. In addition to aesthetics, urban forests conserve natural ecosystems and sustain clean air and water. They reduce stormwater runoff, cool the urban heat island,

reduce air pollution, and provide wildlife habitat. Yet the tree canopy in many U.S. metropolitan areas has declined significantly over the last few decades due to increased urbanization.

Some benefits of trees are obvious: shade from the sun, habitat for wildlife, windbreaks, attractive landscaping, glare and reflection reduction, and sources of some medicines. Other services, while not as obvious, are equally important. Studies have shown that trees can reduce stress, and that views of trees can speed the recovery of surgical patients. All other things being equal, school campuses that have trees have higher graduation rates than those without them.

Figure 1 'The Senator' Pond Cypress, Sanford, FL

Research has also shown that greener urban areas encourage more healthy social interaction between adults and children, as well as lower levels of graffiti, property crime, and violent crime. Tree-shaded sidewalks encourage pedestrian activity – getting people to walk a few blocks rather than drive gives a city a friendlier atmosphere. Suburban and rural children still build tree houses in them. Urban areas tend to become concrete, glass, and steel islands of heat in summer, but trees and other plants help keep things more comfortable by providing shade and evaporation to lower temperatures.

Social Benefits

We like trees around us because they make life more pleasant. Most of us respond to the presence of trees beyond simply observing their beauty. We feel serene, peaceful, restful, and tranquil in a grove of trees. We are "at home" there. Hospital patients have been shown to recover from surgery more quickly when their hospital room offered a view of trees. The strong ties between people and trees are most evident in the resistance of community residents to removing trees to widen streets. Or we note the heroic efforts of individuals and organizations to save particularly large or historic trees in a community.

The stature, strength, and endurance of trees give them a cathedral-like quality. Because of their potential for long life, trees frequently are planted as living memorials. We often become personally attached to trees that we or those we love have planted.

Communal Benefits

Even though trees may be private property, their size often makes them part of the community as well. With proper selection and maintenance, trees can enhance and function on one property without infringing on the rights and privileges of neighbors.

City trees often serve several architectural and engineering functions. They provide privacy, emphasize views, or screen out objectionable views. They reduce glare and reflection. They direct pedestrian traffic. They provide background to and soften, complement, or enhance architecture.

Environmental Benefits

Trees alter the environment by moderating climate, improving air quality, conserving water, and harboring wildlife. Climate control is obtained by moderating the effects of sun, wind, and rain. Radiant energy from the sun is absorbed or deflected by leaves on deciduous trees in the summer and is only filtered by branches of deciduous trees in winter. Trees should be planted on the south side of buildings to take full effect of the sun's radiant energy during winter months. Wind speed and direction can be affected by trees. The more compact the foliage on the tree or group of trees, the greater the influence of the windbreak. The downward fall of rain, sleet, and hail is initially absorbed or deflected by trees, which provides some protection for people, pets, and buildings. Trees intercept water, store some of it, and reduce storm runoff and the possibility of flooding.

Trees Compliment Smart Growth

- Strengthen the urban core by enhancing public spaces and the pedestrian experience.
- Give people access to nature in the city.
- Add visual relief to compact development and enhance street design.
- Support a mix of land uses that increases real estate values and supports the local economy.
- Create an interconnected framework of green infrastructure that restores ecological function, biodiversity, and wildlife habitat.

Source: Smart Growth Network

Dew and frost are less common under trees because less radiant energy is released from the soil in those areas at night.

Temperature in the vicinity of trees is cooler than that away from trees; the larger the tree the greater the cooling. By using trees in the cities, we are able to moderate the heat-island effect caused by pavement and buildings in commercial areas.

Air quality can be improved through the use of trees, shrubs, and turf. Leaves filter the air we breathe by removing dust and other particulates. Rain then washes the pollutants to the ground. Leaves absorb carbon dioxide from the air to form carbohydrates that are used in the plant's structure and function. In this process, leaves also absorb other air pollutants—such as ozone, carbon monoxide, and sulfur dioxide—and give off oxygen.

By planting trees and shrubs, we return to a more natural, less artificial environment. Birds and other wildlife are attracted to the area. The natural cycles of plant growth, reproduction, and decomposition are again present, both above and below ground. Natural harmony is restored to the urban environment.

Economic Benefits

Individual trees and shrubs have value, but the variability of species, size, condition, and function makes determining their economic value difficult. The economic benefits of trees can be both direct and indirect. Direct economic benefits are usually associated with energy costs. Air-conditioning costs are lower in a tree-shaded home. Heating costs are reduced when a home has a windbreak. Trees increase in value from the time they are planted until they mature. Trees are a wise investment of funds because landscaped homes are more valuable than non-landscaped homes. The savings in energy costs and the increase in property value directly benefit each home owner.

The indirect economic benefits of trees are even greater. These benefits are available to the community or region. Lowered electricity bills are paid by customers when power companies are able to use less water in their cooling towers, build fewer new facilities to meet peak demands, use reduced amounts of fossil fuel in their furnaces, and use fewer measures to control air pollution. Communities also can save money if fewer facilities must be built to control storm water in the region. To the individual, these savings are small, but to the community, reductions in these expenses are often in the thousands of dollars.

Trees Require an Investment

Trees provide numerous aesthetic and economic benefits but also incur some costs. You need to be aware that an investment is required for trees to provide the desired benefits. The biggest cost of trees and shrubs occurs when they

are purchased and planted. Initial care almost always includes some watering. Leaf, branch, and whole tree removal and disposal can be expensive.

To function well in the landscape, trees require maintenance. Corrective pruning and mulching gives trees a good start. Shade trees, however, quickly grow to a size that may require the services of a professional arborist. Arborists have the knowledge and equipment needed to prune, spray, fertilize, and otherwise maintain a large tree.

Forests and Fires

Forest ecosystems are dynamic and complex. A disturbance to any part of the network can upset the delicate balance of relationships, and affect the entire ecosystem. Fire is unique in that it can be either a beneficial natural process or a devastating catastrophe.

A periodic burning can actually contribute to overall forest health. Because wildfires are a natural occurrence, many plants have adapted to them. In fact, some species can't survive without fire. For example, longleaf pines need the heat produced by wildfires to crack their cones open and release seeds for germination. Without this degree of heat, lodgepole pines would not be able to reproduce. Yet again, a careful balance is necessary. A fire that burns too intensely can still destroy the trees; cones, seeds, and all.

For quite some time, the United States' federal fire policy focused on suppressing all fires in national forests to protect timber resources and rural communities. However, decades of fire exclusion have resulted in unusually dense forests in many areas, actually increasing the risk of intense wildfires. As suppression proved to often be more damaging than beneficial, federal policy turned to more practical measures, such as prescribed burns and forest thinning. Even these, however, must be practiced carefully to avoid damage to the ecosystem by artificially providing a process that would occur naturally.

US Forest Service Programs:
- Forest Legacy
- Forest Stewardship
- Forest Health Protection
- Fire Prevention and Control
- Urban and Community Forestry

Competitive grants available through State Forestry Agencies: www.stateforesters.org

With federal support, State Forestry Agencies assist communities to:–Establish and sustain tree care programs.–Improve management of trees & forests.–Engage and educate

the public.–Grants for inventory, assessment, planning and implementation (some states).

NETWORK DESIGN

Green infrastructure is strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations.

The foundation of green infrastructure networks are their natural elements – woodlands, wetlands, rivers, grasslands – that work together as a whole to sustain ecological values and functions. Healthy functioning natural or restored ecological systems are essential to ensure the availability of the network's ecological services.

Once the foundation is identified, additional elements and functions can then be added to the network, depending on the desires and needs community – working lands, trails and other recreational features, cultural and historic sites. These all can be incorporated into green infrastructure networks that contribute to the health and quality of life.

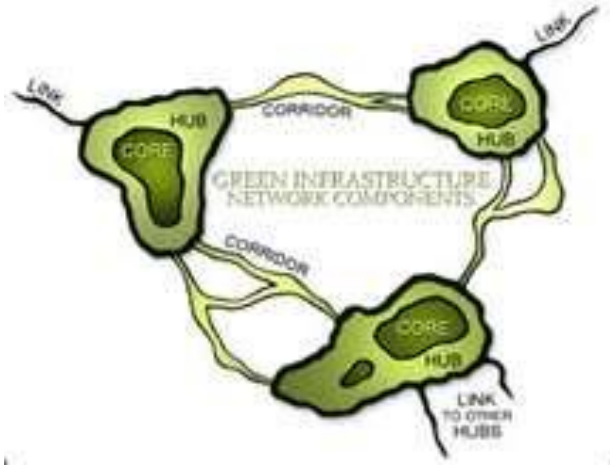
Green Infrastructure at Multiple Scales

While green infrastructure planning occurs at a broad 'landscape scale,' elements of the over-arching network can be found at all scales, from state-wide, to the county, city, and parcel/site scale. Critical elements of the implementation strategy, such as low-impact development practices (LID), conservation developments, green/grey interface, etc. are necessary components to any successful green infrastructure plan, and are frequently found at the smaller, site/parcel scale.

Ten Key Principles of Green Infrastructure

1. **Connectivity is key:** Conservation Biology has demonstrated that linkage is essential for natural systems to function properly and for wildlife to thrive. The strategic connection of ecosystem components is critical to maintaining the values and services of natural systems and to maintaining the health and diversity of wildlife populations. Linkages among the staff and programs of different agencies involved in green infrastructure planning is also vital to success.
2. **Context matters:** Understanding and predicting change in native ecosystems and landscapes require analysis of the context in which ecosystems exist- the biological and physical factors of the surrounding area. Landscape ecology emphasizes that nothing occurs in a vacuum and that the study of content alone is not sufficient when dealing with natural systems
3. **Green infrastructure should be grounded in sound science and land-use planning theory and practice:** Drawing from the theories and practices of disciplines such as conservation biology, landscape ecology, urban and regional planning, landscape architecture, geography and civil engineering ensures an appropriately balanced and integrated ecological, cultural, social and practical foundation for any green infrastructure initiative.

4. **Green infrastructure can and should function as the framework for conservation and development:** By prioritizing green infrastructure, a community can plan for conservation needs and determine where to direct new growth and development in the most efficient manner. Green infrastructure provides the framework for future growth while ensuring significant natural resources are preserved for future generations.
5. **Green infrastructure should be planned and protected before development:** Green infrastructure planning identifies critical ecological hubs and linkages in advance of development. This helps to ensure that restoration, which is more expensive and less efficient than natural protection, is minimized in lieu of protection.
6. **Green infrastructure is a critical public investment that should be funded up front:** Green infrastructure should be planned, designed and funded following the same approaches used for built infrastructure such as roads, bridges, waterlines, etc.
7. **Green infrastructure affords benefits to nature and people:** Numerous benefits arise from a green infrastructure approach, including reducing the need for gray infrastructure, freeing public funds for other community needs and reducing susceptibility to floods, fires, and other natural disasters.
8. **Green infrastructure respects the needs and desires of landowners and other stakeholders:** Green infrastructure does not require all land to be in public ownership or control. Green infrastructure should be presented as a concept that will help plan development and should consider the perspectives of various stakeholders in the public, private and non- profit sectors.
9. **Green infrastructure requires making connections to activities within and beyond the community:** Green infrastructure affords opportunities for and can build on programs related to everything from Smart Growth to historic heritage, to outdoor recreation, to brownfield development, to flood mitigation. Green infrastructure sees beyond political boundaries to focus on the natural landscape as an ecological whole.
10. **Green infrastructure requires long- term commitment:** Green infrastructure plans and documents should be considered strategic "living" documents for updating and amending. This includes remaining flexible and longsighted in funding mechanisms and opportunities.



KEY DESIGN ELEMENTS (McMahon & Benedict, 2006)

HUBS anchor green infrastructure networks and provide an origin or destination for wildlife and ecological processes moving to or through it.

Hubs come in all shapes and sizes, including:

- RESERVES — Large protected areas, such as national and state parks and wildlife refuges;
- MANAGED NATIVE LANDSCAPES — Large publicly owned lands, such as national and state forests, managed for resource extraction as well as natural and recreational values;
- WORKING LANDS — Private farms, forests, and ranches that are managed for commodity production yet remain in a predominantly open and undeveloped state;
- REGIONAL PARKS AND
- PRESERVES — Less extensive hubs of regional ecological significance; and
- COMMUNITY PARKS AND NATURAL AREAS — Smaller parks and other sites at the community level where natural features and ecological processes are protected and/or restored.

LINKS are the connections that tie the system together and enable green infrastructure networks to work. They range in size, function and ownership, including:

- LANDSCAPE LINKAGES — Large protected natural areas that connect existing parks, preserves, or natural areas and provide sufficient space for native plants and animals to flourish while serving as corridors connecting ecosystems and landscapes. Landscape linkages may also provide space for the protection of historic sites and opportunities for recreational use;
- CONSERVATION CORRIDORS — Less extensive linear protected areas, such as river and stream corridors that serve as biological conduits for wildlife and may provide recreational opportunities;
- GREENWAYS — Protected corridors of land managed for resource conservation and/or recreational use;
- GREENBELTS — Protected natural lands or working lands that serve as a framework for development while also preserving native ecosystems and/or farms or ranchland; and
- ECOBELTS — Linear woody buffers that can ease the zone of tension between urban and rural land uses while providing ecological and social benefits for urban and rural residents.

Existing Plans

The Georgia Planning Act of 1989 provides a foundation for many green infrastructure related initiatives in the State. Of primary mention is the Regionally Important Resource program which establishes procedures for Regional Commissions to follow in order to identify Regionally Important Resources statewide. The outcome is an RIR Plan that recommends best practices for use in managing these important resources.

- Regional Plans
  Enabling legislation: The Georgia Planning Act of 1989 DCA Chapter 110-12-6
- Regionally Important Resources
  Enabling legislation: The Georgia Planning Act of 1989 DCA Chapter 110-12-4)
- County and City Comprehensive Plans
  Enabling legislation: The Georgia Planning Act of 1989 DCA Chapter 110-12-1)

Relevant past projects in Georgia include:

- Environmental Corridor Study- 1977- GADNR
- Georgia Trail Corridors and Greenways Plan- 1993- GADNR
- Coastal Georgia Land Conservation Initiative

Existing Model ordinances/ guidelines

- www.crc.ga.gov/planning/qg/default.aspxGreen Growth Guidelines
- Coastal Stormwater Supplement
- Transfer of Development Rights
- Purchase of Development Rights
- Planned Unit Developments
- Conservation Subdivisions

Rules of Georgia Department of Natural Resources Environmental Protection Division (See Map 6.)

Chapter 391-3-16: Rules for Environmental Planning Criteria

- 391-3-16-.01 Criteria for Water Supply Watersheds
- 391-3-16-.02 Criteria for Protection of Groundwater Recharge Areas
- 391-3-16-.03 Criteria for Wetlands Protection
- 391-3-16-.04 Criteria for River Corridor Protection

State Wildlife Action Plan

http://www.georgiawildlife.com/conservation/wildlife-action-plan

- Identifies species and habitats most at risk in Georgia, explores methods for recovery and restoration.

- Prioritized 78 actions to address the conservation needs of these species and habitats.

Green Infrastructure Planning Topics

The term green infrastructure was selected to emphasize its difference from traditional conservation practices and the need to change several popular perceptions about green space planning and protection.

Where-as green space is often viewed as something that is nice to have, the term green infrastructure implies something that we must have. Protecting and restoring our nation's natural life support system is a necessity, not an amenity.

Where-as green space is often thought of as isolated parks, recreation sites or natural areas, the term green infrastructure emphasizes interconnected systems of natural areas and other open spaces that are protected and managed for the ecological benefits they provide to people and the environment.

Where-as green space is often viewed as self-sustaining, the term green infrastructure implies something that must be actively maintained and at times restored.

Integrated Regional Planning Strategies

Green infrastructure planning adheres to the Vision of the *Regional Plan of Coastal Georgia*. In furtherance of the growth leadership initiatives outlined in the Regional Plan of Coastal Georgia, Green Infrastructure Planning is a proactive approach to plan for future growth that is both sustainable and environmentally friendly.

Since Green Infrastructure is a sub- category of Areas of Significant Natural Resources under the Areas Requiring Special Attention (ARSA) section of the Regional Plan, specific implementation measures are necessary for a successful green infrastructure program.

Patterns: Green Infrastructure

Patterns of Development refer to the spatial organization of developed lands. Patterns refer to the location, intensity, and variety of land uses.

Green infrastructure planning provides an alternative to what is common practice in many communities: conserving land on a piecemeal basis without the benefit of a large framework plan that allows a comprehensive approach to land conservation.

Areas of protected open space should follow natural features for recreation and conservation purposes,

including greenways that link ecological, cultural and recreational amenities.

Green Infrastructure shall be considered first in the planning process and in reviewing comprehensive plans, zoning, development review processes and performance standards.

Preservation: Green Infrastructure

Preservation refers to the systematic protection of land for natural resource management, wildlife habitat, parks and recreation and working lands. The long-term preservation of natural resources, open spaces and agricultural lands is an enduring legacy.

Principles for green infrastructure include identifying what is to be protected in advance of development; providing for linkage between natural areas; and designing a system that operates at different functional scales, across political jurisdictions, and through diverse landscapes. Additional principles include sound scientific and land use planning practices, providing funding upfront as a primary public investment (for example, through a dedicated tax or other funding mechanism), emphasizing the benefits to people and nature, and using the green infrastructure as the planning framework for conservation and development.

The concept of green infrastructure planning is based on a strategic approach to ensuring environmental assets of natural and cultural value are integrated with land development, growth management and built infrastructure planning at the earliest stage.

Passages: Green Infrastructure

Passages refer to the ways in which places are connected. Passages can take the form of transportation systems, greenways, water systems, or anything that links people.

Green space or greenway land needs to be set aside for pedestrian, equestrian, and bicycle connections between schools, churches, recreation areas, city centers, residential neighborhoods, and commercial areas.

Open-space, parks, trails, greenways, and natural undeveloped land are not individual but an integrated and organized system. Green infrastructure is as an interconnected system.

Key physical, natural, ecological, landscape, historical, access and recreational assets contribute to the functionality of the green infrastructure network.

The green infrastructure network weaves together a network of recreational and nature areas.

Properly planned greenways provide efficient pedestrian linkages that can serve as alternative transportation to and from work, to services and other daily destinations.

Greenway linkages serve as outdoor recreation for biking, walking, and jogging.

Green infrastructure encourages the creation of transportation corridors and connections, which can foster ecotourism, tourism and outdoor recreation.

Places: Green Infrastructure

Places not only seek to safeguard intrinsic qualities of Coastal Georgia but also focus investment with existing infrastructure.

Green infrastructure planning provides multiple benefits. A benefit to a developer is greater certainty and predictability about where development can go because the lands to be protected, how they are to be protected, and the best locations for development are laid out in advance.

The public benefits from cleaner air and water and because highly valued natural and water resources and processes, parks, and greenways are protected. Green infrastructure can also be used to provide urban services more efficiently and at a lower cost (for example, retention and treatment of stormwater and provision of areas for recreation).

Proper due diligence in creating a green infrastructure network aids in the land development process by proactively identifying areas to be left undisturbed while identifying areas for development.

Coastal Georgia's Green Infrastructure network preserves and supports biodiversity and functional ecosystems.

Green infrastructure protects native plant and animal species and lessens the disruption to natural landscapes.

Green infrastructure supports the implementation of stormwater management plans and regulations.

Smart Growth

In recent years, an increasing number of communities have attempted to better plan development through smart growth initiatives.

Smart growth has been defined as development that is economically sound, environmentally friendly and supportive of community livability — growth that enhances our quality of life.

Certainly the sprawl that has resulted from our growing dependence on the automobile and the haphazard spread of strip malls and nondescript subdivisions is not smart growth. Smart growth advocates point out that we can have development that is more attractive, more efficient, more affordable and more environmentally sensitive than much of what has been built since World War II.

Studies show that the pace of land development far exceeds the rate of population growth in America. This suggests that the problem is not growth itself, but the pattern of growth; in other words, where we put it, how we arrange it, and how growth impacts natural and cultural resources.

Simply put, some places are better for development than other places. The first principle of better development is figuring out where we should not develop. Green infrastructure planning can help communities figure this out. Taken together, smart growth initiatives and green infrastructure planning are two sides of the same coin. Communities need to make better use of existing infra-structure and to encourage more compact, walkable, mixed use communities; they also need a framework for shaping where growth will go. This can be provided by green infrastructure.

Smart Conservation

Smart growth programs are designed to address the problems of haphazard development and sprawl. Likewise, we also need smart conservation programs to strategically direct conservation practices. Smart conservation promotes resource planning, protection, and management in a way that is:

- proactive not reactive;
- systematic not haphazard;
- holistic not piecemeal;
- multi-jurisdictional not single jurisdictional;

- multifunctional not single purpose; and
- multiple scales not single scale.

Green infrastructure offers a smart solution to our land conservation challenges because it seeks to plan land development and land conservation *together* in a way that is consistent with natural environmental patterns. In doing this, green infrastructure promotes both smart growth and smart conservation.

Transportation Planning and Green Infrastructure

Green infrastructure plans are helping transportation agencies meet federal guidelines for consultation, use of natural resource inventories, and consideration of environmental mitigation as specified in section 6001 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) legislation enacted in 2005. The regional vision proposed by a green infrastructure plan outlining hubs and corridors for the system is exactly the type of information that transportation agencies currently seek as part of their requirements to identify potential mitigation areas as part of the long-range planning process. In addition, the Federal Highway Administration (FHWA) advocates this approach as part of the Planning and Environmental Linkages initiative and as part of the Eco-Logical framework espousing the need for goal-driven, ecosystem-based mitigation.

Forestry Management

Forestry is the only land use practice in the state that monitors BMP implementation through random stratified surveys. The Statewide Water Management Plan recognizes GFC's Water Quality Program as a model for other land-use organizations.

Sustainable Forest Management in Georgia

The Forest Legacy Program protects environmentally important working forests threatened by conversion to non-forest uses. The program allows for the donation and/or purchase of conservation easements or fee simple land from willing participants who wish to keep the land in forestry use. Landowners may continue to own their land or sell it to someone who wants undeveloped forestland. The State holds title to the Forest Legacy conservation easements and provides technical advice to landowners. Landowners who donate a conservation easement are eligible for certain Federal and State income tax credits. Priority is given to lands that can be effectively protected and managed. Georgia has identified areas that have multiple public benefits such as water quality protection, key wildlife habitat, and outstanding recreation opportunities or scenic views, while providing the opportunity to continue traditional forest uses such as timber harvesting and wildlife management. Landowners continue to own their land and use the property at their discretion. Public access is not required, but can be allowed if the landowner

chooses. A written forest management plan is developed by the GFC to address the landowner's specific goals.

Working Forest Conservation Easements (WFCEs) do more than strip specified development rights from a property. Traditional conservation easements, sometimes called "open space," "no build," or "scenic"easements, remove landowners' rights to engage in certain activities, such as mining, subdivision, and residential and commercial development. These easements may not mention forestry at all, or may simply allow timber harvesting according to "good practices" with no additional detail. A WFCE adds language that guides forest management in order to protect specified forest values. WFCEs can protect property-specific forest values by prohibiting damaging forest practices and encouraging management practices that promote a desired forest type. WFCEs can also protect landscape values by encouraging management of a forest in relation to its surroundings. Further, WFCEs can address broader societal goals, such as sustaining a forest economy and the regional community that depends upon it, by protecting the productive forest base. WFCEs can enable landowners to continue to derive economic value from the land to support the ongoing costs of ownership and stewardship.

The Georgia Forestry Commission administers the Forest Legacy Program through a grant from the USDA Forest Service State and Private Forestry branch. For the purchase of easements or land, grants are awarded on a competitive basis and are based on a national priority ranking of projects. Any interested landowner can contact their local Georgia Forestry Commission office to obtain further information.

Georgia Statewide Forest Resources Strategy 2010

The *Georgia Statewide Forest Resources Strategy* was developed on the basis of the *Georgia Statewide Assessment of Forest Resources* by identifying landscapes and projects where an investment of federal competitive grant funding could most effectively accomplish goals or leverage desired action.

The Georgia Forestry Commission identified the primary issues related to Georgia's forests. The issues ranked in order of importance as communicated by stakeholders are:

1) Water quality and quantity
2) Urbanization
3) Forest health
4) Biodiversity
5) Air quality
6) Fire management
7) Fragmentation and parcelization
8) Economics and changing markets

To meet the challenges posed by these complex issues across the state, geospatial analyses were used to identify priority areas in which to focus cooperative program work. With an integrated and strategic approach, the GFC has developed goals, objectives and strategies to address each primary issue in identified priority areas. To address critically important program functions not addressed under Strategic Issues, the State Forestry Programs section provides a more comprehensive description of how the GFC will prioritize work to address Georgia's issues.

Those programs are:
1) Fire Management
2) Forest Health
3) Forest Legacy
4) Forest Stewardship
5) Urban and Community Forestry
6) Water Quality
7) Forest Utilization and Marketing
8) Reforestation

By identifying critical forestry issues and resolving them with knowledge, resources and targeted programs, the Georgia Forestry Commission can conserve and protect working forests while enhancing the myriad benefits of Georgia's 24 million acres of trees.

Georgia Land Conservation Partnership Plan 2004

The Plan proposes a framework that recognizes that land can provide critical benefits to society and can function as a "green" infrastructure. Thus, the heart of the Plan is to identify lands that provide the environmental benefits needed to sustain a high quality of life and a sound economy in Georgia. The most important benefits that conservation lands can provide include:

- Clean and abundant water;
- Clean air;
- Biodiversity;
- Cultural identity; and
- Outdoor recreation and education.

GREENWAYS AND TRAILS

The Georgia Department of Natural Resources has established the Colonial Coast Birding Trail. This Trail runs through the Georgia's six coastal counties. Sites along the trail offer a variety of coastal birding habitats, along with many historical and cultural sites.

For more information on the Colonial Coast Birding Trail, visit: http://www.georgiawildlife.com/node/1356

Coastal Georgia Greenway

The Coastal Georgia Greenway (CGG) lies within Bryan, Camden, Chatham, Glynn, Liberty, and McIntosh counties. In 2009, the 15 jurisdictions through which the greenway passes adopted the route within each jurisdiction. All six counties are within the area served by the Coastal Georgia Regional Commission.

The CGG calls for a 158.31-mile long facility through coastal Georgia connecting to the East Coast Greenway in South Carolina and Florida. The East Coast Greenway is a proposed continuous bicycle and pedestrian facility from Calais, Maine to Key West, Florida.

The Coastal Georgia Greenway route, as adopted, predominantly follows US Highway 17. Some of these segments are proposed to be shoulder bikeway, while others are proposed to be developed as shared use path within the US Highway 17 right of way as shown on the map 6. The spine route greenway consists of 65.9-miles of on-road segments (42 percent) and 92.41-miles of off-road segments (58 percent). The proposed on-road segments generally are 5 to 6-foot wide paved shoulders on both sides of the existing road. There are some On-road segments that are just signed. The off-road segments of the proposed greenway are 10-foot wide shared-use paths. In many instances, the new bridges are located on the old roadbed bridge approaches. Several spur segments are also included in the greenway.

Some of the segments of the Coastal Georgia Greenway (spine route) do not follow Highway 17.

For more information on the Coastal Georgia Greenway visit: www.coastalgeorgiagreenway.org

Multiple agencies and parties are responsible for Land Conservation in Coastal Georgia, some of these include:

- **US Army Corps of Engineers:** www.usace.army.mil
- **United States Marine Corps:** www.marines.com
- **U.S. Fish and Wildlife Service:** www.fws.gov
- **U.S. Department of Defense:** www.defense.gov
- **The Georgia Conservancy:** www.georgiaconservancy.org
- **The Nature Conservancy:** www.nature.org
- **The Conservation Fund:** www.conservationfund.org
- **St. Simons Land Trust:** www.sslt.org
- **Southeast Regional Land Conservancy:** www.serlc.org
- **Wildlife Conservation Society (WCS):** www.wcs.org
- **Natural Resources Conservation Service:** www.nrcs.usda.gov
- **National Wild Turkey Federation:** www.nwtf.org
- **National Park Service:** www.nps.gov
- **Jekyll Island Authority:** www.jekyllislandauthority.org
- **Girl Scouts of the USA:** www.girlscouts.org
- **Georgia Land Trust:** www.galandtrust.org
- **Georgia Department of Natural Resources:** www.gadnr.org
- **Georgia Department of Transportation:** www.dot.state.ga.us
- **Audubon Society:** **www.**audubon.org

COMPREHENSIVE PLANNING

In addition to the agencies listed in the previous section, local County governments and municipalities play what may be the most important role in promoting and implementing conservation and Green Infrastructure.

As stewards of Comprehensive planning, local ordinances and zoning, local governments and municipalities have the power to promote, adopt and implement Green Infrastructure on the smallest, yet possibly the most important scale.

An effective strategy recommended in these guidelines is for County (and local) governments to undertake a more refined and in depth analysis and inventory of the Green Infrastructure found within their boundaries. This allows for community involvement and consensus building prior to moving forward.

Inventorying Green Infrastructure and identifying a local GI Network can be tedious. Partners identified in these Guidelines are available for technical assistance and should be contacted early on when undertaking Green Infrastructure endeavors.

The first step is comparing the current local Conservation layer against findings from these guidelines. Using the map series contained herein and the GI network developed as part of this study, community leaders can get a visual picture of where inconsistencies and gaps exist and therefore which areas need to be studied in more depth as it relates Green Infrastructure principles. It is recommended that local counties and governments partner with regional agencies early on when mapping and developing their own GI network; this ensures consistency with Integrated Regional Planning Strategies. Agencies such as the CRC, CRD and GFC are available to provide expert technical assistance to local governments.

Once a local Green Infrastructure Network has been identified, the Future Land Use Map and Comprehensive Plan can be modified to reflect the preferred, altered land use pattern and to identify specific issues and opportunities and strategies, goals and policies regarding Green Infrastructure.

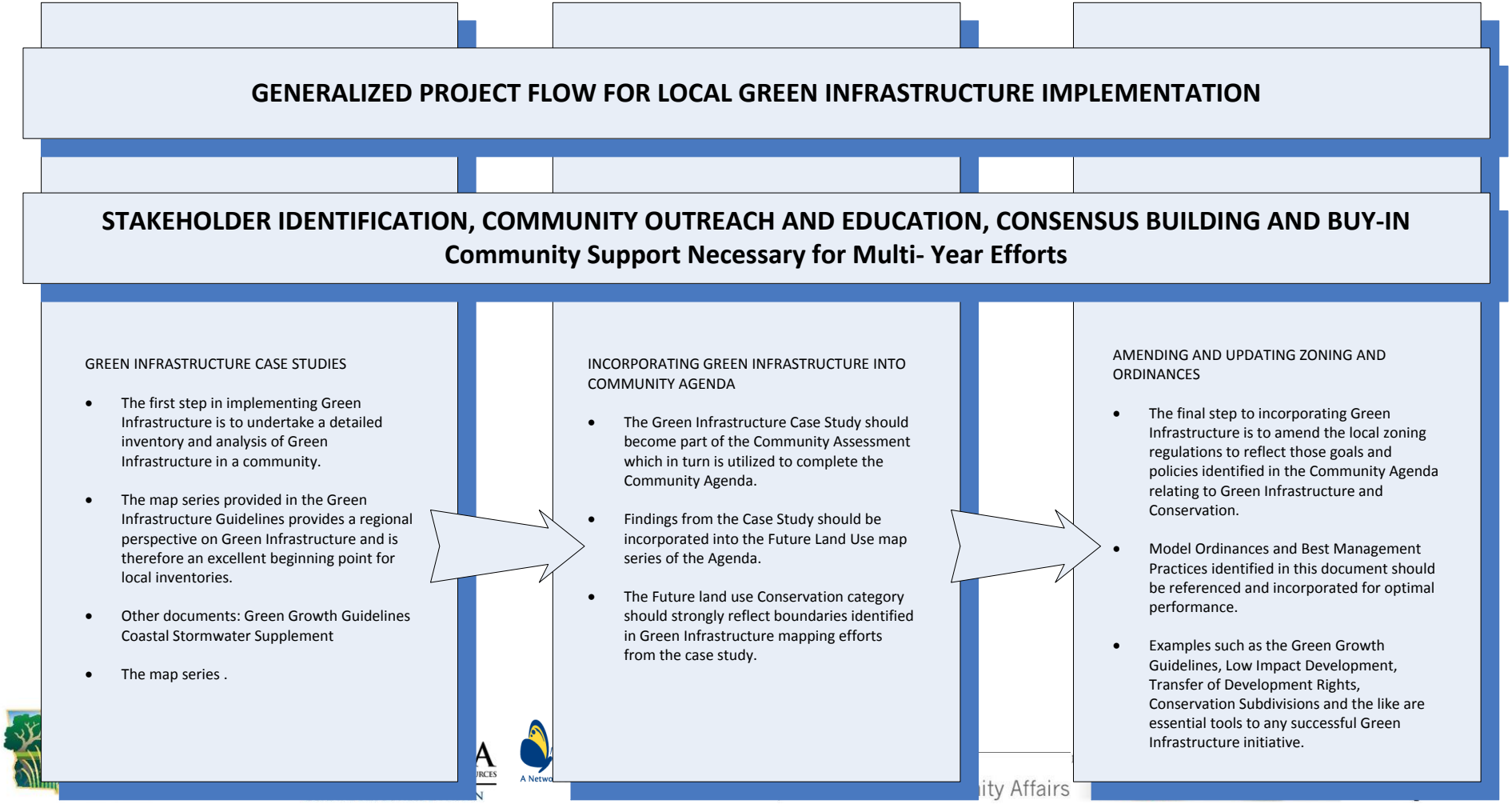
Once the Comprehensive Plan reflects Green Infrastructure principles and policies, it is imperative to review local zoning and ordinances so as to not be in conflict with the revised long range agenda.

Some tools and strategies that can be used locally to promote and strengthen Green Infrastructure principles within local

Comprehensive Plans and zoning ordinances are identified in Appendix A.

The above summary is simplified. In actuality, the process of incorporating Green Infrastructure is a long term process that requires commitment and resolve from multiple levels of a community.

Project flow for Green Infrastructure Implementation should follow the below generalized methodology. Community specific methodology will vary based on a community's specific Green Infrastructure case study, analysis and inventory.



The Southeastern Ecological Framework (SEF)

The Southeastern Ecological Framework (SEF) framework was used as a base layer to identify priority ecological areas upon which to build the regional network identified in these guidelines. It was also utilized as a Quality Assurance/ Quality Control (QAQC) measure to identify consistency between the final Coastal Regional Green Infrastructure Network Elements and the larger, Southeastern Ecological Framework. **See Map 3.**

CONTEXT

The Southeastern Ecological Framework (SEF) is a decision support tool created through systematic landscape analysis of ecological significance and the identification of critical landscape linkages in a way that can be replicated, enhanced with new data, and applied at different scales. It is intended to provide a foundation for the adoption and implementation of effective and efficient conservation measures to minimize environmental degradation and protect important ecosystem services. It has been developed for all eight southeastern states contained within the boundaries of the Environmental Protection Agency Region 4: Florida, Georgia, South Carolina, North Carolina, Alabama, Mississippi, Tennessee and Kentucky by staff of the Planning and Analysis Branch of EPA Region 4 and researchers at the University of Florida. Work on the project began in October 1998 and was completed in December 2001.

The Framework was derived using Geographic Information Systems (GIS), a computer mapping technology that links maps and related information. Data on which the work was built were acquired for the entire region and from individual states within the region. Data availability and consistency is improving rapidly, but is currently somewhat limited for projects of this scale. The land area identified in the Framework represents 43 percent of the land in the eight states. Of that 43 percent, 22 percent is in existing conservation lands, 12 percent in open water (rivers, lakes and reservoirs), 14 percent is in wetlands outside existing conservation lands and 52 percent is in privately held uplands (that include 100 year floodplains).

The identification of linked regional networks of lands critical for conserving natural resources is a key strategy for applying landscape ecology principles in planning efforts to avoid and minimize the degradation of ecological integrity caused by habitat fragmentation. By identifying a large scale, regional conservation framework, it is possible to provide a foundation in which protection of the important ecological properties and

processes can be optimized for multiple benefits at local and regional scales (Noss 1996). Trends in regional conservation during the past 5 years have moved toward regional approaches to natural resource protection in an attempt to address issues of scale and complexity. Many organizations such as the World Wildlife Fund, The Nature Conservancy, and the Trust for Public Land are attempting to develop geographical information system tools for identifying hot spots, priority areas, or the last great remaining places to better facilitate effective conservation.

The Southeastern Ecological Framework represents a similar strategy to identify areas of natural resource conservation significance, or green infrastructure, at a regional scale. The Southeastern Ecological Framework is a first iteration of a region-wide assessment of areas critical for conserving natural resources including important ecological services and biodiversity that will help promote the need for regional conservation assessments and planning and will continue to be improved as more data and assessment techniques are developed in the near future.

GOAL AND OBJECTIVES OF THE SOUTHEASTERN ECOLOGICAL

FRAMEWORK

The following overall project goal and objectives were adopted by the University of Florida team and staff of the Environmental Protection Agency. They served to direct the project, including modeling decisions and weightings based on the data available to address them.

Goal: Use a regional landscape approach to identify an ecologically functional system of areas of ecological significance in the southeastern United States.

Objective A) Include ecological elements that:

- protect ecosystems, landscapes and processes native to the southeastern United States across their natural range of distribution and variation, including coastal, riverine and upland landscapes, while giving special consideration to those inadequately protected by existing conservation programs;
- protect the full range of biodiversity in the southeastern United States, including viable populations of native plant and animal species that are endangered, threatened, rare or otherwise imperiled;
- conserve surficial and groundwater resources for the benefit of the region's native ecosystems, landscapes, residents and visitors;
- incorporate ecologically compatible working landscapes that minimize the impacts of human-built environments on native ecosystems and landscapes;

- incorporate disturbed lands that through restoration will enhance the ecological function of the Regional System.

Objective B) Incorporate functional ecological linkages, including river floodplains, ridgelines and other linear native landscape features that will enhance the ecological viability and manageability of presently isolated biological reserves.

Objective C) Include ecological elements with a mind to their ability to absorb and dissipate the effects of naturally occurring events, such as hurricanes, fire, and flood across the landscape.

Objective D) Maintain ecological and evolutionary processes, such as disturbance regimes, nutrient cycles, biotic interactions and range shifts, by protecting functionally juxtaposed landscape gradients of aquatic, wetland and upland ecosystems.

Identification of Priority Ecological Areas (PEAs) and Significant Ecological Areas (SEAs)

PEAs and SEAs are identified using state and/or regionally available data sets and analyses. PEAs are the areas with the highest ecological significance identified using the best available GIS data and analyses. PEAs are the primary building blocks of the modeling process and are used to identify the larger ecologically significant areas in the region (Hubs) and the best opportunities to maintain ecological connectivity. All of the PEA criteria (See Table 1) are combined into one cumulative PEA dataset where all PEAs are treated equally. PEA data layers represent a variety of criteria that address the identification of areas important for conserving regional biodiversity and ecosystem services. However, they are based on available data and do not represent a complete depiction of all areas that may be important for biodiversity conservation and ecosystem services. Many PEA data layers are based on data and methods used in the FEN modeling process that was developed in consultation with many agencies and experts. Therefore, it was deemed appropriate to incorporate similar methods including thresholds used to delineate PEAs in the SEF modeling process. The identification of PEAs and SEAs and the SEF modeling process in general should be an iterative process that is modified as and ecosystem services.

SEAs are secondary areas that either may be "bumped up" to PEA status in some cases or are used in the landscape linkage identification process. They are other areas within the region that are of ecological significance but are not considered to be as important as PEAs. The SEA criteria are combined into one cumulative grid where all SEA criteria are treated equally.

Priority Ecological Area Exclusion

After PEAs were identified, portions overlapping any areas of incompatible land use, high road density, or negative edge

effect zones were removed. The result, called the PEAX grid, contains the remaining Priority Ecological Areas that do not overlap with incompatible land uses or landscape features.

The features deleted include:
1. All areas of Category III (urban, residential, commercial) and Category II (intensive agriculture) land use.
2. Areas with road densities greater than or equal to 3 miles per square mile that greatly exceed general road density standards for protecting sensitive species (Noss 1992), using all roads except jeep trails within the 1990 TIGER roads data set.
3. All areas within "neighborhoods" with extensive urban land use in 90-meter 3X3, 9X9, and 27X27 windows. All areas with greater than or equal to 60% urban land use within all three window sizes are deleted. These areas were removed based on the high level of influence from intensive land uses that typically results in significantly impaired ecological function and the erosion of biodiversity.
4. All areas within 270 meters of a block of urban land use greater or equal to 100 acres that are close enough to urban areas to be significantly affected by negative edge effects.

For more information on the Southeastern Ecological Framework, visit: www.geoplan.ufl.edu/epa

USGS GAP Analysis Program- Protected Areas Database

The Protected Areas Database (PAD-US) was also used as a base layer to identify potential regional hubs prior to and during mapping analysis of the Green Infrastructure network. It was also utilized as a Quality Assurance/ Quality Control (QAQC) measure to identify consistency between the final Coastal Regional Green Infrastructure Network Elements and the larger, Protected Areas Database. **See Map 4.**

The Protected Areas Database of the United States (PAD-US) is a national geodatabase, created by USGS GAP, that represents public land ownership and conservation lands, including voluntarily provided privately protected areas, for the continental United States, Alaska, Hawaii, Puerto Rico, the Pacific and US Virgin Islands. PAD-US is an inventory of marine and terrestrial protected areas that are defined as being dedicated to the preservation of biological diversity and to other natural, recreation and cultural uses, managed for these purposes through legal or other effective means. The lands included in PAD-US are assigned conservation status codes that both denote the level of biodiversity preservation and indicate other natural, recreational and cultural uses.

Information about the conservation status of common species – the purpose of protected area analyses — is important for decision makers, planners, researchers, private interests and others:

- **Biodiversity**: Protected areas (parks, preserves, etc.) have often been set aside without full understanding of their value to species conservation. As a result, many protected areas have little significance in terms of biodiversity, while many biodiversity-rich areas lack protection. Information provided by the PAD-US Program can help land conservation decision makers better match biodiversity goals to land protection programs and activities.
- **Habitat Loss:** Human population in the U.S. is predicted to grow by 25% in the next 50 years. This population increase, coupled with our land consumption patterns, means that there will be significant decreases in habitat for other species. Efforts to target the most effective lands for biodiversity conservation can offset some or many of the effects of habitat loss.
- **Climate:** Accelerating climate change is elevating the importance of effectively targeted species protection efforts. For many species, warming climates could push them to the brink of extinction unless habitat migration corridors can be set aside. Protected Areas analysis is critical to understanding where to focus such corridor planning.
- **Energy Siting:** Renewable energy projects are growing, as solar and wind farms are planned and built across the U.S., often aided by governmental incentives. Protected area analysis can inform this planning and siting work, helping energy projects to find the best balance between habitat conservation and much-needed energy production.
- **Management:** Agencies and non-profits that manage protected areas often lack good information about the full range of species that might be present or could be encouraged on their lands. The Protected Area Analysis Program can provide tools to improve land management practices that support continued biodiversity.

For more information on the US Geological Survey, Gap Analysis Program (GAP), visit: www.gapanalysis.usgs.gov

MAPPING

The green infrastructure network seeks to identify, protect, restore, and manage natural ecosystem values and functions. The network therefore gives priority to natural ecosystem attributes.

Coastal Georgia's green infrastructure network emphasizes areas of regional (and State) ecological significance based on analysis of upland, wetland and aquatic ecosystems.

The analysis and inventory takes into account presence of large unmodified wetlands, large blocks of contiguous forests, healthy streams and riparian zones, presence of rare, threatened or endangered species, existing conservation lands, prime farmland and compatible agricultural lands, ecologically or environmentally significant soils (GW recharge and Pollution susceptibility,

Mapping Green Infrastructure in Coastal Georgia largely entailed the utilization of existing datasets.

The primary feature layers used in the analysis were as follows:

- DFIRMs
- Soil Data
    - Prime Farmland
    - Pollution Susceptibility
    - Groundwater Recharge Area
- Hydrology Datasets
- Wetlands
- Watersupply Watersheds
- Developed Areas
- Roads
- Habitat Data
- Conservation Lands
- Land Use Data (NLCD)
- Southeastern Ecological Framework
- USGS Gap Analysis Program

The Design goals of the green infrastructure network design were as follows:

1. Conserve critical elements of the Region's ecosystems and landscape
2. Restore and maintain connectivity among native ecological systems and processes.
3. Facilitate the ability of these ecosystems and landscapes to function as dynamic systems
4. Maintain the evolutionary potential of the elements of these ecosystems to adapt to future environmental changes.

The objectives were to

1. Protect ecosystems, landscapes and processes native to Coastal Georgia across their natural range of distribution

and variation, including coastal, riverine, and upland landscapes.

2. Protect biodiversity including viable populations of native plant and animal species that are endangered, threatened or otherwise imperiled
3. Conserve surface and groundwater resources for the benefit of native ecosystems, landscapes, residents and visitors
4. Incorporate ecologically compatible working lands that minimize the impact of natural disturbances such as fire on the human built environment and/ or minimize the impact of human built environments on native ecosystems and landscapes.
5. Incorporate degraded lands through restoration that will enhance the ecological function of the green infrastructure network.
6. Incorporate functional linkages, including floodplains, ridgelines, and other native landscape attributes that will enhance the green infrastructure key network elements.
7. Design the green infrastructure network elements to absorb and dissipate the effects of naturally occurring events such as hurricanes, fires and floods across the landscape whenever necessary.
8. Maintain ecological and evolutionary processes, such as disturbance regimes, biotic interactions and range shifts by protecting functional landscape gradients of aquatic, wetland and upland ecosystems.

Georgia Coast Green Infrastructure Technical Methods

The green infrastructure project builds on the Coastal Georgia Land Conservation Initiative (CGLCI). The CGLCI completed its three-year-long coastal habitat mapping project in 2011. The CGLCI—a unique collaboration of the Department of Natural Resources Wildlife Resources and Coastal Resources Divisions (CRD, the Association of County Commissioners of Georgia, and the Georgia Conservancy—created 11 fine- and course-scale maps of the coastal region that detailed more than 70 different habitat types[1]. To help complete the spatial

[1] This vegetation map was created using the U.S. National Vegetation Classification (USNVC), with alliance and association as base map units. Plot data were used to determine classification and assisted in establishing reference 'signatures' for mapping. Color infrared aerial photography from 1999 and sets of true color aerial photography from 2005-2007 (1:3000 scale) were used for mapping. Polygons were drawn on-screen (heads-up digitizing). One-hundred one land cover categories were mapped. Of these 101 categories, classification of natural vegetation using the USNVC resulted in 22 ecological systems, 51 alliances, and 65 associations. An accuracy assessment was performed using field verification and overall corrected map accuracy was 80.3%.

analysis, DNR partnered with non-profit organization NatureServe.

NatureServe worked in conjunction with DNR, assisting in the development and compilation of regional datasets including information about the conservation elements (species of greatest conservation need and their habitats and representative ecosystem types) and scenarios of current land use, future land use, and areas of potential inundation from global climate change. NatureServe also assisted GADNR with the development of a database of element conservation requirements and probable responses of the conservation elements to the range of existing and proposed land uses. Much of this work was organized inside NatureServe Vista decision support system (Vista) for analysis. NatureServe utilized Vista and other relevant tools to conduct analyses for the entire coastal region and two pilot counties. These analyses document the relative significance of existing conservation lands, identify areas of high conservation opportunity – and vulnerability, and prioritize areas for efficient conservation action.

Creating the Green Infrastructure Components

The Vista project created during the CGLCI provided an excellent platform to create the components of the region's Green Infrastructure.

The first component taken from the Vista project was a conservation value summary (CVS), a raster layer that aggregates data about conservation elements. This layer combined two types of element information:

1. Ecological communities: Mapped at a very fine scale, these are areas of natural vegetation mapped by DNR, including upland and wetland communities.
2. Ecological occurrences: the spatial representation of a species or ecological community at a specific location. An element occurrence generally delineates a species population or ecological community stand, and represents the geo-referenced biological feature that is of conservation or management interest. Under the CGLCI, the DNR organized and updated this information for the 11 county coastal region.

Each conservation element was assigned an importance weight by the staff of DNR that weighed heavily on state and national ranks of imperilment (a ranking of the relative rarity or endangerment of the element at the state or national level). Conservation elements were also given ranks that reflected confidence and condition, which are important components of natural heritage methodology. Confidence is a ranking given to each element that reflects the overall confidence that a species occurrence or distribution is located where our map indicates. It can be thought of in terms of a pirate treasure map- a rank of how certain we are that X

indeed, marks the spot. This is often a reflection of age (how old is the information we're using) and the method used to map the feature (we are more confident using a GPS to map a feature versus a narrative account).

In the case element condition, many element occurrences have field verified values that reflect the quality or integrity of the occurrence. One can think of condition as a measure of element health as measured by a field biologist. In the case an element did not have a field verified condition value, a condition model was used to provide the score. The condition model was based on anthropogenic disturbances (roads, urban development) and distance effects based on a national model of landscape condition developed by NatureServe (Comer et al 2009). Vista combined values of condition and confidence with the importance weights assigned by DNR to create the CVS index. The result is a map with a range of values between zero and one; higher values reveal areas with greater condition, higher confidence and higher ranked elements. Lower values reveal areas that are less important for conservation.

The CVS provided an ideal summary of all the conservation features included in the green infrastructure layer: patches of natural habitat that had been ranked according to importance, condition and confidence. From an ecological perspective these patches provided most of the important habitat and environmental services (flood control, water and soil conservation). The CVS was used to select the largest areas (areas over 200 acres in size) and important small ones (areas less than 200 acres with CVS scores between 0.75 and 1.0).

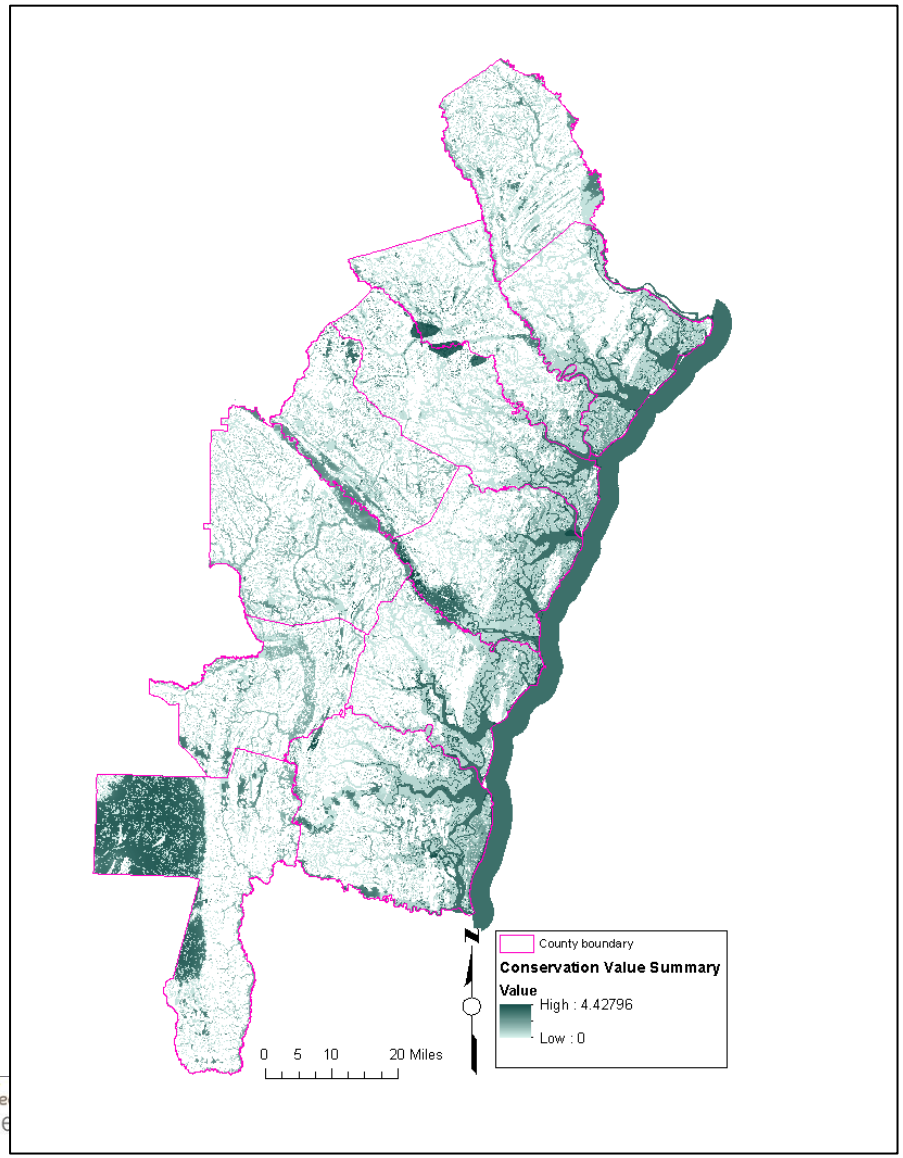


Figure 2 Regional Conservation Value Summary

This approach incorporated large habitat areas as well as the most important smaller ones. This approach eliminated smaller natural areas that scored highest in terms of conservation value. This incorporated the concept of coarse filter/fine filter biodiversity conservation (TNC 1982). The coarse filter/fine filter approach attempts to identify two scales of conservation samples: a coarse filter which facilitates the conservation of most species and the fine filter which focuses on conserving individual rare or specialized species that "fall through" through the large areas of natural habitat (the coarse filter) (Noss 1987, Hunter 1991).

The second component of the Vista project was species distribution models of habitat for gopher tortoise (*Gopherus polyphemus*) and eastern indigo snake (*Drymarchon couperi*). Eastern indigo snake is on the federal endanged species list and the gopher tortoise is "under review" in its range in northern Florida and Georgia. Because large amounts of land and wide variety of habitats are used by the species, many academics have suggested that these two qualify as umbrella or keystone species, species which have effects on their biological communities disproportionate to their abundance and biomass. The gopher tortoise in particular is a good example of an umbrella species as its burrows provide refuge for hundreds of species including the eastern indigo snake. With umbrella species, management and conservation goals benefit more species and assist in larger-scale biodiversity conservation.

In Georgia, conservation of large tracts of relatively undisturbed land is potentially the most important factor for maintaining populations of eastern indigo snake and gopher tortoise. To identify green infrastructure cores and corridors, this required the use of a species distribution models to identify a matrix of habitats that these two species are using. These models combine observations of the species in the field with environmental variables to predict the actual distribution of the species As a part of the CGLCI, NatureServe worked with DNR to create these models for gopher tortoise and eastern indigo snake.

Much of Coastal Georgia is a complex mosaic of upland and wetland forested areas interspersed with pine plantations. These timberlands are largely planted with slash pine but occasionally other pine and hardwood species are planted as well. These areas, while intensively managed for wood and fiber production, do provide habitat for some species and generally provide good connectivity between areas of natural

vegetation. In some areas of the coast, this mosaic of pine plantation and natural vegetation provides suitable habitat for gopher tortoise and eastern indigo snake. These models revealed what biologists and locals were certainly aware of; the species' distributions are closely linked and some areas of pine plantation appear to provide valuable habitat for these species. The inclusion of the gopher tortoise and eastern indigo distribution model provided a way to identify high quality pine plantations and incorporate them into the green infrastructure. Including these areas of agricultural open space (pine plantations, recreational parks, pastures and farmlands is consistent with the green infrastructure approach as described in previous sections of this document.

A combination of the species distribution models and the regional landscape condition map were used to select high quality patches of eastern indigo snake and gopher tortoise habitat and incorporate it as an input to the green infrastructure. In many cases these areas overlapped with areas already prioritized by the CVS but importantly it included many areas of agricultural open space which were not selected by the CVS analysis.

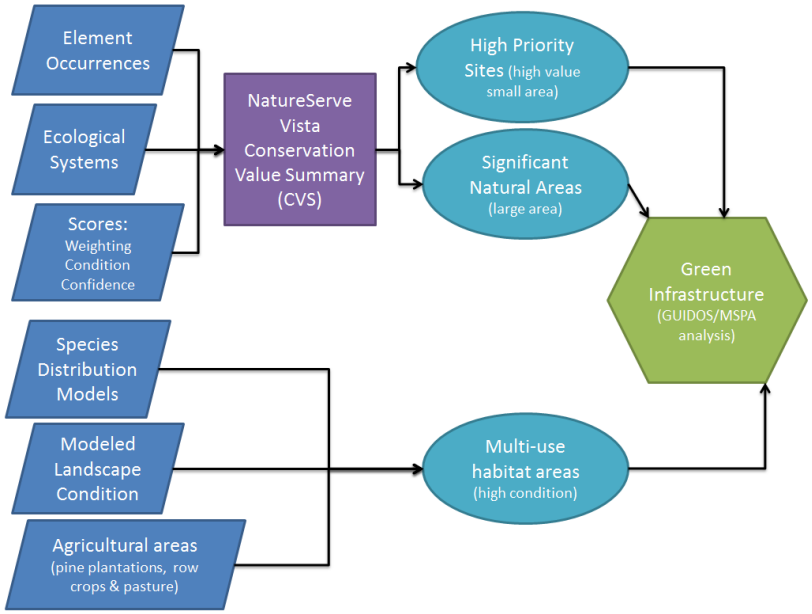


Figure 3 Components of the Green Infrastructure

In sum, the Green Infrastructure of the coastal region has three components:

- Significant natural areas: large natural habitat areas (greater than 100 acres)-(See Map 10),
- High priority sites- small areas of higher importance (using a ranking of importance, condition and confidence)-(See Map 11) and
- Multi-use buffer areas (habitat for eastern indigo snake and gopher tortoise than integrates pine plantations and other agricultural open spaces).

Creating Green Infrastructure Cores and Corridors

Using the inputs described in the previous section, we then set out to create the cores and corridors for the green infrastructure plan. For this we employed a software called GUIDOS 1.4 (Graphical User Interface for the Description of image Objects and their Shapes), a product of the European Commission Joint Research Centre (Vogt 2010). GUIDOS includes a morphological spatial pattern analysis tool (MSPA) which targets the geometry and connectivity of a input raster image. With the proper preprocessing, an image can be classified into seven generic MSPA classes Core, Islet, Perforation, Edge, Loop, Bridge, and Branch.

The Vista CVS was combined with the eastern indigo snake and gopher tortoise species distribution models inside the ArcGIS 10 map document. These were then transformed into a simplified raster with a 30m cell size which was consistent with the scale of the source data. These were input into GUIDOS and the MSPA analysis was performed. The MSPA analysis was then exported from GUIDOS and imported back into ArcGIS where the seven MSPA classes were condensed into four: cores, corridors and sites (which the MSPA called islets, smaller core areas which are disconnected from the rest of the GI network) and multi-use buffer areas. The multi-use buffer areas were separated out as a unique class because they consist of areas of agricultural areas that were identified as important areas for our keystone species (See Map 13).

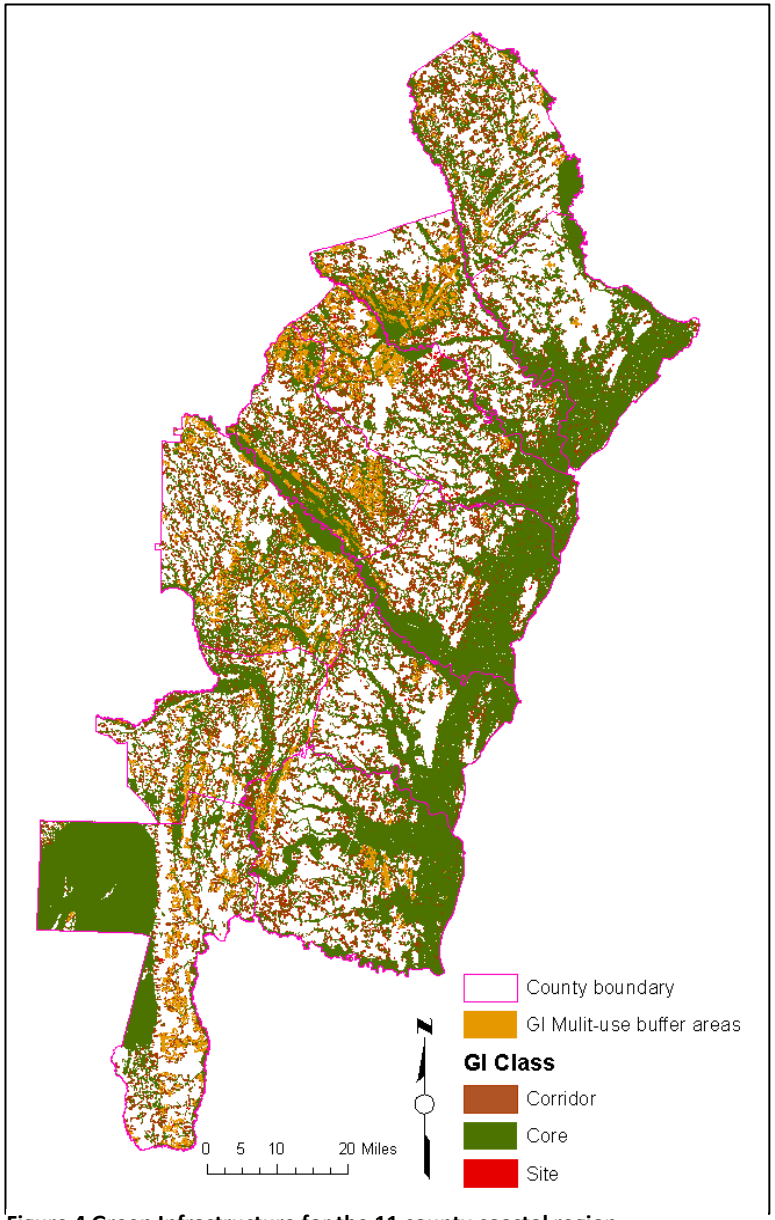


Figure 4 Green Infrastructure for the 11 county coastal region.

Evaluating the Green Infrastructure

The GI classes were input into the Vista project (developed during the CGLCI) as conservation elements. During the course of the CGLCI, a series of land use scenarios were developed reflecting current as well as potential future conditions and all of the elements were assigned compatibility with the different land uses/land covers represented in the scenarios. This process was undertaken with the assistance of species biologists and ecologists at DNR and took nearly six months to complete. The cores, corridors and islets were largely composed of natural areas, while the multi-use habitat areas were a mix of open space types, including pine plantation and agricultural areas. For the four green infrastructure classes, we relied heavily on DNR's original compatibility assignments (see Table 1 below). Cores, corridors and islets were assigned compatibility with parks, protected areas, open water areas and low-impact rural uses (non-industrial forestry, hunting, etc). Multi-use habitat areas were assigned similar compatibility assignments but we included a larger array of agricultural types: pine plantations, row crops, pasture. Gray infrastructure (roads, commercial, industrial and residential areas) was generally viewed as incompatible with green infrastructure. Using these relationships, the green infrastructure was evaluated against two land use scenarios: a scenario representing current land use and a second representing the conversion of the area's Developments of urban land use.

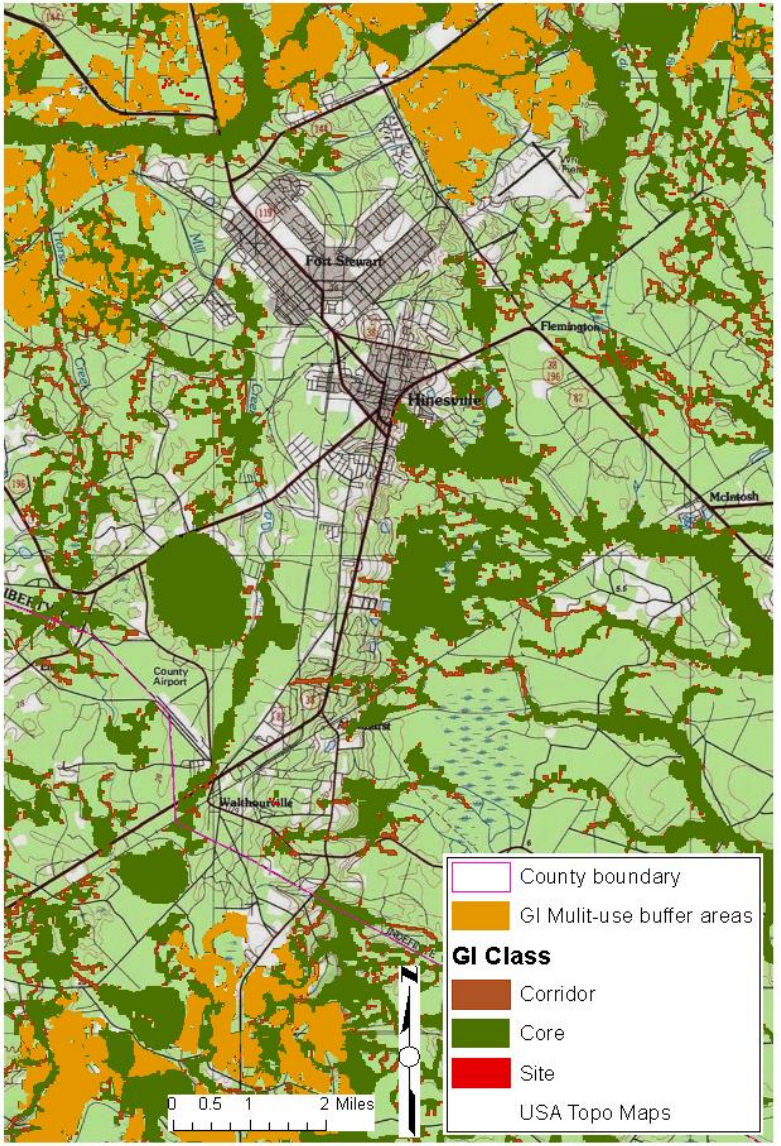


Figure 5 Green Infrastructure near Ft Steward & Hinesville, GA

Table 1 Land use compatibility and conflict assignments for green infrastructure classes and simplified land use/land cover types in the coastal region.

	Land Uses			
GI Component	Urban*	Row crops and pasture	Pine Plantation	Protected Area††
Sites	X	X	X	+
Cores	X	X	X	+
Corridors	X	X	X	+
Multi-use buffer areas	X	+	+	+

* Includes areas of commercial, industrial and residential use.

†Includes wildlife refuges, wildlife management areas, state parks and military reservations

Results and Discussion

The Green Infrastructure for the eleven county area encompasses 1,877,159 acres. The estuarine rivers and bays combined with salt and freshwater marshes of the coast and river plains make up the majority of the Green Infrastructure and the largest core area. Moving inland, large blackwater marshes (such as the Okefenokee Swamp) and the brownwater riparian areas along the Altamaha, Satilla and Savannah rivers are significant components. Upland forests such as those protected within Ft. Stewart, sand hills forests southeast of Ludowici and the western extreme of Camden County.

Table 2 Current Scenario land use/land cover compatibility

GI Component	Distribution Area (acres)	Patches	Compatible Area (acres)	Patches	percent compatible
Sites	737	705	600	616	81.57%
Cores	1,584,446	14,177	1,456,273	13,218	91.91%
Corridors	77,654	77,429	53,942	61,057	69.47%
Multi-use buffer areas	214,354	9,370	206,779	9,076	96.47%

The scenario evaluation is an important indicator of how impacted the region's green infrastructure is currently and how it may be impacted in the future. Overall compatibility with current land use is quite high for the cores and multi-use buffer areas but somewhat lower for corridors and sites (Table 2, Current Scenario land use/land cover compatibility). While some of this incompatibility is due to misclassification of the land use, much of it is due to these areas coinciding with low density residential areas and pine plantations. In the future scenario, we predicted that many of the DRIs would be urbanized. This land use change is largely incompatible with all our green infrastructure classes and generates considerable conflict in the future scenario (Table 3, Future scenario land use/land cover compatibility) Future conflict with green infrastructure classes is especially severe along the coastal bluffs or headlands of Glynn, Camden and Bryan counties where most of the DRIs area located. While our assumption that the DRIs will be

entirely converted to urban use is simplistic, it is consistent with the development patterns seen across the SE coastal region. It is important to note that many areas of the coastal region are more suitable for development and that development is possible within and around the region's green infrastructure. Local governments should encourage protection of the green infrastructure and encourage developers to avoid and minimize impacts whenever possible.

Table 3 Future scenario land use/land cover compatibility

GI Component	Distribution Area (acres)	Patches	Compatible Area (acres)	Patches	Percent compatible
Sites	737	705	548	568	74.43%
Cores	1,584,446	14,177	1,429,859	12,768	90.24%
Corridors	77,654	77,429	52,015	59,264	66.98%
Multi-use buffer areas	214,354	9,370	199,227	8,787	92.94%

The scenario evaluation analysis focused on land use change, a significant problem but not the only impact to the region's green infrastructure. Additional studies should consider the effects of water pollution which continues to impact many of the region's core aquatic areas, especially around the cities of Savannah and Brunswick. In the future, climate change may drastically alter the coastal region as sea level rise transforms the current shoreline and marsh system. As human communities respond to these changes, a thoughtful planning approach will need to be pursued in order to maintain the integrity of the green infrastructure system.

APPENDIX A: CONSERVATION TOOLS AND STRATEGIES

Following is a brief list of government tools, strategies, and voluntary programs for conservation:

Governmental Tool Box

Administrative Tools

- **Dedications** - Dedications are requests from a local government that a developer dedicate a negotiated portion of their land as open space as a condition for building approval.

- **Impact Fees** - These are fees charged to the developer to help pay for infrastructure and public amenities costs necessitated by the new development. Impact fees may be used for off-site improvements such as funding for a new school, or for on-site improvements, such as building roads or funding road improvements.

- **Development Incentives** - An example development incentive is offering higher densities to landowners or developers who wish to set aside large portions of their land as open space. Transfer of development rights would be one way to develop at higher densities.

- **Development Disincentives** - Disincentives discourage traditional "cookie cutter" development designs by imposing a density reduction for developers who do not incorporate open space protection goals.

- **Deed Restrictions** - Deed restrictions constrain the use of one's property and are recorded on the property's deed. Deed restrictions may be placed on new developments or with current landowners.

Zoning Tools

- **Agricultural and Forest Districts** - The purpose of these districts is to help preserve blocks of agricultural and forest lands. These districts usually require that an area be kept in agricultural or forest use for the length of the agreement.

- **Planned Unit Developments (PUDs) -** PUDs offer more flexible development practices than traditional zoning, while still meeting overall community density and land use goals. PUDs encourage open space preservation through the use of mixed use, massed, or clustered development practices that result in smaller individual lot sizes. Provisions within the PUD can require developers to preserve part of the development for open space. Local governments can create a PUDs zoning district or permit a PUD in a regular zoning district on a site by site basis.

- **Open Space Districts** - Open space districts are created to protect natural areas and/or unique features. These districts usually allow the same overall amount of development, but use clustering, density limitations, and other development restrictions to preserve open space and restrict development to a smaller area. The focus of open space districts (i.e. agriculture, forests, wetlands, parks) is flexible depending upon the desires of the local community.

- **Overlay District** - These districts are used to impose additional development restrictions in a certain area because a unique feature warrants protection. For instance, a floodplain overlay district can be used to further restrict development in the floodplain, in additional to the zoning that currently exists in the floodplain.

Outright Purchase

Fee-simple Acquisition

Fee-simple acquisition is direct and outright purchase of a piece of property. This option can insure protection of a sensitive area, but is often difficult because it requires landowners who are willing to sell their land as well as sufficient funds available for purchase.

Voluntary Programs

Conservation Easements

A conservation easement is a voluntary legal agreement made by a landowner to restrict the land uses permitted on his or her property. It is a flexible option that can be tailored to suit the goal of the easement and the desires of the landowner. Landowners can choose to restrict one or more land uses, or to permit only particular land uses on the property, for a specified period of time. The purpose of the easement is flexible. Its purpose can be to protect sensitive habitat, to keep the land in forestry or agricultural land uses, for aesthetics, etc. Some example types of easements include conservation, agricultural, historic preservation, scenic, and more. Also, the landowner can choose to only include a portion of his or her land in the easement.

Furthermore, landowners can benefit financially from conservation easements through reduced income taxes and estate taxes. A conservation easement is considered a tax-deductible charitable gift and can be used to reduce the landowner's taxable income. Also, conservation easements can reduce estate taxes, which can help families who wish to pass land to their relatives. If a landowner dies and wishes to pass his or her land to their family, the land is subject to an estate tax, which is often so high that the land must be sold to pay

the tax. Conservation easements can reduce estate taxes and consequently help families keep their land.

Biodiversity banking

(conservation banking)A system in which a landowner who restores, enhances, establishes, or preserves habitat of an endangered species generates credits that compensate for the loss of habitat of the same species. Landowners receive payment when they make "deposits" into a "conservation bank." These deposits are purchased as "credits" by developers or other landowners who are converting or otherwise reducing the quality of habitat of the endangered species. Landowners can apply credits to their own properties. In 2000, International Paper created a red-cockaded woodpecker conservation bank near Bainbridge, Georgia by expanding habitat for the endangered bird from 1,500 acres to more than 5,000 acres. The credits generated allowed the company to harvest timber in woodpecker habitat in other sites.

Federal Conservation Programs

The U. S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA), both offer conservation programs which local governments and landowners can benefit from technical and financial resources. The following list is just a few of the conservation programs offered through NRSC and FSA.

Natural Resources Conservation Service (NRCS) Programs

Wildlife Habitat Incentive Program (WHIP): WHIP is a voluntary program that aims at protecting wildlife habitat primarily on private lands. NRCS provides technical assistance and some financial assistance to improve wildlife habitats. WHIP agreements generally last from 5 to 10 years.

State of Georgia WHIP**: The Georgia WHIP focuses on priority habitats, such as longleaf pine ecosystems and early successional plant habitats, and management practices, including wildlife upland and wetland habitat management, prescribed burning, riparian buffers, and more.**

Wetlands Reserve Program (WRP): The WRP is a voluntary program that offers financial assistance to landowners wishing to protect wetlands on their property. Usually, the landowner enters an agreement with the USDA to restore and protect the wetland, while limiting the use of the land. The program offers agreements of varying lengths, from 10 years to permanent.

Forestry Incentive Programs (FIP): The FIP promotes good forest management practices on privately owned, non-industrial forest lands in an effort to reduce wind and soil

erosion, enhance water quality and wildlife habitat, and promote longevity of forest resources. Practices include tree planting, timber stand improvements, and natural regeneration. The FIP offers cost share assistance for participating landowners, with a limit of $10,000 per landowner and no more than 65% of total costs maybe paid.

A full list of NRSC programs can be found at:

http://www.nhq.nrcs.usda.gov/PROGRAMS/cpindex.html

Farm Service Agency Programs Farmland Protection Program (FPP): The FPP is a voluntary program that aims at keeping productive farmland in agricultural land uses. It provides funding for conservation easements that purchase development rights on agricultural lands.

Conservation Reserve Program (CRP): The CRP is a voluntary program for agricultural land owners. It offers technical and financial assistance to landowners who convert highly erodible and environmentally sensitive land to long-term resource- 294 conserving cover for the purpose of improving soil conditions. CRP offers annual rental payments and cost share assistance, and agreements generally last from 10 to 15 years.
A full list of FSA programs can be found at:
http://www.fsa.usda.gov/dafp/cepd/conserva.htm

APPENDIX B: ecosystem services analysis- iTree

Ecosystem Services were calculated for the Study area utilizing iTree Vue. i-Tree Vue was conceived and developed by Alexis Ellis (US Forest Service, Northern Research Station), Mike Binkley (The Davey Institute) and David J. Nowak (US Forest Service, Northern Research Station). The software allows users to make use of National Land Cover Data (NLCD) maps to assess land cover, including tree canopy and some of the ecosystem services provided by a region's habitats. The iTree Vue analysis utilized 3 types of imagery derived from Landsat satellite data: land cover classifications, impervious cover and tree canopy. All data had 30 meter resolution and utilized 2001 datasets (See Map 9). More recent datasets from 2006 were not utilized due to the absence of final tree canopy imagery at the time of this report.

Ecosystem services were modeled for carbon storage and sequestration and pollution removal (CO-Carbon monoxide; NO_2- Nitrogen dioxide; O_3- Ozone; PM_{10}- particulate matter of 10 micrometers or less; SO_2- Sulfur dioxide).

The following calculations are provided on a region-wide scale. More location specific analyses are recommended as individual communities (counties and cities) seek to implement green infrastructure in their community. Being able to represent ecosystem services on a quantitative scale such as this is integral during outreach and consensus building efforts.

iTree uses state average data to calculate ecosystem services. Values are computed for each pixel based upon the amount of tree canopy present. The equivalent amounts of Carbon dioxide ($CO^{2)}$) are provided to assist with Carbon offset determinations.

Carbon storage: The carbon storage output report estimates the total carbon (and carbon dioxide equivalents) stored in the total urban forest. Results are also presented for each land cover type.

- Carbon storage was calculated using 81,188.3 pounds per acre of tree canopy (CO^2 equivalent: 297,636.31pounds per acre). Carbon storage monetary values calculated using $20.68/ US ton.

Carbon sequestration: The carbon sequestration report estimates the annual carbon (and carbon dioxide equivalents) sequestered each year by the urban forest. Results are also presented for each land cover type.

- Carbon sequestration calculated using 2,676.53 pounds per acre per year of tree canopy (CO^2 equivalent: 9,812.19 pounds per acre per year). Carbon sequestration monetary values calculated using $20.68/ US ton.

CO pollution removal: The CO pollution removal report estimates the amount of carbon monoxide removed by the urban forest annually. Results are also presented for each land cover type.

- Carbon monoxide (CO) removal calculated using 1.92735 pounds per acre per year of tree canopy. Carbon monoxide (CO) removal monetary values calculated using $1,276.40/ US ton.

NO2 pollution removal: The NO2 pollution removal report estimates the amount of nitrogen dioxide removed by the urban forest annually. Results are also presented for each land cover type.

- Nitrogen dioxide (NO_2) removal calculated using 7.36324 pounds per acre per year of tree canopy. Nitrogen dioxide (NO_2) removal monetary values calculated using $8,986.57/ US ton.

O3 pollution removal: The O3 pollution removal report estimates the amount of ozone (smog) removed by the urban forest annually. Results are also presented for each land cover type.

- Ozone (O_3) removal calculated using 37.2825 pounds per acre per year of tree canopy. Ozone (O_3) removal monetary values calculated using $8,986.57/ US ton.

SO2 pollution removal: The SO2 pollution removal report estimates the amount of sulfur dioxide removed by the urban forest annually. Results are also presented for each land cover type.

- Sulfur dioxode (SO_2) removal calculated using 4.31991 pounds per acre per year of tree canopy. Sulfur dioxode (SO_2) removal monetary values calculated using $8,986.57/ US ton.

PM10 pollution removal: The PM10 pollution removal report estimates the amount of small particulate matter removed by the urban forest annually. Results are also presented for each land cover type.

- Particulate matter (PM_{10}) removal calculated using 21.2075 pounds per acre per year of tree canopy. Particulate matter (PM_{10}) removal monetary values calculated using $8,986.57/ US ton.

Limitations:

The basic approach to i-Tree Vue is to use spatial tree cover maps developed by the National Land Cover Database (NLCD) (http://www.mrlc.gov/) and apply average ecosystem service values per unit of canopy cover to estimate services of the local area. This generalized approach using national or state averages has significant limitations at the local scale. For more information, visit: www.itreetools.org

TOTAL STUDY AREA

Image Area: 4,646,798.6 acres

Impervious Cover: 145,776.0 acres, 3.3 %

Tree Canopy: 2,945,959.6 acres, 66.1 %

Carbon Storage: 119,588,725.6 short tons; $2,473,550,726.6 @ $20.68 per short tons"

CO2 Equivalent Storage: 438,412,268.1 short tons; $2,473,550,726.6 @ $5.64 per short tons

Carbon Sequestration: 3,942,485.5 short tons per year; $81,545,628.3 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 14,453,151.7 short tons per year; $81,545,628.3 @ $5.64 per short tons per year

Pollution Removal - CO: 2,839.0 short tons per year; $3,623,667.8 @ $1276.41 per short tons per year

Pollution Removal - NO2: 10,845.9 short tons per year; $97,467,541.8 @ $8986.57 per short tons per year

Pollution Removal - O3: 54,916.4 short tons per year; $493,509,909.1 @ $8986.57 per short tons per year

Pollution Removal - PM10: 31,238.3 short tons per year ; $187,433,258.0 @ $6000.12 per short tons per year

---

NLCD DEVELOPED

Developed, All: 307,961.9 acres, 6.6 %

Impervious Cover: 24,744.2 acres; or 8.0 %

Tree Canopy: 186,999.9 acres; or 60.7 %

Carbon Storage: 7,591,104.0 short tons ; $157,012,969.5 @ $20.68 per short tons"

CO2 Equivalent Storage: 27,828,987.4 short tons; $157,012,969.5 @ $5.64 per short tons

Carbon Sequestration: 250,256.2 short tons per year; $5,176,251.7 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 917,439.1 short tons per year ; $5,176,251.7 @ $5.64 per short tons per year

Pollution Removal - CO: 180.2 short tons per year; $230,018.7 @ $1276.41 per short tons per year

Pollution Removal - NO2: 688.5 short tons per year; $6,186,923.1 @ $8986.57 per short tons per year

Pollution Removal - O3: 3,485.9 short tons per year; $31,326,406.8 @ $8986.57 per short tons per year

Pollution Removal - PM10: 1,982.9 short tons per year ; $11,897,654.7 @ $6000.12 per short tons per year

Developed, Open Space: 209,394.3 acres, 4.5 %

Impervious Cover: 12,432.1 acres; or 5.9 %

Tree Canopy: 133,000.4 acres; or 63.5 %

Carbon Storage: 5,399,038.6 short tons; $111,672,699.5 @ $20.68 per short tons

CO2 Equivalent Storage: 19,792,875.5 short tons; $111,672,699.5 @ $5.64 per short tons

Carbon Sequestration: 177,990.3 short tons per year; $3,681,517.6 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 652,512.4 short tons per year ; $3,681,517.6 @ $5.64 per short tons per year

Pollution Removal - CO: 128.2 short tons per year; $163,596.7 @ $1276.41 per short tons per year

Pollution Removal - NO2: 489.7 short tons per year; $4,400,339.7 @ $8986.57 per short tons per year

Pollution Removal - O3: 2,479.3 short tons per year; $22,280,353.2 @ $8986.57 per short tons per year

Pollution Removal - PM10: 1,410.3 short tons per year ; $8,461,996.6 @ $6000.12 per short tons per year

Developed, Low Intensity: 68,767.4 acres, 1.5 %

Impervious Cover: 7,550.7 acres; or 11.0 %

Tree Canopy: 38,466.2 acres; or 55.9 %

Carbon Storage: 1,561,503.9 short tons; $32,297,854.0 @ $20.68 per short tons

CO2 Equivalent Storage: 5,724,473.4 short tons; $32,297,854.0 @ $5.64 per short tons

Carbon Sequestration: 51,478.2 short tons per year; $1,064,764.4 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 188,718.9 short tons per year; $1,064,764.4 @ $5.64 per short tons per year

Pollution Removal - CO: 37.1 short tons per year; $47,315.3 @ $1276.41 per short tons per year

Pollution Removal - NO2: 141.6 short tons per year; $1,272,661.4 @ $8986.57 per short tons per year

Pollution Removal - O3: 717.1 short tons per year; $6,443,899.0 @ $8986.57 per short tons per year

Pollution Removal - PM10: 407.9 short tons per year ; $2,447,369.3 @ $6000.12 per short tons per year

Developed, Medium Intensity: 19,784.9 acres, 0.4 %

Impervious Cover: 2,991.1 acres; or 15.1 %

Tree Canopy: 10,492.3 acres; or 53.0 %

Carbon Storage: 425,927.8 short tons; $8,809,810.4 @ $20.68 per short tons

CO2 Equivalent Storage: 1,561,451.3 short tons; $8,809,810.4 @ $5.64 per short tons

Carbon Sequestration: 14,041.6 short tons per year; $290,433.3 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 51,476.4 short tons per year; $290,433.3 @ $5.64 per short tons per year

Pollution Removal - CO: 10.1 short tons per year; $12,906.1 @ $1276.41 per short tons per year

Pollution Removal - NO2: 38.6 short tons per year; $347,140.9 @ $8986.57 per short tons per year

Pollution Removal - O3: 195.6 short tons per year ; $1,757,687.3 @ $8986.57 per short tons per year

Pollution Removal - PM10: 111.3 short tons per year ; $667,563.2 @ $6000.12 per short tons per year

Developed, High Intensity: 10,015.3 acres, 0.2 %

Impervious Cover: 1,770.2 acres; or 17.7 %

Tree Canopy: 5,041.0 acres; or 50.3 %

Carbon Storage: 204,633.7 short tons; $4,232,605.7 @ $20.68 per short tons

CO2 Equivalent Storage: 750,187.3 short tons; $4,232,605.7 @ $5.64 per short tons

Carbon Sequestration: 6,746.2 short tons per year; $139,536.5 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 24,731.4 short tons per year; $139,536.5 @ $5.64 per short tons per year

Pollution Removal - CO: 4.9 short tons per year; $6,200.6 @ $1276.41 per short tons per year

Pollution Removal - NO2: 18.6 short tons per year; $166,781.2 @ $8986.57 per short tons per year

Pollution Removal - O3: 94.0 short tons per year; $844,467.4 @ $8986.57 per short tons per year

Pollution Removal - PM10: 53.5 short tons per year ; $320,725.6 @ $6000.12 per short tons per year

---

NLCD FOREST

Forest, All: 1,860,007.9 acres, 40 %

Impervious Cover: 53,061.3 acres; or 2.9 %

Tree Canopy: 1,329,277.1 acres; or 71.5 %

Carbon Storage: 53,960,873.3 short tons; $1,116,116,562.5 @ $20.68 per short tons

CO2 Equivalent Storage: 197,820,561.5 short tons; $1,116,116,562.5 @ $5.64 per short tons

Carbon Sequestration: 1,778,929.9 short tons per year; $36,795,051.5 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 6,521,557.0 short tons per year; $36,795,051.5 @ $5.64 per short tons per year

Pollution Removal - CO: 1,281.0 short tons per year; $1,635,072.8 @ $1276.41 per short tons per year

Pollution Removal - NO2: 4,893.9 short tons per year; $43,979,343.7 @ $8986.57 per short tons per year

Pollution Removal - O3: 24,779.4 short tons per year; $222,681,741.4 @ $8986.57 per short tons per year

Pollution Removal - PM10: 14,095.3 short tons per year ; $84,573,710.8 @ $6000.12 per short tons per year

Deciduous: 31,067.4 acres, 0.7 %

Impervious Cover: 1,188.3 acres; or 3.8 %

Tree Canopy: 19,542.6 acres; or 62.9 %

Carbon Storage: 793,315.0 short tons; $16,408,777.6 @ $20.68 per short tons

CO2 Equivalent Storage: 2,908,292.7 short tons; $16,408,777.6 @ $5.64 per short tons

Carbon Sequestration: 26,153.2 short tons per year; $540,948.7 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 95,877.8 short tons per year; $540,948.7 @ $5.64 per short tons per year

Pollution Removal - CO: 18.8 short tons per year; $24,038.3 @ $1276.41 per short tons per year

Pollution Removal - NO2: 71.9 short tons per year; $646,569.8 @ $8986.57 per short tons per year

Pollution Removal - O3: 364.3 short tons per year; $3,273,793.5 @ $8986.57 per short tons per year

Pollution Removal - PM10: 207.2 short tons per year; $1,243,374.8 @ $6000.12 per short tons per year

Evergreen: 1,386,230.9 acres, 29.8 %

Impervious Cover: 38,859.8 acres; or 2.8 %

Tree Canopy: 1,006,437.4 acres; or 72.6 %

Carbon Storage: 40,855,471.2 short tons; $845,046,887.9 @ $20.68 per short tons

CO2 Equivalent Storage: 149,776,157.3 short tons; $845,046,887.9 @ $5.64 per short tons

Carbon Sequestration: 1,346,883.7 short tons per year; $27,858,688.6 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 4,937,675.5 short tons per year; $27,858,688.6 @ $5.64 per short tons per year

Pollution Removal - CO: 969.9 short tons per year; $1,237,965.0 @ $1276.41 per short tons per year

Pollution Removal - NO2: 3,705.3 short tons per year; $33,298,141.8 @ $8986.57 per short tons per year

Pollution Removal - O3: 18,761.3 short tons per year; $168,599,337.1 @ $8986.57 per short tons per year

Pollution Removal - PM10: 10,672.0 short tons per year ; $64,033,411.4 @ $6000.12 per short tons per year

Mixed: 69,076.1 acres, 1.5 %

Impervious Cover: 2,207.8 acres; or 3.2 %

Tree Canopy: 47,174.2 acres; or 68.3 %

Carbon Storage: 1,914,995.7 short tons; $39,609,410.8 @ $20.68 per short tons

CO2 Equivalent Storage: 7,020,374.2 short tons; $39,609,410.8 @ $5.64 per short tons

Carbon Sequestration: 63,131.7 short tons per year; $1,305,804.8 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 231,440.9 short tons per year; $1,305,804.8 @ $5.64 per short tons per year

Pollution Removal - CO: 45.5 short tons per year; $58,026.4 @ $1276.41 per short tons per year

Pollution Removal - NO2: 173.7 short tons per year; $1,560,765.2 @ $8986.57 per short tons per year

Pollution Removal - O3: 879.4 short tons per year; $7,902,662.6 @ $8986.57 per short tons per year

Pollution Removal - PM10: 500.2 short tons per year ; $3,001,402.3 @ $6000.12 per short tons per year"

Shrub/Scrub: 373,633.6 acres, 8 %

Impervious Cover: 10,805.3 acres; or 2.9 %

Tree Canopy: 256,122.9 acres; or 68.5 %

Carbon Storage: 10,397,091.5 short tons; $215,051,486.2 @ $20.68 per short tons

CO2 Equivalent Storage: 38,115,737.4 short tons; $215,051,486.2 @ $5.64 per short tons

Carbon Sequestration: 342,761.3 short tons per year; $7,089,609.4 @ $20.68 per short tons per year"

CO2 Equivalent Sequestration: 1,256,562.8 short tons per year; $7,089,609.4 @ $5.64 per short tons per year

Pollution Removal - CO: 246.8 short tons per year; $315,043.1 @ $1276.41 per short tons per year

Pollution Removal - NO2: 942.9 short tons per year; $8,473,866.9 @ $8986.57 per short tons per year

Pollution Removal - O3: 4,774.5 short tons per year; $42,905,948.2 @ $8986.57 per short tons per year

Pollution Removal - PM10: 2,715.9 short tons per year ; $16,295,522.2 @ $6000.12 per short tons per year

---

NLCD WETLANDS

Wetlands, All: 1,698,675.2 acres, 36.6 %

Impervious Cover: 49,579.7 acres; or 2.9 %

Tree Canopy: 1,087,837.4 acres; or 64.0 %

Carbon Storage: 44,159,835.4 short tons; $913,393,735.5 @ $20.68 per short tons

CO2 Equivalent Storage: 161,889,956.4 short tons; $913,393,735.5 @ $5.64 per short tons

Carbon Sequestration: 1,455,818.7 short tons per year; $30,111,881.4 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 5,337,031.5 short tons per year; $30,111,881.4 @ $5.64 per short tons per year

Pollution Removal - CO: 1,048.3 short tons per year; $1,338,090.8 @ $1276.41 per short tons per year

Pollution Removal - NO2: 4,005.0 short tons per year; $35,991,274.0 @ $8986.57 per short tons per year

Pollution Removal - O3: 20,278.6 short tons per year; $182,235,542.8 @ $8986.57 per short tons per year

Pollution Removal - PM10: 11,535.2 short tons per year ; $69,212,392.5 @ $6000.12 per short tons per year"

Woody Wetlands: 1,213,072.9 acres, 26.1 %

Impervious Cover: 34,723.0 acres; or 2.9 %

Tree Canopy: 894,274.0 acres; or 73.7 %

Carbon Storage: 36,302,293.5 short tons; $750,869,817.2 @ $20.68 per short tons

CO2 Equivalent Storage: 133,084,208.1 short tons; $750,869,817.2 @ $5.64 per short tons

Carbon Sequestration: 1,196,778.9 short tons per year; $24,753,950.0 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 4,387,391.5 short tons per year; $24,753,950.0 @ $5.64 per short tons per year

Pollution Removal - CO: 861.8 short tons per year; $1,099,998.8 @ $1276.41 per short tons per year

Pollution Removal - NO2: 3,292.4 short tons per year; $29,587,198.1 @ $8986.57 per short tons per year

Pollution Removal - O3: 16,670.4 short tons per year; $149,809,620.3 @ $8986.57 per short tons per year

Pollution Removal - PM10: 9,482.7 short tons per year ; $56,897,145.7 @ $6000.12 per short tons per year

Emergent Herbaceous Wetlands: 485,602.3 acres, 10.5 %

Impervious Cover: 14,856.7 acres; or 3.1 %

Tree Canopy: 193,563.4 acres; or 39.9 %

Carbon Storage: 7,857,541.8 short tons; $162,523,918.3 @ $20.68 per short tons

CO2 Equivalent Storage: 28,805,748.3 short tons; $162,523,918.3 @ $5.64 per short tons

Carbon Sequestration: 259,039.8 short tons per year; $5,357,931.4 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 949,640.1 short tons per year; $5,357,931.4 @ $5.64 per short tons per year

Pollution Removal - CO: 186.5 short tons per year; $238,092.0 @ $1276.41 per short tons per year

Pollution Removal - NO2: 712.6 short tons per year; $6,404,076.0 @ $8986.57 per short tons per year

Pollution Removal - O3: 3,608.3 short tons per year; $32,425,922.5 @ $8986.57 per short tons per year

Pollution Removal - PM10: 2,052.5 short tons per year ; $12,315,246.7 @ $6000.12 per short tons per year

---

NLCD AGRICULTURE

Agriculture, All: 358,871.7 acres, 7.7 %

Impervious Cover: 11,223.5 acres; or 3.1 %

Tree Canopy: 193,695.7 acres; or 54.0 %

Carbon Storage: 7,862,910.8 short tons; $162,634,969.6 @ $20.68 per short tons

CO2 Equivalent Storage: 28,825,431.0 short tons; $162,634,969.6 @ $5.64 per short tons

Carbon Sequestration: 259,216.8 short tons per year; $162,634,969.6 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 950,288.9 short tons per year; $162,634,969.6 @ $5.64 per short tons per year

Pollution Removal - CO: 186.7 short tons per year; $238,254.7 @ $1276.41 per short tons per year

Pollution Removal - NO2: 713.1 short tons per year; $6,408,451.8 @ $8986.57 per short tons per year

Pollution Removal - O3: 3,610.7 short tons per year; $32,448,078.9 @ $8986.57 per short tons per year

Pollution Removal - PM10: 2,053.9 short tons per year ; $12,323,661.7 @ $6000.12 per short tons per year

Cultivated Crops: 278,311.6 acres, 6 %

Impervious Cover: 8,652.1 acres; or 3.1 %

Tree Canopy: 145,133.8 acres; or 52.1 %

Carbon Storage: 7,862,910.8 short tons; $162,634,969.6 @ $20.68 per short tons

CO2 Equivalent Storage: 28,825,431.0 short tons; $162,634,969.6 @ $5.64 per short tons

Carbon Sequestration: 259,216.8 short tons per year; $162,634,969.6 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 950,288.9 short tons per year ; $162,634,969.6 @ $5.64 per short tons per year

Pollution Removal - CO: 186.7 short tons per year; $238,254.7 @ $1276.41 per short tons per year

Pollution Removal - NO2: 713.1 short tons per year; $6,408,451.8 @ $8986.57 per short tons per year

Pollution Removal - O3: 3,610.7 short tons per year; $32,448,078.9 @ $8986.57 per short tons per year

Pollution Removal - PM10: 2,053.9 short tons per year ; $12,323,661.7 @ $6000.12 per short tons per year

Pasture/Hay: 80,560.1 acres; 1.7 %

Impervious Cover: 2,571.5 acres; or 3.2 %

Tree Canopy: 48,561.9 acres; or 60.3 %

Carbon Storage: 1,971,328.0 short tons; $40,774,577.4 @ $20.68 per short tons

CO2 Equivalent Storage: 7,226,888.4 short tons; $40,774,577.4 @ $5.64 per short tons

Carbon Sequestration: 64,988.8 short tons per year; $40,774,577.4 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 238,249.1 short tons per year; $40,774,577.4 @ $5.64 per short tons per year

Pollution Removal - CO: 46.8 short tons per year; $59,733.4 @ $1276.41 per short tons per year

Pollution Removal - NO2: 178.8 short tons per year; $1,606,677.3 @ $8986.57 per short tons per year

Pollution Removal - O3: 905.3 short tons per year; $8,135,130.5 @ $8986.57 per short tons per year

Pollution Removal - PM10: 514.9 short tons per year ; $3,089,692.8 @ $6000.12 per short tons per year

---

NLCD MISCELLANEOUS

Miscellaneous, All: 229,648.5 acres; 4.9 %

Impervious Cover: 7,167.2 acres; or 3.1 %

Tree Canopy: 148,149.5 acres; or 64.5 %

Carbon Storage: 6,014,002.1 short tons; $124,392,489.4 @ $20.68 per short tons

CO2 Equivalent Storage: 22,047,331.7 short tons; $124,392,489.4 @ $5.64 per short tons

Carbon Sequestration: 198,263.8 short tons per year; $4,100,851.3 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 726,835.1 short tons per year; $4,100,851.3 @ $5.64 per short tons per year

Pollution Removal - CO: 142.8 short tons per year; $182,230.8 @ $1276.41 per short tons per year

Pollution Removal - NO2: 545.4 short tons per year; $4,901,549.0 @ $8986.57 per short tons per year

Pollution Removal - O3: 2,761.7 short tons per year; $24,818,139.1 @ $8986.57 per short tons per year

Pollution Removal - PM10: 1,570.9 short tons per year ; $9,425,838.5 @ $6000.12 per short tons per year

Barren Land (Rock/Sand/Clay): 16,853.7 acres: 0.4 %

Impervious Cover: 734.0 acres; or 4.4 %

Tree Canopy: 8,004.4 acres; or 47.5 %

Carbon Storage: 324,930.2 short tons; $6,720,794.7 @ $20.68 per short tons

CO2 Equivalent Storage: 1,191,194.0 short tons; $6,720,794.7 @ $5.64 per short tons

Carbon Sequestration: 10,712.0 short tons per year; $221,564.7 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 39,270.1 short tons per year; $221,564.7 @ $5.64 per short tons per year

Pollution Removal - CO: 7.7 short tons per year; $9,845.7 @ $1276.41 per short tons per year

Pollution Removal - NO2: 29.5 short tons per year; $264,825.5 @ $8986.57 per short tons per year

Pollution Removal - O3: 149.2 short tons per year; $1,340,897.8 @ $8986.57 per short tons per year

Pollution Removal - PM10: 84.9 short tons per year ; $509,268.1 @ $6000.12 per short tons per year

Grassland/Herbaceous: 212,794.7 acres; 4.6 %

Impervious Cover: 6,433.3 acres; or 3.0 %

Tree Canopy: 140,145.1 acres; or 65.9 %

Carbon Storage: 5,689,071.9 short tons; $117,671,694.7 @ $20.68 per short tons

CO2 Equivalent Storage: 20,856,137.7 short tons; $117,671,694.7 @ $5.64 per short tons

Carbon Sequestration: 187,551.8 short tons per year; $3,879,286.6 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 687,565.0 short tons per year; $3,879,286.6 @ $5.64 per short tons per year

Pollution Removal - CO: 135.1 short tons per year; $172,385.0 @ $1276.41 per short tons per year

Pollution Removal - NO2: 516.0 short tons per year; $4,636,723.5 @ $8986.57 per short tons per year

Pollution Removal - O3: 2,612.5 short tons per year ; $23,477,241.3 @ $8986.57 per short tons per year

Pollution Removal - PM10: 1,486.1 short tons per year ; $8,916,570.4 @ $6000.12 per short tons per year

---

NLCD WATER

Water: 191,633.4 acres; 4.1 %

APPENDIX C: BEST MANAGEMENT, POLICIES AND PRACTICES FOR GREEN INFRASTRUCTURE

POLICIES

- Environmentally, culturally and historically sensitive areas should be protected from negative impacts of development.
- Whenever possible, the natural terrain, drainage, and vegetation of an area should be preserved.
- The traditional character of the community should be maintained through preserving and revitalizing historic, scenic or natural areas or features of the community, encouraging new development that is compatible with the traditional features of the community and are important to defining the community's character.
- Partner and coordinate with state, federal, non-governmental organizations including universities and foundations, and local governments to provide guidance, monitor, and enhance management develop and utilize incentives to restore, remediate or reuse of critical natural areas and cultural/historic sites/areas, land conservation efforts, and land use practices within each jurisdiction
- Maintain a range of landscapes and environments that provide diversity of habitats, species, resources, and opportunities for recreation, commerce, agriculture, community enjoyment, and cultural practices with enhanced access to natural, cultural and historic resources as appropriate within the protection mission.
- Establish a program of monitoring the cumulative impacts of development on natural, cultural and historic resources.
- Encourage the development and use of a method to place a value on ecosystem services.
- Promote the identification of innovative funding sources and development of ecosystem services markets (e.g. carbon, storm buffers, traditional land and water uses).
- Require mitigation measures for all significant natural, cultural, archaeological, and historic resources damaged during the land development process.
- Incorporate the appropriate treatment of natural, cultural and historic resources into the catastrophic preparedness plan.
- Participate in assisting and identifying sites, historical data, associated with the Gullah/Geechee culture for the benefit and education of the public
- Incorporate natural, cultural and historic resource protection into economic development initiatives.
- Adopt water conservation ordinance.
- Seek designation of a Water-Smart, Water-First and/or Water Sense Community.

- Promote use of purple pipe and grey water techniques and use of surface water in addition to groundwater where appropriate.
- Coordinate the development and implementation of the Coastal Georgia Greenway, Rail Trail, scenic byways, Southern Passages (US 17), and the Gullah-Geechee National Heritage Corridor.
- Adopt and implement a sign control ordinance.
- Adopt and implement a way-finding (directional signs) system to attractions/events.
- Adopt wellhead protection ordinance.
- Adopt riparian buffer protection ordinance.
- Adopt ordinance for the protection of open waters, streams and wetlands.
- Adopt sea turtle habitat protection ordinance.
- Protect and enhance Coastal Georgia's water resources, including surface water, groundwater, and wetlands and ground water recharge areas by adoption of DNR's Part V Environmental Planning Criteria protection ordinances.
- Identify the key physical, natural, ecological, landscape, historical, access and recreational assets that contribute to the functionality of the green infrastructure network.
- Implement strategies for enhancing public access to natural, historic, and cultural resources for recreation, public education, and tourist attractions as appropriate within the protection mission.
- Direct growth to those areas that can be efficiently served by water, wastewater and transportation infrastructure.
- Prohibit installation of new septic systems within 100 feet of any marsh or river or any State water body.
- In rural communities allow alternative wastewater collection and treatment technologies methods, including small-diameter gravity, pressure and vacuum systems, sand filters, land treatment, lagoons and constructed wetlands.
- Encourage development practices and sitings that do not significantly impact sensitive natural, cultural or historic areas or allow for the preservation and conservation of sensitive natural, cultural or historic areas through appropriate land use practices.
- Adopt an ordinance consistent with the resource management plan to require examination of tracts prior to development that identifies and evaluates impacts to significant natural, cultural and historic resources
- Review proposed developments for consistency with the resource management plan prior to approval and require mitigation to significant natural, cultural and historic resources as necessary.
- Adopt and implement architectural and design overlay ordinances and design guidelines to support and enhance the desired character of development near and is complementary to significant natural, cultural and historic

resources.

- Adopt minimum uniform land use and development standards that avoid establishment of new land uses which may be incompatible with adjacent natural, cultural and historic resources.
- Adopt ordinances that allow for innovative development while protecting natural, cultural and historic resources.
- Adopt and implement the Coastal Stormwater Supplement to the Georgia Stormwater Management Manual and limit discharge to pre-developed conditions for appropriate types and intensities of storms, requires new developments consider and accommodate stormwater runoff, and do not negatively impact downstream areas.
- Adopt standards or ordinances that require developments to minimize the impervious area wherever possible.
- Adopt standards or ordinances that provide incentives for developments that utilize low impact design, follow green growth guidelines, Earthcraft Coastal Communities principles, the Coastal Supplement to the Georgia Stormwater Management Manual, or follow other quality growth approaches to guide site planning and development.
- Provide incentives for new development/redevelopment to pursue certification for "green" site planning, construction, and post-construction practices.
- Develop and implement a program that encourages use of recommended BMP's (includes incentives) in all new developments/redevelopment (see http://www.georgiaplanning.com/coastal/BMP/default.htm).
- Require the use of the Stormwater Quality Site Development Review Tool (under development), which is a companion to the Georgia Stormwater Manual, or similar tool to review proposed development plans.
- Provide developers a statement of Best Management Practices (BMP's) for Coastal Development.
- Provide incentives for shared docks for all new residential development.
- Provide incentives for best management practices for timber, agriculture, and/or fishing activities.
- Promote green building techniques to maximize energy efficiency and water conservation and minimize post construction impacts on the environment.

Natural Resources BMPs

Conservation Measures

• Development practices that protect natural resources include the use of conservations subdivisions that cluster or concentrate development to maximize and provide large, contiguous open space. Zoning ordinances commonly include requirements for open space preservation in developments. The use of low impact development practices or green growth

guidelines promotes environmental protection by minimizing the foot print of development by avoiding sensitive areas and concentrating development in appropriate areas.

• Buffer Zones are used to distance land disturbing activities for sensitive environments.

• Zoning may be used to control uses and intensity of development in areas requiring protection. Type of zoning districts may include conservation, agricultural or rural zones. Overlay zones may be used to protect scenic corridors or viewsheds.

• Ecosystem services is the recognition of natural assets (goods and services) provided by the environment that benefit human health and economy. There is a growing need to consider ecosystem services with development proposals to provide management and protection for the benefits. USDA Forest Service Ecosystem Webpage includes information on the services provided by wetlands, floodplains, vegetation (carbon absorption and storage), and habitat.

• Natural Resources inventory will identify the natural resources occurring and where they are located in a particular geographic area, from individual property parcel to the whole region. Natural resources inventory may include identifying air quality, water, soils, geologic formations, farmlands, forests, minerals, wetlands, and plant and animal species. The inventory provides a property owner or community with the location, quantity, quality, and vulnerability of its natural resources to development. The inventory can identify natural hazards and development constraints, such as floodplains, poor soils and slopes.

• Site finger printing is a site inventory practice employed to identify natural conditions prior to site planning. Site finger printing is a important part of the development practices promoted in the green growth guidelines low impact development practices and the Coastal Stormwater Supplement. Site finger printing is the identification of naturally sensitive or constrained areas that may be designed around and/or utilized for natural benefits such as stormwater management, or meeting open space/recreation requirements.

• Conservation development is a development design practice that maximizes open space by consolidating site development potential into a smaller area leaving larger, continuous open space. Conservation developments can be used to avoid environmentally sensitive areas identified by site finger printing.

• Subdivision ordinance and land development codes, regulating land development, can include open space preservation, height restrictions, scenic preservation, and limits on impervious surfaces.

Acquisition

• Acquisition and conservation easement programs are methods of preserving natural or agricultural lands from development. Acquisition provides fee simple ownership by the public or non-governmental conservation organizations. Conservation easements are nonpossessory interest that provides control or limitations of use on natural resource located on a property. Conservation Easements may be donated or purchased from a private landowner, who voluntarily gives up development rights of property while maintaining ownership. Tax benefits and incentives are available for the establishment of conservation easements. Oversight of conservation easements is given to a governmental agency or a non-governmental conservation organization.

Greenways

• Greenways are open space that may be used for non-motorized transportation, utilized by people and/or animals to move between the built and natural environments.

• Green infrastructure is preserved green space that can serve as connection between natural areas, and can include Greenways. Green Infrastructure provides ecosystem services, using the natural environment or creating natural features to provide benefits such as stormwater and flood management. Green infrastructure can include working lands, farmlands and forests, with conservation value.

Shared Docks

• Shared docks is a method of protecting marsh resources by reducing the number of docks and their impacts, most notably runoff pollution and marsh die off from shading. The Coastal Resources Division is responsible for permitting docks on tidal waters.

Smart Growth

• Smart Growth is the practice of planning, regulating and developing land in a efficient manner. Smart growth applies techniques of compact development, infill and redevelopment, locating uses to be accessible by a variety of transportation modes including walking and biking, and providing a variety of housing types and choices. The purpose of smart growth is to lessen land consumption, to preserve natural resources and improve livability to all citizens. Smart growth is an approach to achieving sustainability.

Development Practices

Infill is the practice of developing where public infrastructure is present verses continued development beyond the existing limits of public infrastructure and services. Infill is cost effective for developers and local governments as they are not adding and having to maintain new infrastructure. Infill helps preserve agricultural and natural lands from development. It is supportive of and by Communities for a Lifetime with its

focus on development occurring in and with the existing community network of infrastructure and services.

• Low Impact Development is encouraged by both the Coastal Green Growth Guidelines and the Coastal Stormwater Supplement. Low Impact Development manages stormwater by designing the stormwater system to mimic natural processes and can including natural features on the site to retain as much stormwater on the site.

• Conservation Developments is a development practice of concentration development on smaller parcels while preserving a large (typically 50% or greater) area of continuous open space. Environmental benefits improve stormwater runoff reduction, better water quality, and wildlife habitat preservation. Economic benefits include high property values, reduced infrastructure cost and reduced maintenance cost. (FL Toolkit). Density bonus is an incentive that allows development intensity greater than permitted, additional square footage or residential units, typically in exchange for the preservation or provision of an amenity.

• The CRC initiated the development of the Initiative for the Protection of Significant Resources in the Coastal Georgia Region, The Protection of Significant Resources is a suite of model ordinances that include transfer of development rights, purchase of development rights, and planned resource districts. The significant resources include agricultural and environment lands and cultural resources.

• Transfer of Development Rights is a program for transferring development potential of one property to another property that can accommodate additional development. Use to protect the property transferring its rights from development.

• Purchase of Development Rights is a program under the Georgia Land Conservation Act allowing local governments to participate in the acquisition of conservation easements to protect agricultural lands, environmental resources and cultural resources.

• Service delivery strategy is the sequencing the provision of public facilities, water, sewer, streets, within a jurisdiction. Commonly established in a jurisdiction's Capital Improvement Plan.

• Growth boundaries are an established limit of growth by a governmental unit separating "urban/developable land with rural not to be developed (to non rural densities). Growth boundaries are implemented through a plan, the establishment of appropriate zones, and a service delivery strategy. Acquisition, the establishment of conservation easements of the property along the no growth side of the boundary, transfer development rights program and purchase

development rights program are some of the practices to support a growth boundary and avoid takings claims.

• Sensitive environments within the region are critical to the support of agriculture and aquaculture, water quality, critical habitats, and support of rare and threaten or endangered plants and animals. They are the basis for eco-tourism.

Sensitive environments require measures to protect them from the impacts of the developed and developing environment. Sensitive environments include wetlands, marshes, wildlife management areas, high quality agricultural lands, forestlands, rivers, and floodplains. Development adjacent to or in sensitive environments not only has negative impacts on the environment but has negative impacts on development, such as poor soils to support foundations and septic systems, or the risk of flooding.

Agricultural Lands BMPs

Agricultural Conservation

◎ Acquisition in fee (Fl Planning Toolbox Agricultural Land Conservation Tools) is the purchase of land for conservation by local government, agency or land trust. Property can be

deed restricted to agricultural use and leased or sold to keep in or place back into agricultural production.

◎ Agricultural zoning is the establishment of a zoning district where allowable land uses and land development are compatible with agricultural activities. Typically used where the desire is to preserve land and people in agricultural activities. There are two general types of agricultural zoning exclusive and non-exclusive. Non-exclusive zoning is the least restrictive stating a preference for agricultural land uses, but not prohibiting other uses, typically supportive of agricultural activities. Exclusive zoning typically prohibits non-agricultural, retail and non-residential uses.

◎ Conservation easement is a deed restriction is voluntarily place on land, limiting the land to specific uses and to protect from development. Agricultural conservation easements are designed to protect farm land and/or also protect resources such as productive agricultural land, ground and surface water, wildlife habitat, historic sites or scenic views. They are flexible documents tailored to each property and the needs of individual landowners. The agricultural conservation easement may cover an entire parcel or portions of a property. The landowner (grantor) authorizes a qualified conservation organization or public agency (grantee) to monitor and enforce the restrictions set forth in the agreement. The landowner retains title and right to use their land for agricultural purposes and still restrict public access. The agreement is legally binding on all future landowners for the specific time period established. Conservation easements may

be donated for tax benefits or sold as a transfer of development rights.

◎ Contingent valuation survey is a survey-based economic technique to determine the value of non-market resources, typically agricultural or environmental areas. The survey is used to directly ask people how much they would be willing to pay for specific environmental or agricultural services.

Economic Incentives

◎ Green payments are a method to provide farmers economic benefit for conservation activities providing environmental services required by the broader community. Governments would look first to rural, agricultural land to provide required environmental services such as stormwater attenuation and treatment, cleaner air, groundwater supply and recharge, wildlife habitat, open space, areas for recreation connections between environmentally sensitive areas, creating and protecting wetlands, and sequestering carbon (climate change). These services can be provided on agricultural lands well equipped for specific services and whose economic value is quantifiable.

◎ Purchase of development rights (PDR) works like conservation easement with the development rights being sold to private conservation organization or public agency. CRC has developed a suite of model ordinances for local governments interested in establishing a resource land protection programs including a PDR program.

◎ Transfer of Development Rights (TDR) programs allow the transfer of development rights from one parcel of land to another in a designated growth area. This is one means of directing development away from environmentally sensitive and agricultural lands to locations with existing municipal services, usually designated by local governments to receive TDRs. TDR's is included in the CRC's suite of resource land protection model ordinances.

STORMWATER BMPs

Georgia Storm Water Manual

• The Georgia Stormwater Manual's development was lead by Atlanta Regional Commission and Georgia Environmental Protection Division. This three volume manual is designed to address stormwater management throughout the State. Volume One, Stormwater Policy Guidebook, provides guidance to local governments on stormwater management. Volume Two Technical Guidance Handbook provides techniques and measures for implementing stormwater management, and Volume Three Pollution Prevention Guidebook is a compendium of pollution prevention practices.

Coastal Storm Water Supplement (CSS)

• The CSS is a supplement to the Georgia Stormwater Manual addressing stormwater management in the coastal plain environment of Georgia. Chapter Seven (7) of the CSS presents green infrastructure practices of site planning, and low impact development. Chapter Eight (8) presents' stormwater management practices that can be applied based on a site's particular needs. Developed of the Coastal Stormwater Supplement is lead by the Chatham County - Savannah Metropolitan Planning Commission (MPC). The MPC continues to maintain the latest information and edits to the Coastal Stormwater Supplement on their Natural Resources Stormwater Webpage.

Green Infrastructure

• In the context of stormwater management, green infrastructure is the use of techniques and measures design to be "green". Green design features are natural features and natural processes that are interconnected to manage stormwater quality and quantity. Chapter 7 of the CSS provides guidance on applicable green infrastructure stormwater management techniques and measures. US EPA Managing Wet Weather with Green Infrastructure Webpage another resource on use of green infrastructure for stormwater management.

Low Impact Development Practices

• Small scale practices designed to disconnect impervious and disturbed pervious areas from stormwater drainage systems and reduce post construction stormwater runoff rates, pollutant loading and volumes. Low impact design practices are recommended in the Coastal Georgia's Green Growth Guidelines and in chapter 7 of the CSS.

Green Growth Guidelines

• The Green Growth Guidelines were developed by the Coastal Management Division, CRC and EMC Engineering. These guidelines provide an alternative approach to development, using site fingerprinting, designing with landforms, low impact development, and alternative stormwater and bank stabilization techniques to reduce the environmental impact of development.

Floodplain Management

• The practice of managing activities in areas with certain chance of flooding, know as a floodplain, with the purpose to reduce risk and losses associated with flooding. A floodplain is the area of land along a water body that experiences periodic inundation by a flood Activates within a floodplain are at risk of being impacted by the quantity of stormwater flowing through or into a water body. Waters being moved through or around a water body, such as by winds and tides

can also produce flooding. FEMA provides a number of Floodplain Management Resources.

No Adverse Impact (NAI)

• A floodplain management approach developed by the Association of State Floodplain Managers (ASFPM) designed to provide tools for communities to provide a higher level of floodplain protection. The principle behind NAI is to ensure the actions of any community or property owner, public or private, does not adversely impact the property and rights of others. ASFPM has developed two documents "No Adverse Impact" and "Coastal No Adverse Impact Handbook" to assist local communities in identifying their flooding risk, public education and outreach, planning, regulation and development standards, mitigation, infrastructure, and emergency services. The Coastal NAI Handbook was developed with support from NOAA and FEMA.

Community Rating System (CRS)

• The CRS program, under the national flood insurance program, encourages communities to take steps to reduce flood risk that goes beyond the required NFIP minimum standards. Participation is rewarded through the reduction of insurance rates from five (5) percent to 45 percent, based on the activities of a participating community.

FORESTRY BMPs

• Small harvest areas (up to 50 acres) scattered over the landscape provide more edge and landscape diversity.

• Irregularly shaped areas provide more edge than square or round areas.

• Planting at low density stocking rates (less than or equal to 500 trees per acre).

• Separating harvest areas with 100-foot (or wider) areas of uncut timber enhances diversity of habitats and provides travel corridors between fragmented habitats.

• Buffer strips adjacent to streams a nd other water bodies protect water quality, but are also critical wildlife corridors.

• Islands of uncut timber within harvest areas will enhance wildlife habitat by leaving mast (food) producing trees. Oaks, hickories, dogwoods, persimmons and berry producing shrubs are excellent hard and soft mast species to leave.

APPENDIX D: OUTREACH SUMMARY

2011 Annual Report for ACCG-GFC partnership under the 'Sustainable Community Forest Program' to accomplish a coordinated effort to conserve important coastal lands.

The Association County Commissioners of Georgia (ACCG) and the Georgia Forestry Commission (GFC) worked collaboratively from 2008-2011 to build upon the work conducted under the Coastal Georgia Land Conservation Initiative (CGLCI). Overall, the CGLCI worked with private and public interests to conserve critical lands and healthy ecosystems while promoting sustainable economic growth and development and have educated the public about the value of coastal resources. More specifically, the partners worked to develop tools for local governments and private landowners that enable them to make strategic land use decisions, benefiting both the citizens and the important ecosystem in the region.

Glynn and Camden Counties are serving as pilot counties for the CGLCI, and ACCG and the Georgia Department of Natural Resources (DNR) have worked diligently with leaders in those counties to help them integrate the habitat information collected through the initiative into their land use decision-making process. Also, ACCG and DNR conducted individualized meetings and group education sessions for counties throughout Georgia's coastal region to promote the common mission of CGLCI and the ACCG-GFC partnership.

ACCG and GFC worked together to identify outreach opportunities on the coast to build upon the work being conducted under the CGLCI. The maps and tools that were developed through the CGLCI assisted ACCG and GFC staff with educating local leaders about the resources existing in their jurisdictions and to identify potential linkages and corridors for protection.

In addition to work in Georgia's Southeastern region, ACCG continued to work with various statewide partners to help identify new funding sources for land and water protection so that a statewide network of conservation lands can be identified and preserved. Through this effort, a suite of outreach tools have been developed to educate leaders, government officials, and private landowners about the benefits of conservation and the importance of both public lands and well-managed private lands.

Results

Georgia Forestry Commission (GFC) and Association County Commissioners of Georgia (ACCG) Work Plan for the Implementation of the Integrated Green Infrastructure Management System Grant:

1. *Alignment of existing and ongoing conservation efforts with the GFC's effort to assist Counties and communities in integration of conservation into growth planning. Of particular interest is in the effort of the Coastal Georgia Land Conservation Initiative (CGLCI) ACCG, DNR and the Georgia Conservancy are engaged in as principal partners.*

UPDATE: Over the past three years, ACCG has continually collaborated with GFC and the two primary partners to the Coastal Georgia Land Conservation Initiative (CGLCI) to promote land conservation and habitat connectivity in Southeast Georgia. Under the CGLCI, the Georgia Department of Natural Resources completed intensive habitat mapping for eleven Southeastern Georgia counties. Under the CGLCI and the ACCG-GFC partnership, the partners worked with local officials to educate them about the information that can be ascertained from the habitat maps and how that information can be integrated into the local decision-making process regarding land use. More specifically, county and city officials were instructed about how to use the maps to identify the areas in their jurisdictions that provide the highest conservation value and how to identify important conservation linkages and corridors.

Camden and Glynn Counties, the two pilots under the CGLCI, have been the recipients of even more intensive education and outreach. These counties have had individualized programs built that integrated data layers of their future land use plans. The program, piloted in Georgia with specific information from these two counties, utilizes a computer software program called Vista to overlay development and conservation goals with habitat data so that local governments know what unique natural features are impacted when specific land use decisions are made in their counties. The objective is for local governments to have a greater understanding of the resources in their jurisdictions, for leaders to set goals regarding the protection of their unique resources, and for leaders to integrate their conservation objectives into their growth planning processes with the aid of the habitat maps and the Vista tool. The tools have been developed for both Glynn and Camden counties, and each county will have the opportunity for training on the use of the Vista software if they so desire. In the alternative, the Coastal Resources Division (CRD) of the Georgia Department of Natural Resources will also host the Vista software, and Glynn and Camden counties – as well as any of the eleven mapped counties – will be able to have CRD run development scenarios through the Vista tool on their behalf as part of their land-use planning or decision-making process.

In addition to the individualized local government outreach conducted through the CGLCI, ACCG has worked to educate a broader audience of its members through education sessions at ACCG conferences. At ACCG's Newly Elected Conference, a four-day training seminar that new commissioners are mandated by state law to attend, ACCG educated incoming commissioners about the tools provided to local government officials and staff from coastal Georgia through the CGLCI. ACCG staff utilized the CGLCI website (www.conservecoastalgeorgia.org) to promote the goals of the initiative and the ACCG-GFC partnership and to inform county leaders about the importance of land protection and connectivity. Additionally, ACCG hosted a special training session for county commissioners and staff at its annual meeting in April 2011. County officials were taken by bus to a conservation preserve in Chatham County, Georgia and were instructed about one model for identifying and protecting important conservation lands at the local level. The officials were instructed on the tools produced through the CGLCI and were given the opportunity to tour the preserve and hear from Chatham County leaders about the importance of such properties to the local community and why that county has made conservation a priority.

2. *Identify Counties that have opportunities to capitalize on local funding sources to accomplish conservation.*

UPDATE: While funding is currently very hard to come by for most local governments, ACCG has continually worked with a network of conservation organizations to seek significant dollars that can be utilized for acquisition of conservation lands and easements statewide. The coalition has leveraged private funding to help research and educate opinion leaders and citizens about the need for sustainable funding for conservation in Georgia. The alliance of organizations has begun educating a broad audience about the services and benefits that well-managed forests and conservation lands provide to this state. Outreach materials, including an extensive research document, a 25-page case statement, a website (www.galegacy.org), and a short film have been produced to aid with educating citizens about the benefits of conservation and the need for conservation funding. Ultimately, the coalition hopes to leverage support statewide from a broad array of business owners, farmers, land owners, and other citizens so that state funding available for conservation will significantly increase and be made available to conserve important corridors through acquisitions and easements.

3. *Provide a format for dialogue between Counties and the GFC to highlight opportunities for assistance.*

UPDATE: ACCG has worked with GFC staff to offer opportunities to engage county leaders from Southeastern Georgia and from all over the state. GFC officials were invited to attend the ACCG Newly Elected Conference, which new county officials are required by law to attend. Additionally, ACCG has arranged for GFC to present to a cross-section of coastal counties from Georgia and other states around the nation regarding green infrastructure and the benefits of conservation and connectivity. That conference, specifically targeting coastal counties to educate leaders on Green Infrastructure, will be held in October 2011 in Savannah, Georgia and is sponsored by the National Association of Counties (NACo).

In addition to statewide conferences and group presentations, ACCG has offered to arrange and attend individual meetings with target counties from Southeast Georgia. In particular, ACCG and GFC staff have identified a few Southeastern counties for green infrastructure implementation to possibly use as case studies for other coastal counties. ACCG staff has continually expressed a willingness to arrange and attend meetings with GFC staff for this purpose.

4. *Assistance with the development of a comprehensive plan that addresses growth management and resource conservation across geographical and jurisdictional boundaries, including an analysis of current land-use policies and practices. Other outcomes include stakeholder meetings, prioritizing and mapping of key landscapes, identification and mapping of greenspace and transportation corridors, development of Community Wildfire Protection Plans and incorporation of Firewise practices at a community level.*

UPDATE: The Georgia Department of Natural Resources is utilizing the habitat maps that were created through the CGLCI to develop a regional analysis of Georgia's coastal counties that will inform local governments, state agencies, and coastal citizens about regionally significant habitats. This regional analysis will be an additional tool to the information counties already have about the global significance of habitats present within their specific jurisdictions. Once the regional analysis is complete, GFC, ACCG, and the other CGLCI partners can work to encourage local government and regional leaders to utilize the information to create growth management plans that take into account the needs and resources of the entire coastal region and that will maximally protect the resources of local, regional, and global significance that exist in Southeast Georgia.

5. *Next Steps.*

RECOMMENDATIONS: Although ACCG's formal partnership with the GFC is coming to an end, there are several action items that ACCG recommends to help further the goals that the two organizations have shared in this collaborative effort. The following are specific recommendations offered by ACCG to help continue the mission of promoting conservation and green infrastructure in Southeast Georgia:

- Attend and present on the benefits of land and forest protection to the local government officials attending the National Association of Counties' Coastal Forum, October 27-28 in Savannah, Georgia.

- Identify one county in Southeast Georgia with which GFC can work to implement a countywide green infrastructure plan that can serve as a case study for other counties in coastal Georgia and throughout the state. ACCG has recommended Charlton County as a possible opportunity due to: (1) a relative lack of existing land use regulations in that county, (2) the existence of the Okefenokee Wildlife Refuge in that county that could serve as a green infrastructure hub, and (3) a demonstrated interest by new local officials regarding conservation and eco-tourism as an economic benefit for their county.

- Meet with staff at the Coastal Resources Division of the Georgia Department of Natural Resources to obtain access to habitat maps generated through the Coastal Georgia Land Conservation Initiative and to learn how the Vista software might be utilized to help inform the development of county and regional green infrastructure plans.

- Promote the conservecoastalgeorgia.org website and the habitat information made available through the CGLCI as a resource for leaders and landowners in Georgia's coastal region.

- Continue to utilize ACCG as a resource for reaching out to county officials by calling on ACCG staff to help arrange individual meetings with specific county officials, by submitting information and articles regarding green infrastructure and forest protection to be included in ACCG publications, and by attending ACCG conferences to promote green infrastructure and fire protection plans to local government leaders.

Building upon the above efforts and recommendations, the GFC partnered with the Coastal Regional Commission of Georgia to develop a set of Planning Guidelines for Green Infrastructure. The CRC expanded the partnership to include the other two regional commissions within the coastal area as well as DNR CRD and NatureServe, both of which were integral in the CGLCI.

Two regional outreach workshops were held in early May, 2012. Presentations from CRC, GFC and CRD were highlights of the workshops. Preliminary mapping results were presented and discussed as well.

APPENDIX E: WORKS CITED

Works Cited

(2012). Retrieved from American Forests: www.americanforests.org

Benedict, M., Allen, W., & McMahon, E. (2004). *Advancing Strategic Conservation in the Commonwealth of Virginia- Using a Green Infrastructure Approach to Conserving and Managing the Commonwealth's Natural Areas, Working Landscapes, Open Space and Other Critical Resources.* Arlington, VA: The Conservation Fund, Center for Conservation and Development.

Carr, M. H., & et al. (2002). *Final Report Southeastern Ecological Framework.* Atlanta, GA: U.S. Environmantal Protection Agency, Planning and Analysis Branch.

Coder, K. D. (2011). *Identified Benefits of Community Trees and Forests.* Warnell School of Forestry and Natural Resources, The University of Georgia.

Comer, P.J & J. Hak. 2009. NatureServe Landscape Condition Model. Technical documentation for NatureServe Vista decision support software engineering. NatureServe, Boulder CO.

EPA et al. (2008, January). *Managing Wet Weather with Green Infrastructure.* Retrieved from http://www.epa.gov/npdes/pubs/gi_action_strategy.pdf

Georgia Department of Natural Resources. (1977). *Environmental Corridor Study.*

Georgia DNR. (2005). *Georgia Wildlife Action Plan.* Georgia Department of Natural Resources Wildlife Resources Division.

Georgia Forestry Commission. (2001). *Georgia Model Urban Forest Book.* Georgia Forestry Commission.

Hunter, M. L. 1991. Coping with ignorance: The coarse filter strategy for maintaining biodiversity. Pages 266-281 in. Kohm KA, ed. Balancing on the Brink of Extinction. Wash. D.C. : Island Press.

Maryland Department of Natural Resources. (2003, May). *Maryland's Green Infrastructure*. Retrieved from http://www.dnr.state.md.us/greenways/gi.html

McMahon, E., & Benedict, M. (2006). *Green Infrastructure.* Washington D.C.: Island Press.

Noss, R. F. 1987. From plant communities to landscapes in conservation inventories: a look at the Nature Conservancy (USA). Biol. Conserv. 41:11-37.

Southern Forests for the Future. (n.d.). Retrieved from http://www.seesouthernforests.org

Sustainable Sites Initiative. (2009). *Guidelines and Performance Benchmarks.* The Sustainable Sites Initiative.

The Conservation Fund. (2012, January 1). *Green Infrastructure*. Retrieved from www.greeninfrastructure.net.

The Nature Conservancy. 1982. Natural Heritage Program Operations Manual. The Nature Conservancy, Arlington, Virginia (Unpublished). 238pp.

The Trust for Public land. (n.d.). *The Trust for Public Land-Conservation Vision & GIS*. Retrieved January 24, 2012, from http://www.tpl.org/what-we-do/services/conservation-vision/

Trees Are Good. (n.d.). Retrieved January 24, 2012, from Trees Are Good: http://www.treesaregood.com/home.aspx

U.S. Environmental Protection Agency. (2007, April 19). *Green Infrastructure Statement of Intent*. Retrieved from http://www.epa.gov/npdes/pubs/gi_intentstatement.pdf

Urban Forestry South. (n.d.). Retrieved January 2012, from http://www.urbanforestrysouth.org/

Vogt, Peter. 2010. Guidos v1.4. European Commision Joint Research Centre. http://forest.jrc.ec.europa.eu/download/software/guidos

USDA Forest Service. (2002). *The Southern Forest Resource Assessment Summary Report.* Southern research Station, USDA Forest Service.

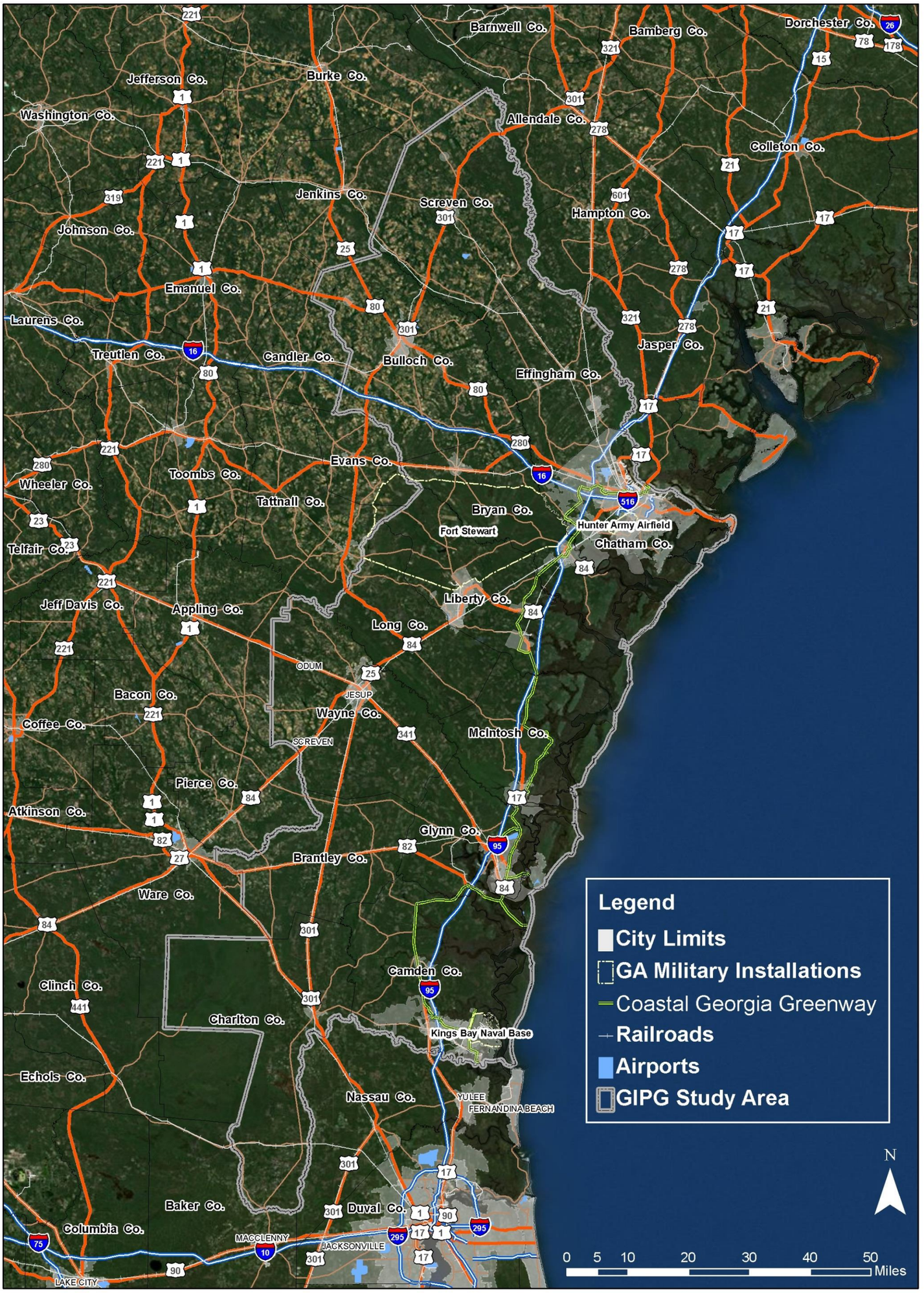
Wise, S. (2008, August/ September). Green Infrastructure Rising. *Planning*.

Young, R. F. (2001). Planting the Living City. *Journal of the American Planning Association, 77:4*, 368-381.

APPENDIX F: MAP SERIES

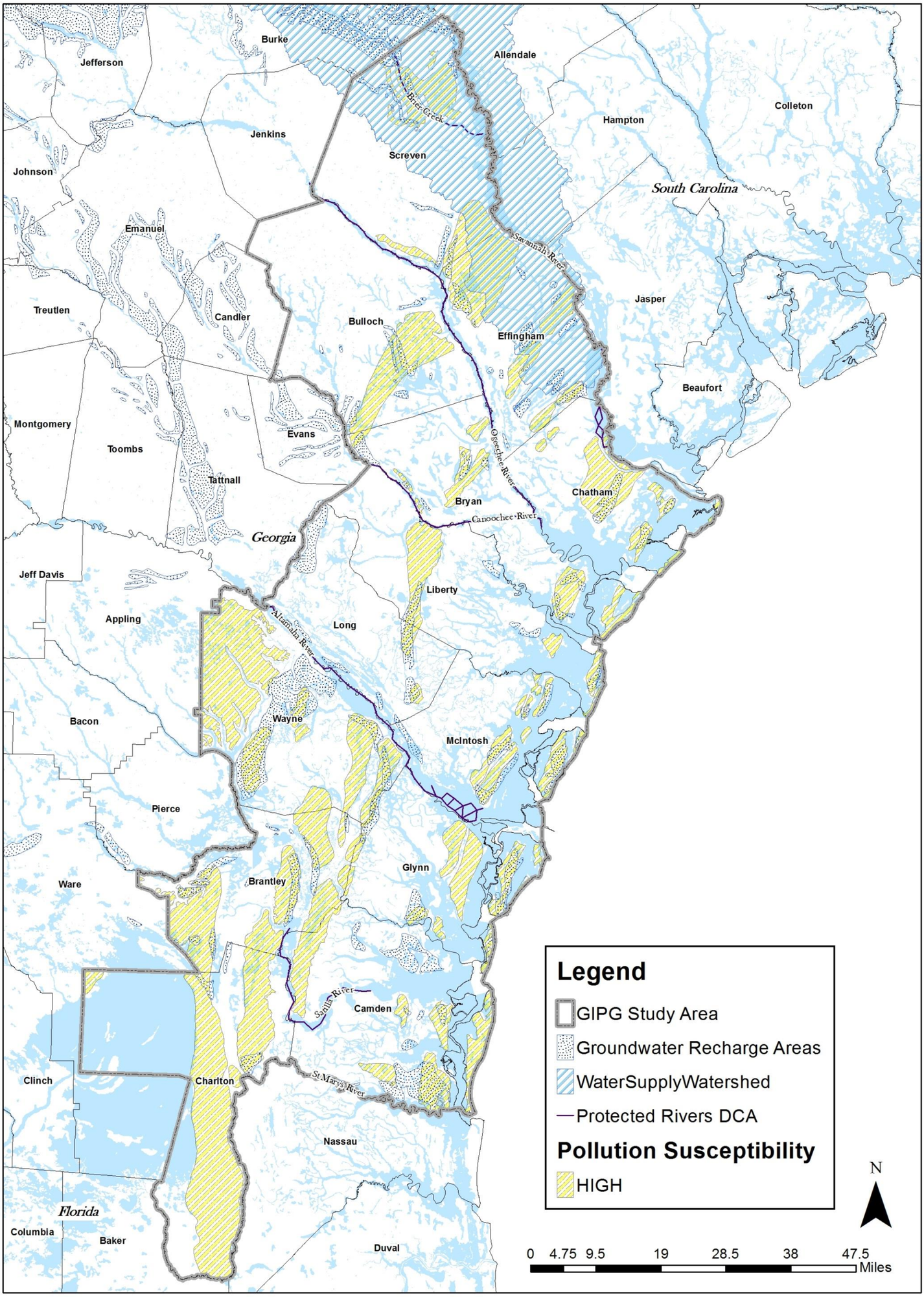
Green Infrastructure Planning Guidelines (GIPG)

MAP # 1
Study Area



Green Infrastructure Planning Guidelines (GIPG)

MAP # 2
Population Centers



Green Infrastructure Planning Guidelines (GIPG)

Coastal Regional Commission of Georgia

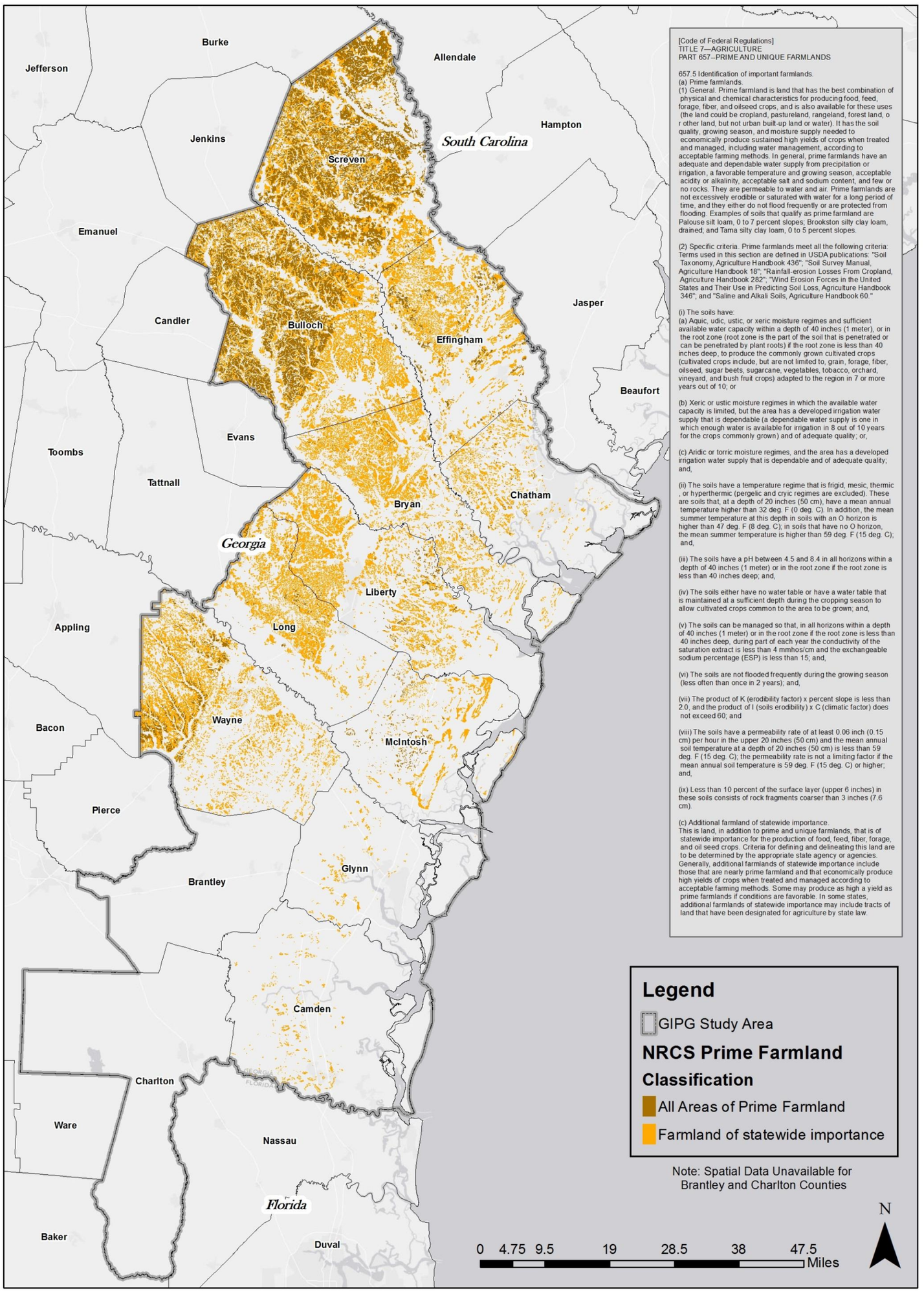
GEORGIA Department of Natural Resources Coastal Resources Division

NatureServe

Georgia Department of Community Affairs

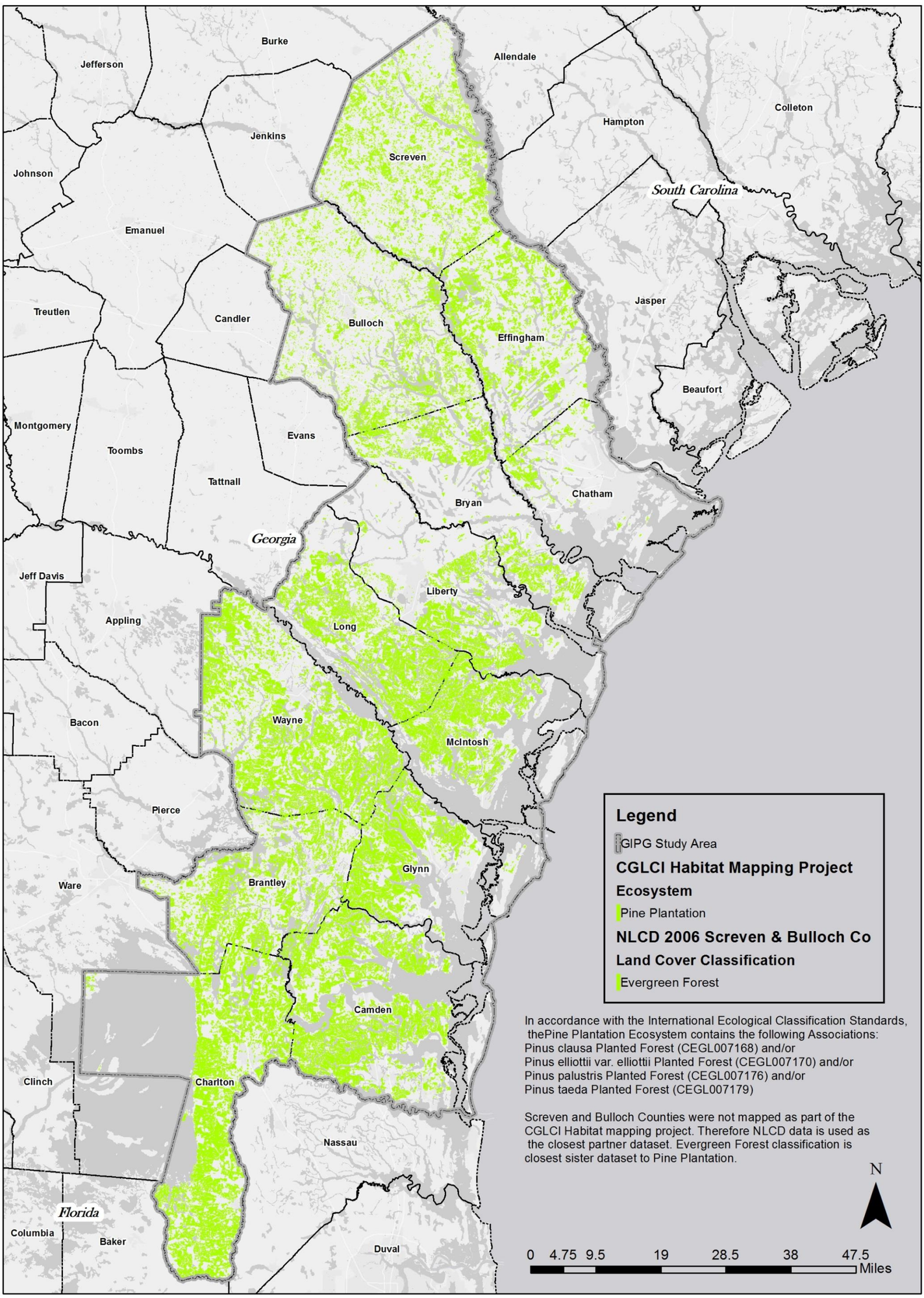
Heart of Georgia Altamaha Regional Commission

MAP # 6
Hydrology



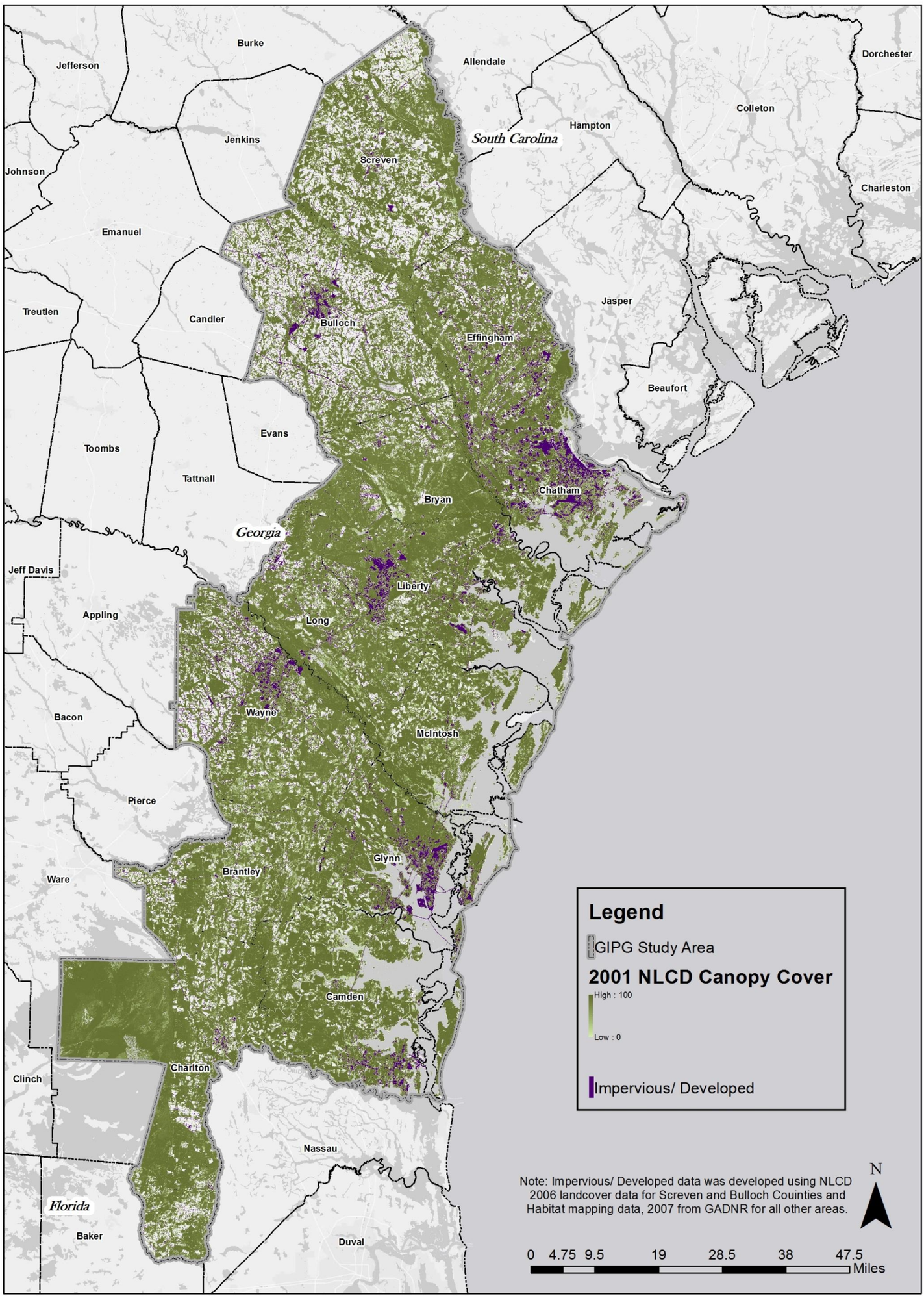
Green Infrastructure Planning Guidelines (GIPG)

MAP # 7
Natural Resources Conservation Services Prime Farmlands



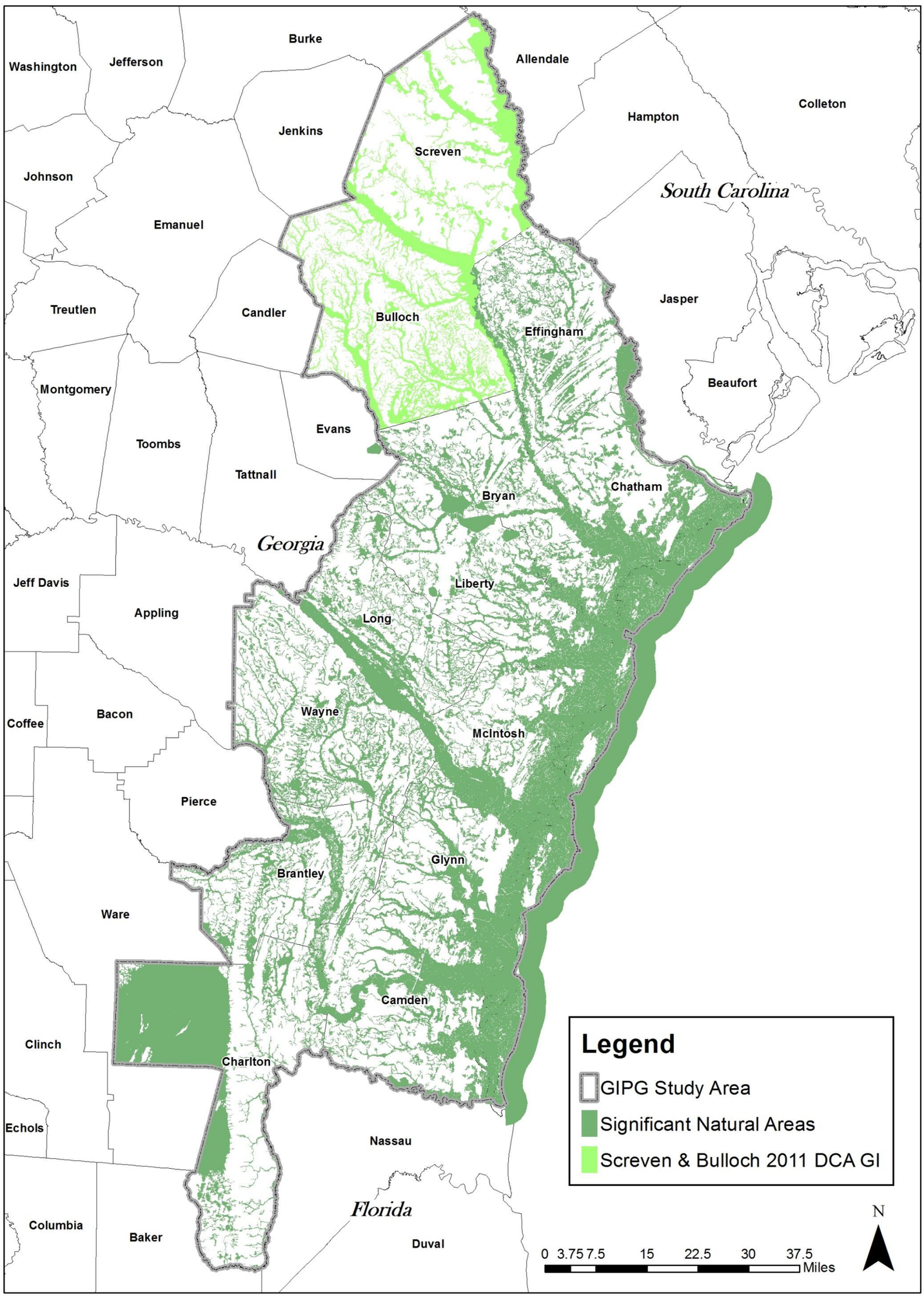
Green Infrastructure Planning Guidelines (GIPG)

MAP # 8
Pine Plantations



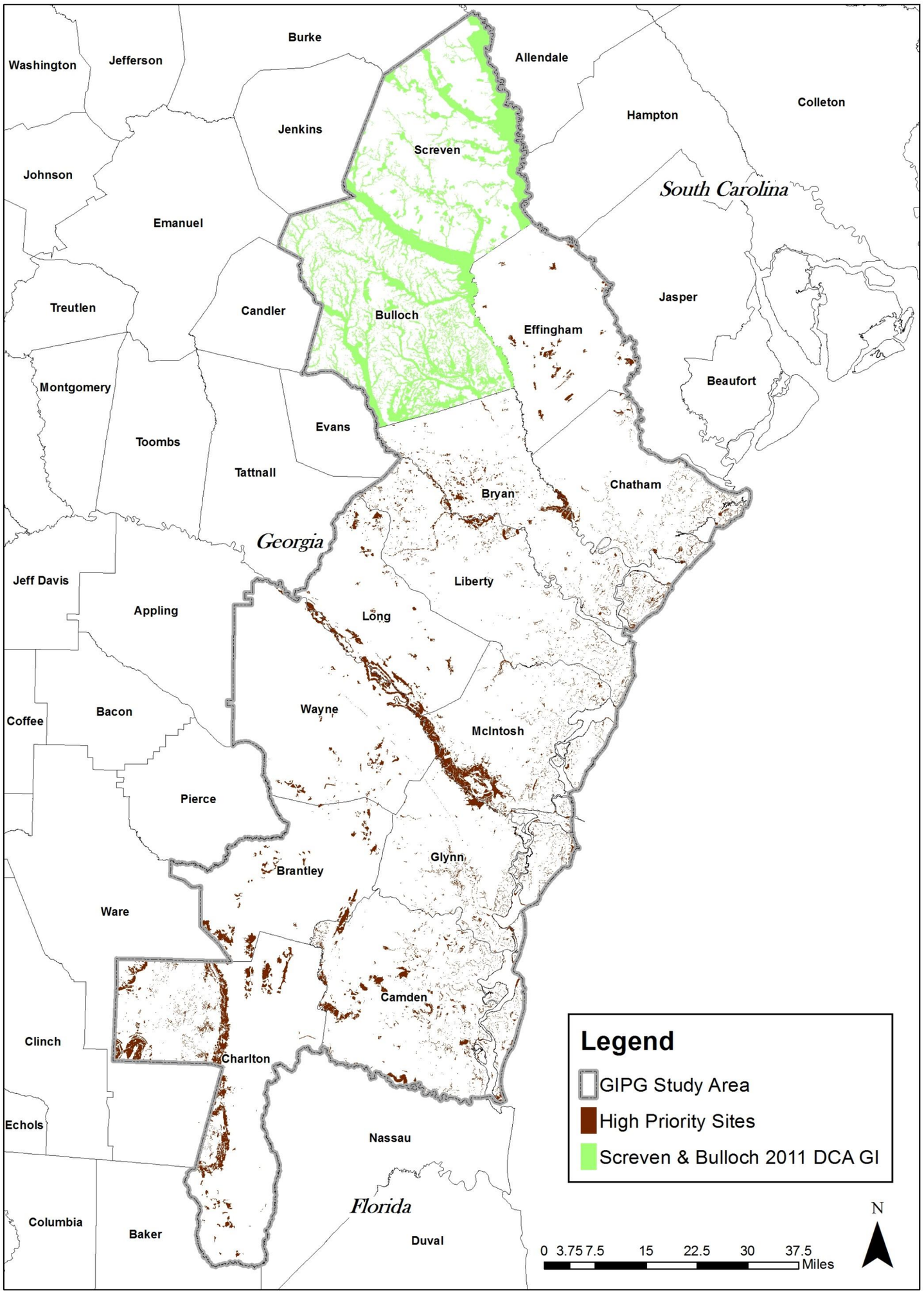
Green Infrastructure Planning Guidelines (GIPG)

MAP # 9
NLCD 2001 Canopy Cover



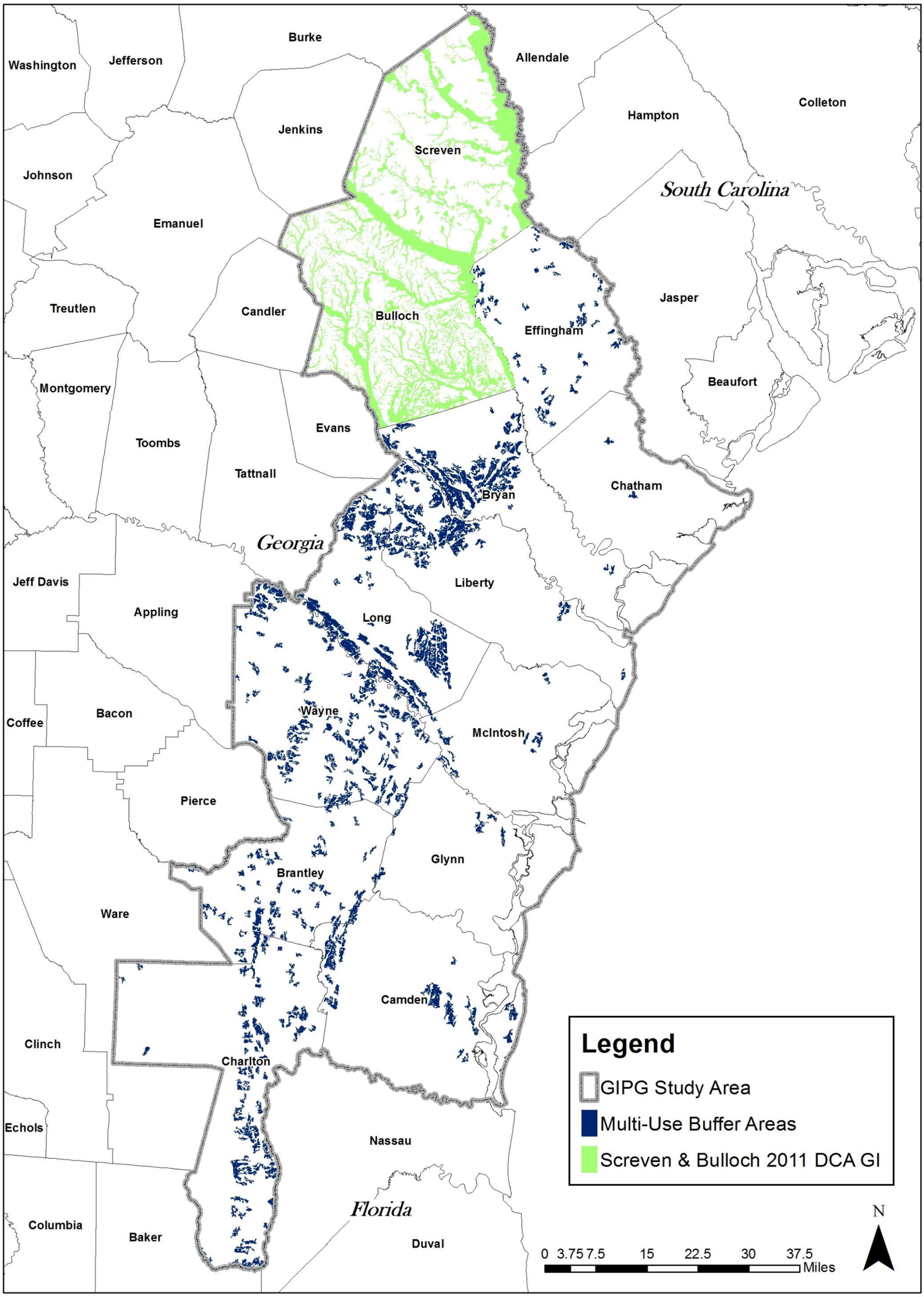
Green Infrastructure Planning Guidelines (GIPG)

MAP # 10
Green Infrastructure Network Components



Green Infrastructure Planning Guidelines (GIPG)

MAP # 11
Green Infrastructure Network Components



Green Infrastructure Planning Guidelines (GIPG)

Coastal Regional Commission of Georgia

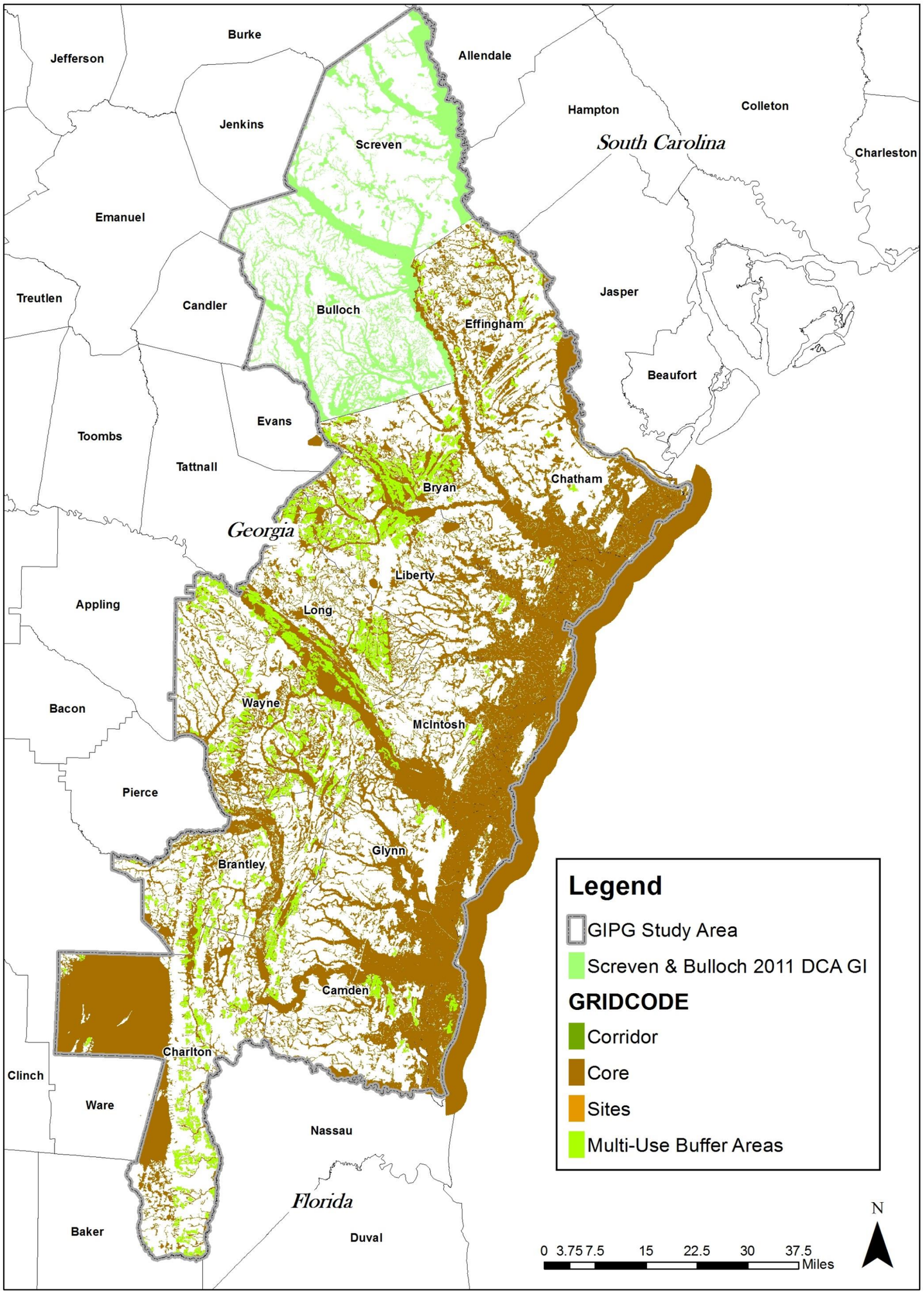
Georgia Department of Natural Resources Coastal Resources Division

NatureServe

Georgia Department of Community Affairs

Heart of Georgia Altamaha Regional Commission

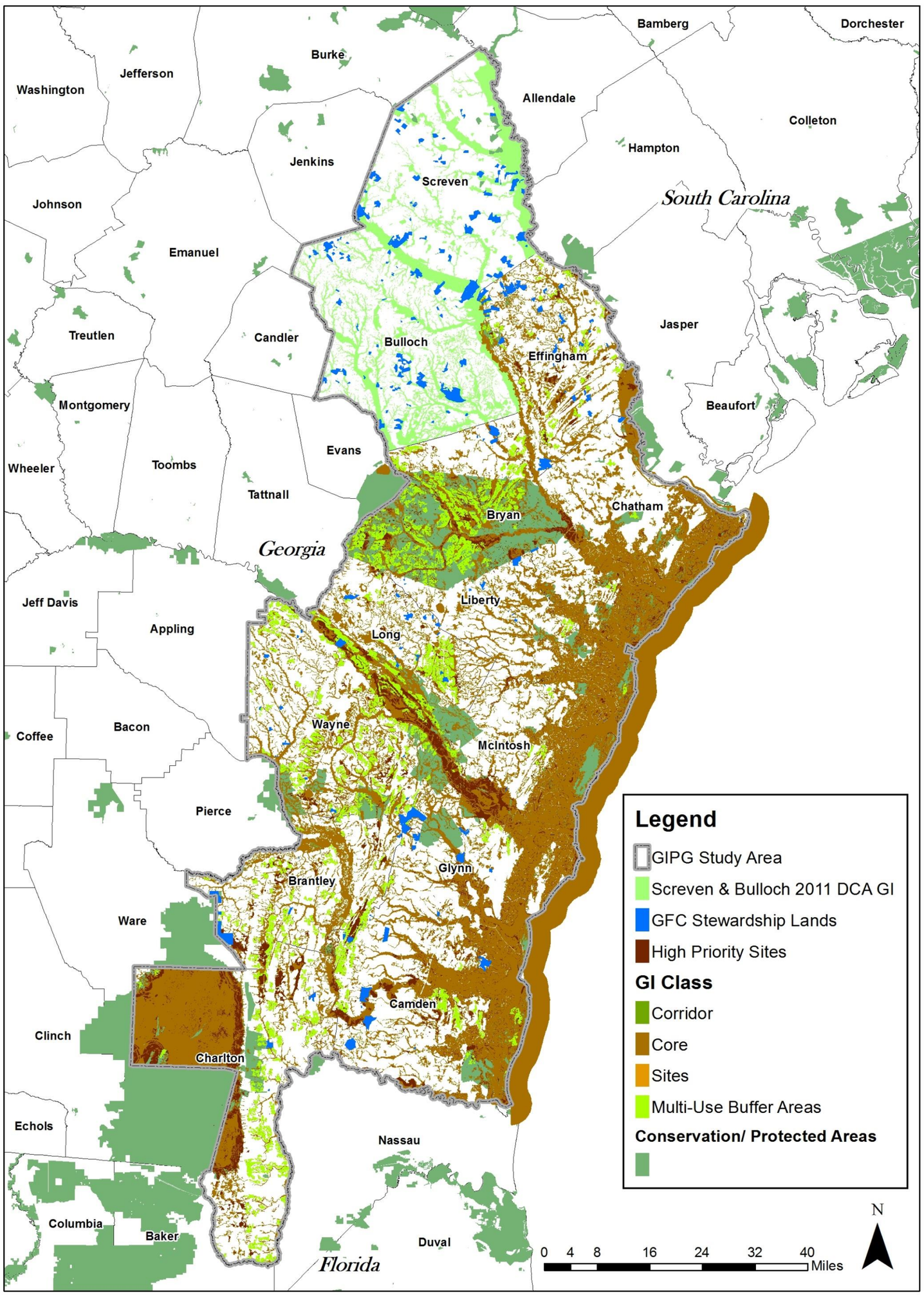
MAP # 12
Green Infrastructure Network Components



Green Infrastructure Planning Guidelines (GIPG)

Coastal Regional Commission of Georgia | Georgia Department of Natural Resources, Coastal Resources Division | NatureServe | Georgia Department of Community Affairs | Heart of Georgia Altamaha Regional Commission

MAP # 13
Green Infrastructure Network Components



Green Infrastructure Planning Guidelines (GIPG)

Coastal Regional Commission of Georgia · Georgia Department of Natural Resources Coastal Resources Division · NatureServe · Georgia Department of Community Affairs · Heart of Georgia Altamaha Regional Commission

MAP # 14
Green Infrastructure Network Components