



Community Associations and  
Stormwater Management:  
*A Coastal South Carolina Perspective*



**CLEMSON**  
PUBLIC SERVICE



*Total print cost: \$8,020.00*  
*Total number printed: 1,500*  
*Cost per unit: \$5.35*

# Community Associations and Stormwater Management:

*A Coastal South Carolina Perspective*

BY

Angela C. Halfacre, Daniel R. Hitchcock, and Jessi A. Shuler

WITH CONTRIBUTIONS BY

Megan Barkes

PUBLICATION DATE:  
July, 2007

This study was funded by the Urbanization and Southeastern Estuarine Systems (USES) Project.  
[www.urbanestuary.org](http://www.urbanestuary.org)





# Executive Summary

In coastal areas, localities are consistently faced with important decisions that will affect the short- and long-term quality of life in their communities. How to plan? When to preserve? What to protect? How to prosper? Residents often ask these questions and wonder how they can, or if they should be, involved with these debates. Coastal community citizens are seeking quality growth that balances economic development, human health, conservation, and environmental protection. The sustainable management of resources is one set of practices that can be used to address the changes spurred by growth while maintaining quality lifestyles for residents.

The population in coastal South Carolina is expanding at a rapid rate, and natural, cultural, and economic resources draw newcomers to and keep long-term residents in the area. Individuals are attracted to the South Carolina Lowcountry for its many appealing traits, including recreational opportunities (e.g., fishing, birding, boating, walking beaches) and the quality of the area resources. Water is a key resource to the sustainability of these recreational activities and is vital for the health of coastal communities. Specifically, residents are consistently facing challenges posed by stormwater and associated runoff and flooding. Promoting good water quality, environmental health, and community involvement are the goals of this *Water Quality Improvement and Community Enhancement Series*. This document — “Community Associations and Stormwater Management: A Coastal South Carolina Perspective” – is one in the series which attempts to provide specific mechanisms to address these goals.

Significant scientific research, such as the Urbanization and Southeastern Estuarine Systems (USES) project conducted in the South Carolina Lowcountry, has provided many results about the current state of water quality (and the impact of water quality on flora and fauna) and the extent of polluted runoff or nonpoint source pollution. These scientific results have provided recommendations that promote consistent protection of coastal water quality for human health and sustainable environmental management. Several of these recommendations point to the use of alternative stormwater management techniques to protect and improve water quality.

Inherent in this document is the recognition that cultural, environmental, and political variability exists from one community association to another. Community case analyses provide lessons learned for community associations in the coastal zone to enhance their protection of water quality and the involvement of stakeholders. Our approach captures stakeholder sentiment about the process and the level of success about the use of current environmental management techniques and consideration of alternative approaches.

This outreach document is intended to provide practical insight for communities, and especially community associations, that are seeking to devise strategies for the protection or improvement of their environmental resources. A focus on managing polluted runoff is one way that local residents, especially those in the eight coastal South Carolina counties, can directly participate in practices that not only improve water quality, but also enhance their community. We hope that the reader finds this document to be informative, useful, and timely.

Dan Hitchcock, PhD  
Assistant Professor  
Baruch Institute of Coastal  
Ecology and Forest Science  
Clemson University

Angela C. Halfacre, PhD  
Associate Professor of Political Science  
College of Charleston



# Table of Contents

	PAGE
Acknowledgements	6
1.0 Introduction	7
1.1 Defining the Problem	7
1.2 The Lowcountry of South Carolina	11
1.2.1 Geography and Watersheds	11
1.2.2 Natural Resources and the Environment	14
1.2.3 Economy and Culture	14
1.3 Examples of Relationships between Community Associations and Environmental Management	16
1.3.1 Benefits of Communal Governance	16
1.3.2 Residential Satisfaction, Quality of Life, and the Environment	16
1.3.3 “Not In My Backyard”	18
1.3.4. Community Associations and Stormwater Management	19
1.4. Nonpoint Source Pollution and Stormwater Management	20
2.0 The Focus Group Approach	21
2.1 Data and Methodology	22
2.2 Assessing the Residential Landscape and Mindset	22
2.2.1 Demographics and Community Representation	22
2.2.2 Awareness of Local Issues Associated with Development	27
2.2.3 Knowledge of Solutions	33
2.3 Summary of Findings: A Lowcountry Perspective	34
3.0 Solutions	35
3.1 Knowledge, Attitudes and Behavior	35
3.2 Stormwater Education and Outreach Strategies	36
3.2.1 Basic Stormwater Concepts	36
3.2.2 Engagement: Recommendations for Improving Homeowner Activities	37
3.2.3 Community Stormwater Management: Landscape Features	41
3.2.4 Community Stormwater Management: Stormwater Ponds	52
3.2.5 Community Stormwater Management: Maintenance	56
3.2.6 Addressing Stormwater Management: Community Associations	56
4.0 References Cited	58
Appendix A: Glossary of Terms	62
Appendix B: Useful Web Sites	66
Appendix C: Rain Garden Plant List	70
Appendix D: Vegetated Buffer Plant List	73
Appendix E: Maintenance Checklist for Homeowners and Community Associations	76





# List of Figures

**FIGURE 1.**  
Total Projected (except 2000) Populations by County  
(SC Budget Control Office) .....8

**FIGURE 2.**  
Total Projected (except 2000) Percent Population Density  
Change by County (SC Budget Control Office) .....8

**FIGURE 3.**  
South Carolina Coastal Counties and Associated Watersheds .....13

**FIGURE 4.**  
Community Associations (with red labels) Represented by Focus  
Group Participants (GH) from Georgetown and Horry Counties .....23

**FIGURE 5.**  
Community Associations (with red labels) Represented by Focus  
Group Participants (BCD) from Berkeley, Charleston, and  
Dorchester Counties .....24

**FIGURE 6.**  
Community Associations (with red labels) Represented by Focus  
Group Participants (BJC) from Beaufort, Jasper, and Colleton Counties .....25

**FIGURE 7.**  
A Diagram Indicating the Relationship Between Urban Planning,  
Stormwater Runoff, Nonpoint Source Pollution (or Polluted Runoff),  
and Quality of Life Impacts .....37



# List of Tables

**TABLE 1:**  
Summary of Focus Group Participant Demographics and Representation.....23

**TABLE 2:**  
Summary of Participant Responses to Questions about the Lowcountry .....28  
and Quality of Life

**TABLE 3:**  
Summary of Participant Responses to Questions about Lowcountry  
Communities and Associations.....29

**TABLE 4:**  
Summary of Participant Responses to Questions about  
Environmental Quality and Stormwater Management .....31





# Acknowledgements

University of South Carolina/National Oceanographic and Atmospheric Administration (USC/NOAA) Urbanization and Southeastern Estuarine Systems (USES) project funded this outreach document. The College of Charleston and Clemson University provided significant in-kind resource support.

Many individuals helped to make this project a success. Jeff Pollack of the North Inlet-Winyah Bay National Estuarine Research Reserve (NERR) Coastal Training Program and Rebekah Walker Szivak of the ACE Basin NERR Coastal Training Program were instrumental in providing assistance with outreach concept development and contacting focus group participants, as well as for reviewing the draft document. Sarah Skigen with the Town of Hilton Head was also very helpful in contacting focus group participants and in planning our focus group session in Beaufort County. Other document reviewers included Calvin B. Sawyer of Clemson University, Dr. Marie DeLorenzo and Dr. Tom Siewicki of the NOAA Center for Coastal Environmental Health and Biomolecular Research, Dr. Dwayne Porter of the USC Arnold School of Public Health, April Turner of the SC Sea Grant Consortium, and Sandra Salmon of the Community Associations Institute (CAI). Jack Whetstone of Clemson's Baruch Institute of Coastal Ecology and Forest Science reviewed portions of the draft, particularly those related to ponds. Dr. Norm Levine, College of Charleston Department of Geology and Environmental Geosciences, provided assistance in developing Geographic Information Systems (GIS) mapping of community associations in the region. Dr. Mitchell Colgan, College of Charleston Department of Geology and Environmental Geosciences, provided some of the photographs. Mark McConnell, Master of Environmental Studies (MES) Program Coordinator at the College of Charleston, was very helpful in assisting with grant administrative support. Alan Moore, a student in the MES Program at the College of Charleston, provided research support for the overview on stormwater and nonpoint source pollution management. The cover photo was provided by the students of the Department of Political Science Capstone conducted in May, 2006.

The authors particularly appreciate the participation of the focus group interview respondents. Their insight, honesty, involvement, and contributions were vital to creating and providing the most useful guidance for their communities and for other communities along the South Carolina coast.

Without the contributions of time, energy, and expertise of the individuals who participated in this study and assisted with the document preparation, this project would not have been possible.





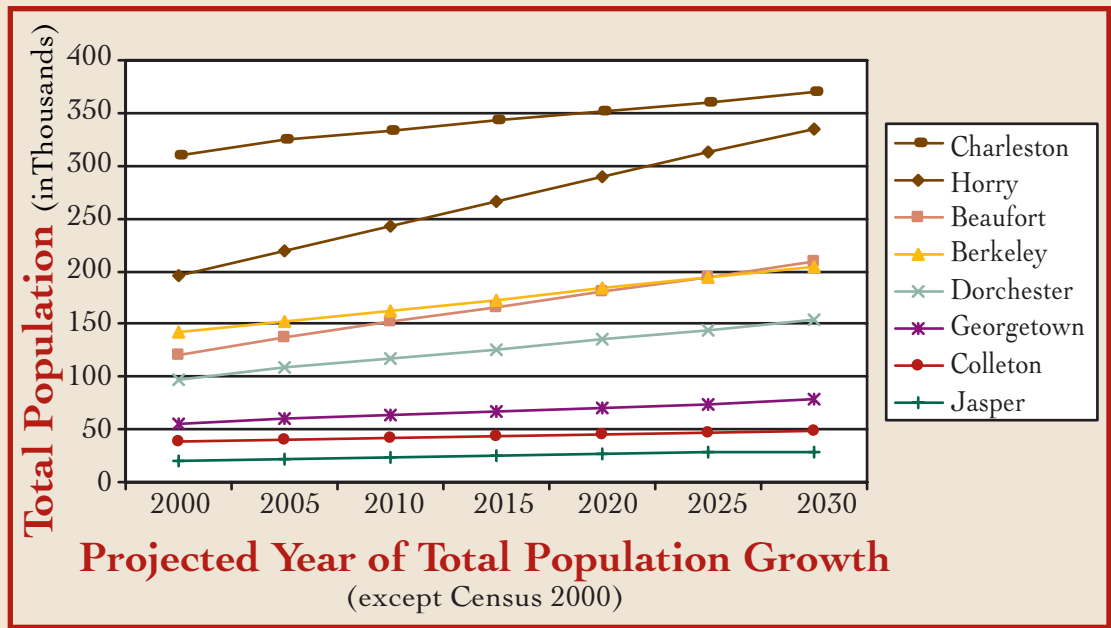
# 1.0 Introduction

Water resources are at the heart of the quality of life enjoyed by South Carolina's citizens and are the crux of the tourist economy. Further, coastal natural resources are valuable with respect to recreation, tourism, and commercial fisheries, and the protection of these resource-based activities typically depends on good water quality. The rate of development and subsequent impacts on water quantity and quality are potentially damaging to these coastal resources. A delicate yet necessary balance exists between encouraging economic growth and development while protecting and preserving coastal resources. Toward maintaining this balance, the everyday actions of individual citizens and communities can exert either a positive or negative influence on water quantity and quality management. Therefore, it is important that the growing South Carolina Lowcountry population be aware of the potential environmental consequences of their actions. In the specific case of stormwater management, small individual actions can have large communal or regional effects. Stormwater is defined as water resulting from a rain event that can typically move quickly to water bodies due to impervious (hard, undrainable) surfaces. Improperly managed stormwater is also known as "runoff." The purpose of this manual is to provide guidance for Lowcountry citizens and community associations toward understanding environmental perceptions and issues while recommending certain behavior changes and possible solutions, especially with respect to stormwater management.

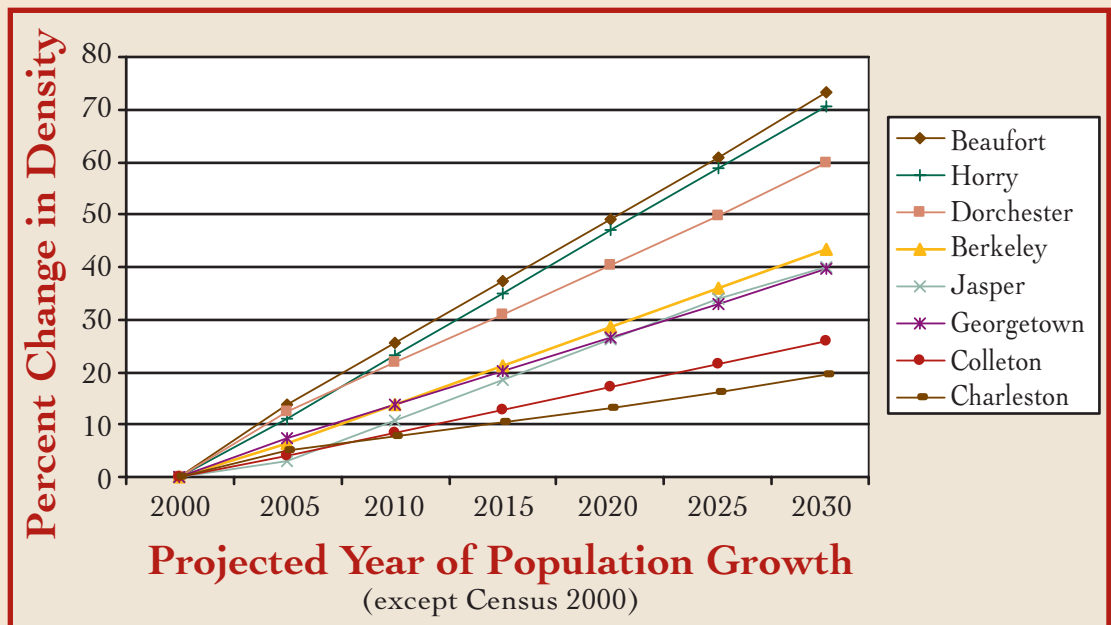
## 1.1 Defining the Problem

Throughout the United States, the growth of coastal populations and the subsequent expansion of residential areas is rapidly encroaching upon the open space of undeveloped and rural lands. This growth trend is particularly evident in the Lowcountry region of South Carolina. The coastal counties of South Carolina experienced a population growth rate of 151 percent from 1950-2000, compared to an increase of only 86 percent for the national population (South Carolina Budget and Control Board, 2006). Projected total population and population density trends for the eight coastal counties representing a majority of shoreline in South Carolina are presented in Figures 1 and 2, respectively. By 2030, the eight counties are projected to see an average percent increase in population density per square mile of land area of 46% with a range of approximately 20% in Charleston County to 73% in Beaufort County (South Carolina Budget and Control Board, 2006). The future population growth in the Lowcountry has the potential to impact the remainder of currently existing natural areas and undeveloped lands. With increasing population density, the construction of new infrastructure for residential and commercial development is expected to increase, which typically leads to the conversion of farms and forests into urban areas as well as an increase in impervious surface area within a given watershed – changes which can have potentially profound impacts on coastal ecological health (Van Dolah et al., 2004). Many of these areas function to preserve and maintain biodiversity, wildlife habitat, environmental quality, recreational amenities, and open space; these factors ironically attracted much of the growing new population to coastal South Carolina in the first place (Elmendorf and Luloff, 1999; Bastian et al., 2002). Considering the population growth that has occurred and will continue to occur, land-use planning for new developments and sustainable management of existing developed lands are emerging as key elements to addressing urban development patterns.





**FIGURE 1.**  
**Total Projected** (except 2000)  
**Populations by County** (SC Budget Control Office).




**FIGURE 2.**  
**Total Projected** (except 2000) **Percent Population**  
**Density Change by County** (SC Budget Control Office).

As residential growth in the Lowcountry increases at a remarkable rate, the developing areas are typically dominated by subdivisions, driven by the attraction of available, and sometimes more affordable lands, as future residents move away from urban centers into suburban and rural areas. Often, the attraction of future residents from urban centers is due to the availability of open space and natural amenities (Elmendorf and Luloff, 1999; Bastian et al., 2002; Austin, 2004). Within developed entities such as subdivisions, community associations are emerging as the new prevailing form of local governance (Kennedy, 1995; McCabe, 2005; Nelson, 2005). As of 2005, greater than 54 million Americans lived within a community association, a category which includes homeowners associations, property owners associations, condominiums, cooperatives, and other gated and planned communities (Community Associations Institute, 2005). According to Nelson (2005), the powers of community associations or homeowners associations in many areas exceed those of the local governments. In many cases, these organizations have gained increasing control over local municipalities in providing goods and services at the neighborhood level. Community associations are considered private, non-profit organizations, but are typically financed by assessments or fees. The associations often provide services normally left to the local municipality, such as streets, lighting, water, and sewage, including stormwater management and the maintenance of other common areas (McCabe, 2005; Chen and Webster, 2005). Growing numbers of developments are governed by these community associations in coastal South Carolina, and the question often arises as to whether these associations are willing to or can provide and maintain the natural amenities, landscape, and environmental quality that may have attracted homebuyers away from the urban areas.

Beyond planning strategies and policies, stormwater management is of particular environmental concern and regulatory interest in developed and developing areas. Nonpoint source pollution includes both natural and human-made pollutants from diffuse sources that are collected in stormwater or runoff which flows into water bodies (EPA, 2005). Nonpoint source pollution is also known as “polluted runoff”. The United States Environmental Protection Agency has reported nonpoint source pollution to be the number one threat to surface water quality nationwide (Sleavin and Civco, 2000). Stormwater ponds, lakes, and lagoons have become common management practices in addressing water quantity or flooding in urban and suburban neighborhoods, especially in subdivisions. These ponds and other constructed bodies of water, which are designed to collect runoff from upland areas and retain (store) stormwater runoff, are prevalent in coastal South Carolina. Two types of ponds, typically referred to as wet detention and dry detention, can hold water either for a long-term period (weeks to months) or for a short time (days) after a storm event, respectively. Both types of ponds are designed to allow sediment, and thus any sediment-associated pollutants, to settle out before the water leaves the pond and enters natural waterways (SCDHEC, 2001). Stormwater ponds are typically designed based on the ability of the pond to capture rain from a certain size storm event and also remove 80% of sediment (in the form of total suspended solids) associated with runoff during construction and land disturbance activities. Further, and of equal importance, stormwater ponds require ongoing maintenance if they are to continue their desired effectiveness in managing water quantity and quality over the long term. Without proper care, these ponds can become less able to manage stormwater quantity and quality. In addition, stormwater ponds may not be adequate or even the best option to control all stormwater or runoff. For example, these ponds have been documented to be poor treatment practices for nutrients, which, upon accumulation, can lead to algal blooms and fish kills (Lewitus et al., 2003). In many communities in coastal South Carolina, these ponds are perceived as amenities for recreation, including swimming, boating, and fishing, as well as landscape features that are aesthetically pleasing and have the ability to increase real estate value. All ponds require routine inspection and maintenance, and the community association is often responsible for these tasks. If not adequately maintained, stormwater ponds can become visibly unpleasing, breed mosquitoes, and create undesirable odors. Required maintenance may include dredging and weed control, among other activities (SCDHEC-OCRM, 2001). Generally along the South Carolina coast, local stormwater management, including responsibility for ponds and other





stormwater management practices, is falling into the hands of community associations, even if pond management services are utilized. Therefore, the given perceptions of community associations about stormwater management, nonpoint source pollution, and water quality issues, as well as their understanding of practices for managing polluted runoff, are important for sustaining water resources in coastal South Carolina.

Studies have shown that perceptions and knowledge about the environment influence environmental attitudes (Kaltenborn, 1998; Stedman, 2003; Thompson, 2004). This document explores homeowner perceptions of the environment through the use of content or qualitative analysis of focus groups made up of community association members throughout the Lowcountry of South Carolina, which includes the eight coastal counties: Horry, Georgetown, Berkeley, Charleston, Dorchester, Colleton, Beaufort, and Jasper.

**The primary overarching research question that is the focus of this document is:**

*How do Lowcountry community association members' perceptions and knowledge about the environment and quality of life affect their attitudes about stormwater management and pollution?*

The following secondary questions can be posed for addressing the proposed overarching research question, specifically for the purposes of developing the focus group survey instrument and for creating these connections through analysis of the resulting data:

1. Do the majority of these selected community association members perceive the quality of their environment to be good?
2. Is this perception important for having a high quality of life?
3. Does the belief in good existing environmental quality signify a lack of knowledge in stormwater management issues?
4. Does the recognition of the importance of environmental quality to the quality of life indicate a willingness to gain knowledge to address certain existing and future environmental problems, including those associated with stormwater and nonpoint source pollution?



## 1.2 The Lowcountry of South Carolina

The Lowcountry is a term typically used to describe South Carolina's coastal counties. The region supports a remarkably diverse community with various appealing characteristics, including a moderate climate, rich culture, beautiful land and seascapes, extensive water and related resources, and a deep historical heritage. The Lowcountry of South Carolina is a unique region in terms of its geography, natural resources, economy, and culture.



A marshview sunrise with the Morris Island Lighthouse in the distance, Charleston County, SC.

(Photo credit: Mitchell Colgan)



### 1.2.1 Geography and Watersheds

The Lowcountry is typically defined as any land east of the fall line of South Carolina's Atlantic bound rivers. More specifically, however, the Lowcountry is characterized by numerous creeks and rivers, tidal marshes, sea islands, an extremely flat topography, and a shallow water table. From the northern boundary at Little River Inlet south to the Savannah River, the geography of the Lowcountry is extremely popular with residents and tourists alike because of its abundance of water resources, warm climate, and numerous beaches.



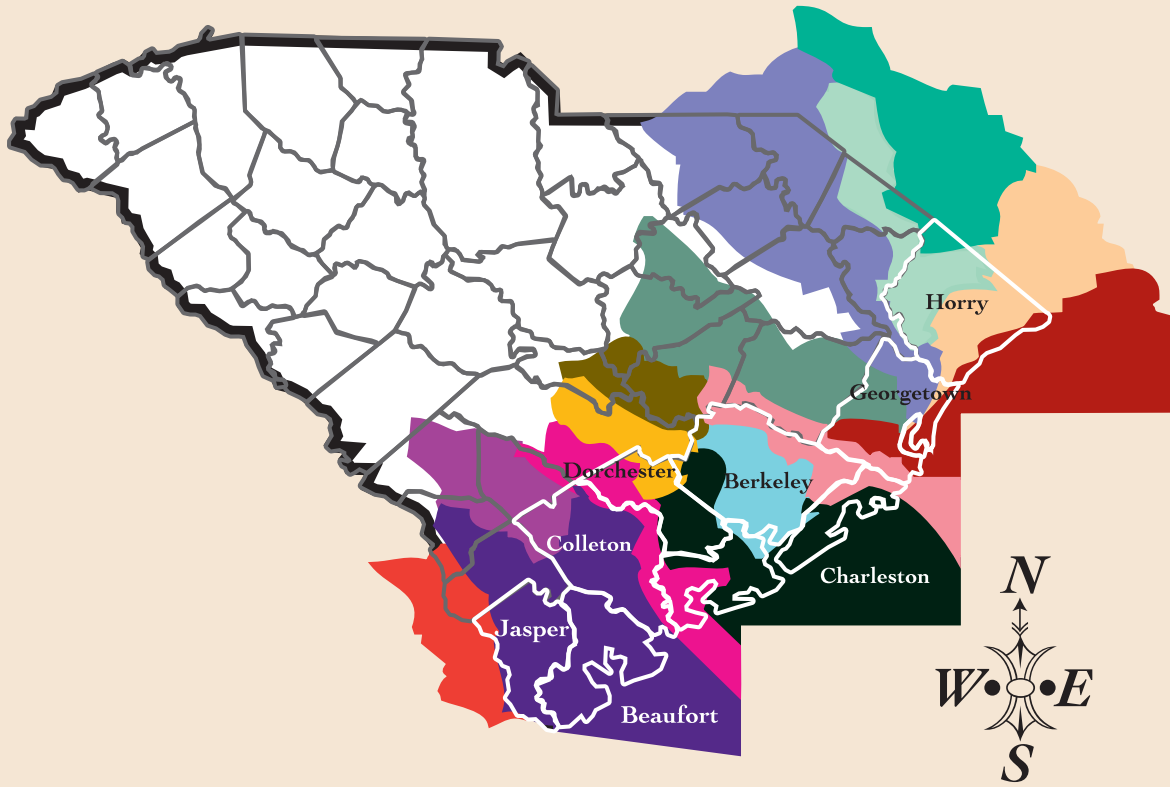


Everyone, including Lowcountry citizens, lives within a watershed, which is defined as the area from which all water drains to a specific, usually single, surface discharge point. According to the SCDHEC Bureau of Water, Watersheds and Planning Division (<http://www.scdhec.net/environment/water/shed/>), the eight counties of the Lowcountry cross 15 distinct watersheds, based on the 8-digit HUC (Hydrological Unit Code) system (Figure 3). By county, from north to south along the South Carolina coast:

- Horry County* crosses the Carolina Coastal-Sampit, Lower Pee Dee, Little Pee Dee, Waccamaw, and Lumber River Watersheds;
- Georgetown County* crosses the Santee, Carolina Coastal-Sampit, Black, Lower Pee Dee, Little Pee Dee, and Waccamaw River Watersheds;
- Berkeley County* crosses the Four Hole Swamp, South Carolina Coastal, Cooper, Lake Marion, and Santee River Watersheds;
- Charleston County* crosses the Edisto, South Carolina Coastal, Cooper, and Santee River Watersheds;
- Dorchester County* crosses the Edisto, Four Hole Swamp, South Carolina Coastal, and Cooper River Watersheds;
- Colleton County* crosses the Broad River-St. Helena Sound, Salkehatchie, and Edisto River Watersheds;
- Beaufort County* crosses the Broad River-St. Helena Sound Watersheds;
- Jasper County* crosses the Broad River-St. Helena Sound and Lower Savannah River Watersheds.

For more information about South Carolina watersheds, including statewide river basins as well as smaller local watersheds, visit <http://www.scdhec.net/eqc/water/shed/home.html>. Also, for more local watershed information, visit [www.epa.gov/surf](http://www.epa.gov/surf).

**FIGURE 3.**  
**South Carolina Coastal Counties and**  
**Associated Watersheds.**



- |  |  |
|--|--|
|  Black River             |  Lower Pee Dee River              |
|  Broad-St. Helena Sound  |  Lower Savannah River             |
|  Carolina Coastal-Sampit |  Lumber River                     |
|  Cooper River            |  Salkehatchie River               |
|  Edisto River            |  Santee River                     |
|  Four Hole Swamp         |  South Carolina Coastal Watershed |
|  Lake Marion             |  Waccamaw River                   |
|  Little Pee Dee River    |  |





## 1.2.2 Natural Resources and the Environment

The Atlantic Ocean and Intracoastal Waterway offer a variety of boating activities from kayaking to fishing for red fish, sea bass, cobia, and others. The South Carolina coastal landscape consists of unencumbered wetlands, marshes, creeks, and rivers that provide ecological habitat for hundreds of species of plants and animals. The marshes and rivers provide homes for species like fish, crabs, shrimp, and oysters. The Lowcountry is located directly on the coastal migratory route for a multitude of bird species. Raccoons, white-tailed deer, bobcats, and coastal foxes are also prominent in the Lowcountry. “The plant diversity is also vital to the Lowcountry and there are longleaf pine sandhills, bottomland hardwood forests, cypress-tupelo swamps, and savannas” (Porcher, 1995). Due to population growth pressures, there has been a dramatic shift in traditional land uses, incompatible land use practices, and ecological disturbances that all potentially threaten the natural resources of the Lowcountry region. South Carolina has an estimated 400,000 acres of coastal marsh and 100,000 acres of tidal wetlands (TNC, 2005). Conservation easements are a vital tool that allow landowners to voluntarily protect the ecological features of their property in perpetuity through a legal agreement with conservation organizations. Conservation groups such as the Nature Conservancy and the Coastal Conservation League are making great strides in preserving and protecting natural spaces. Further, environmental preserves in coastal South Carolina, such as the Cape Romain National Wildlife Refuge, the Hollings ACE Basin National Wildlife Refuge, a variety of Wildlife Management Areas (WMAs), and the Francis Marion National Forest, are just a few examples of areas where open space is being preserved and maintained.

## 1.2.3 Economy and Culture

Both historically and today, the South Carolina Lowcountry is economically dependent on its natural resources. The plantation system became a popular style of agricultural life and was made possible with help from West African labor and technology. Rice was the crop that produced enormous wealth in the Lowcountry for 200 years. Enslaved West Africans cleared the swamps and built the dikes, canals, and other water control devices needed for rice cultivation. They planted, tended, and harvested the crop, as well as constructed and manned the boats that transported it to market.

One of the Lowcountry’s most valuable economic assets is tourism, and areas such as Myrtle Beach, Charleston, and Hilton Head draw visitors from throughout the United States and around the world. Horry County has over 100 golf courses and is known to have some of the best beaches on the east coast, including Myrtle Beach. Tourists travel to Charleston to visit one of America’s most historic and culturally rich cities, to see historic buildings, to tour restored plantations, and to taste the Lowcountry cuisine. Hilton Head Island is popular because of its upscale atmosphere, world-renowned golf courses and resorts, and attractive beaches.

Although the tourism provides a significant economic contribution to coastal South Carolina, other industries contribute to the regional economy as well. Charleston’s port is one of the busiest in the country, and the cities of Georgetown and Beaufort are also involved in the shipping industry. The Lowcountry’s pine forests are harvested for paper production. Coastal tidal creeks, salt marshes, and the ocean support an important fishing industry; however, working waterfronts are in a decline, and many coastal amenities are becoming more and more difficult to access. Manufacturing is prevalent in certain hubs, but especially in the greater Charleston area. The military is also an economic driver in the region, with bases in Charleston and Beaufort. Economic development efforts are underway in the Lowcountry to bring manufacturing and technical jobs to the area which will pay better salaries and reduce its dependence on tourism.





In 1970, when South Carolina celebrated its Tricentennial, more than eighty percent of its residents had been born in the state. Today, new residents have presented a shift in focus in both political and economic policies for the state of South Carolina, as well as in residential and commercial development trends, especially in the Lowcountry region. Within the last 20 years, the Lowcountry has become a magnet for retirees, and many wealthy transplants have broadened the economic gap. There is a prevalent perception, and perhaps reality, that people from out-of-town, second-home owners, and the wealthy are populating a number of the barrier islands and coastal areas, turning tomato and tobacco fields and small towns into sprawling suburbs with subdivisions, condos, and golf courses. In the Charleston coastal areas, from 1990 to 2000 the number of households increased while the population fell because older households with one or two members are moving in while families with children are moving to more affordable developments. In addition to the changing shoreline, larger residential developments are moving further inland because of rising property taxes and land values on the coast and the abundance of affordable land farther up the watersheds (Tibbetts, 2005).

The Lowcountry has a special call for preservation related to the human ecology in the region — the Gullah culture. The Gullah people have a language, history, economic system, and artistic vision that make their presence and heritage a unique cultural resource and key attribute to the history of the Lowcountry (GGSRS, 2003). The Sea Islands off the South Carolina coast have provided Gullah roots for millions of African Americans. The coastal aquatic resources on which the Gullah culture historically depended are the same resources that are at risk from poorly managed coastal development today. Among these islands, the most heavily Gullah-populated areas are Edisto Island, Coosaw Island, Daufuskie Island, and St. Helena Island. The establishment of these particular communities has enabled the Gullah Geechee people to be autonomous, retain their own languages and dialects, and preserve their African culture.



A Sweetgrass basket maker practices her craft.





## 1.3 Examples of Relationships between Community Associations and Environmental Management

An assessment of community association and homeowner perceptions toward environmental issues requires a review of existing research studies and literature that has examined relevant analyses and trends. Related literature includes the acknowledged benefits of governance within a community beyond those available from local governments. Also, the perceived community relationships between the quality of life, environmental quality, a proximity to natural areas, and a sense of place have been explored in various studies. Several studies have focused on interactions within a community, including relationships between personal possessions and property ownership and subsequent responses to environmental issues. Some studies have explored various levels of community perceptions toward, and their responsibility for, stormwater management.

### 1.3.1 Benefits of Communal Governance

With the increasing presence and power of community associations, a number of studies have examined the reasons behind their popularity and the success of their communal governance. Foldvary (2002) states that subdivisions or planned communities governed by community associations typically provide and maintain amenities beyond those supplied by local governments. Residents are able to live in an area with shared amenities, such as a pool, tennis courts, or golf course that they may not have been able to afford on their own. Dissatisfaction with the public goods provided by local governments, such as security and water and sewage services also draws people to subdivisions with community associations that are able to provide these goods (Kennedy, 1995). In addition, the conditions, covenants, and restrictions (CC&Rs) that accompany these subdivisions are seen to maintain the character of the community and protect property values (Kennedy, 1995; MacCallum, 2002). Although the popularity of community associations is evident, questions have been raised about the effectiveness of their management of common areas and other services. McCabe (2005) states that homeowner associations face the same problems of communal ownership of common property and supervising and implementing regulations that local governments face. Even with mandatory assessments to finance these associations, participation in decision-making and management is not mandatory, which leads to apathy among many residents (Blandy and Lister, 2005) and the decline of environmental quality and other community features (Chen and Webster, 2005). Further, according to Blandy and Lister (2005), in a particular gated community governed by a community association, a majority of residents were not even aware of the full responsibilities of communal management at the time of their purchase.

### 1.3.2 Residential Satisfaction, Quality of Life, and the Environment

Given the amenity- and service-driven reasons for the popularity of subdivisions, coupled with the apparent lack of participation in community management, what aspects of these communities satisfy residents or contribute to their quality of life? Quality of life is an elusive concept that varies with each individual; however, residents' level of satisfaction with their neighborhood or subdivision provides some insight into how a person might define quality of life. Local residential satisfaction has been found to be an important predictor in overall life satisfaction or quality of life (Kearney, 2006). Various studies found the presence of nearby natural areas or views of nature to be an important indicator of neighborhood satisfaction (Kaplan and Austin, 2004; Kearney, 2006). Kearney (2006) found that the residents with the highest neighborhood satisfaction were those who had access to an expansive nature area within their own subdivision and those with vegetated space bordering their houses. Other studies have found that nature or wilderness views and surroundings, particularly those of water or woodlands, are preferred or more highly valued than those with human dominated structures (Bastian et al., 2002; Kaltenborn and Bjerke, 2002). The presence of natural areas, which implies



high environmental quality, appears to be an integral factor in determining community satisfaction and value; therefore these studies show that the surrounding environment appears to significantly contribute to residents' overall quality of life.


Why might one's physical surroundings play such a large role in quality of life? Stedman (2003) asserts that this influence is due to the contribution of the physical environment to sense of place. Sense of place can be defined as the attachment, meanings, and satisfaction that one applies to his/her different environments to give value and stability to his/her existence (Kaltenborn, 1998). According to Kaltenborn (1998) those residents with a strong sense of place perceive the environment as being less degraded from a natural state, although sense of place is vulnerable to significant changes in the physical landscape (Stedman, 2003). If the physical environment is important to place attachment and satisfaction, then continued environmental degradation, which can be a result of increased development or deficient management, will lead to a loss of sense of place and a decline in quality of life (Stedman, 2003).

The environment or environmental quality plays an important role in neighborhood satisfaction, quality of life, and sense of place; however these concepts are all based on residents' perceptions of the environment. Environmental perception and knowledge possess a strong influence on residents' attitudes, but perception does not always reflect reality. A South Carolina study commissioned by SCDHEC (2003) examined public perceptions about nonpoint source pollution and polluted runoff. These researchers found that just over half of the people surveyed did not know whether or not stormwater was treated and almost 20% believed that it was treated. In addition, over 30% of people incorrectly believed that industries cause more water pollution than farms and cities. Other studies have found that perceptions and knowledge about water quality or environmental quality are based on the distance from the water or the existence of previous degradation (Brefle et al., 1998; Austin and Kaplan, 2003; Brody et al., 2005).



An aerial photograph of residential development existing directly adjacent to forested areas.





The concept of the conservation subdivision, introduced by Arendt (1996), is a land-use planning approach that incorporates cluster development on relatively small lots with open space conservation of natural areas or sensitive lands either owned and/or managed communally by homeowners, land trusts, a private landowner, or a public entity. These developments attempt to accommodate residential growth while preserving natural areas for community enjoyment and protection of environmental quality (Austin, 2004). The conservation subdivision approach attempts to remedy the problems associated with traditional subdivision design, which basically subdivides a property by a minimum lot size, leaving little open space and potentially disrupting the function of many natural features, including sensitive lands and wildlife habitat, while fracturing landscapes and increasing impervious (hard) surfaces (Elmendorf and Luloff, 1999; Austin, 2004; Arendt, 2004; Kaplan and Austin, 2004). Although this innovative planning technique appears to be effective in conserving sensitive lands, which typically include forests and wetlands as well as other natural areas (Arendt, 2004), the conserved open space still may be communally owned and managed by the community association. The preservation of these lands does not necessarily imply that they are going to be managed in a sustainable and ecologically-sound fashion.

A notable example of sprawl impact assessment that is local to coastal South Carolina is the Belle Hall Plantation Charrette (Caban, 1994). The reported analysis of stormwater runoff differences between traditional and sprawl development scenarios was focused on a specific proposed development site, Belle Hall Plantation, which is located in Charleston County in north Mount Pleasant and adjacent to Rat Hall Creek which flows into the Wando River. Three scenarios were assessed through modeling efforts of stormwater runoff: Undeveloped, “town” and “sprawl”. The undeveloped scenario was defined as the category name implies and was based on the 1990 land use prior to development. The “town” scenario included mixed-use development (integrated residential and commercial) similar to that of downtown Charleston or the Old Village of Mount Pleasant. The “sprawl” scenario indicated a development strategy of low density housing with no mixed-use development (residential only) and is typically considered as the current traditional approach for development. Researchers determined through modeling efforts that the “sprawl” scenario “had eight times greater runoff than the undeveloped watershed and 43 percent higher than the ‘town’ scenario”. Further, the “sprawl” scenario had “ten times greater sediment loads than the undeveloped watershed” and “three times greater sediment loads” than the “town” scenario. Similar results were shown for sediment nitrogen and for oxygen demand. The report notes that computer simulation results demonstrated that “vegetated areas (e.g. green space, undeveloped land) were important in reducing sediment loads transported to the watershed outlet”.

### 1.3.3 “Not In My Backyard”

Contributing to the influence of environmental perceptions and knowledge, the development of residents’ attitudes about environmental behaviors and action often depends on whether the resident is directly affected by environmental degradation or perceives a high risk of being affected (Smutko et al., 2002; Austin and Kaplan, 2003; Thompson, 2004; de Loë and Kreutzwiser, 2005). This dependence has often been referred to as the “not in my backyard” or a “NIMBY” reaction. Awareness and/or action about an environmental issue, such as water quality or stormwater management, often does not cross a community’s radar or raise concern from residents until they experience problems or a crisis related to the issue at hand (de Lo and Kreutzwiser, 2005). This reactionary approach to environmental management is a problem that plagues many community associations, even those of conservation subdivisions, in their planning and management of common areas (Austin and Kaplan, 2003).

Research has identified that another characteristic that correlates with the willingness to engage in or with attitudes about environmental action is a community member’s length of residency (Spain, 1993; Johnston et al., 2003; Cho et al., 2005). In examining




homeowners' willingness to pay for conservation easements in Macon County, North Carolina, Cho et al. (2005) found a negative correlation between willingness to pay and duration of residence in the county; as length of duration increased, residents' willingness to pay decreased. Spain (1993) found this negative correlation between length of residency and environmental concern or action to be particularly true when addressing residential growth in rural communities. She explains that the newcomers are more likely to want to stop or control increased development, whereas long-term residents are more likely to welcome any type of development because they have experienced decades without economic investment. Additionally, newcomers do not want the rural qualities that attracted them to the region to be destroyed by further development, reducing their quality of life and property values. Newcomers are not only more concerned about the environmental quality, but they are more likely to be willing to take action to protect their interests, (Spain, 1993; Johnston et al., 2003) including participating in political processes and organizing the community (Spain, 1993). In considering the use of conservation subdivisions as an environmental action to address negative aspects of traditional subdivision development, long-term residents tend to be less supportive than newcomers with regard to preserving open space and the use of cluster development, two aspects that characterize these developments (Johnston et al., 2003).

### 1.3.4 Community Associations and Stormwater Management

Stormwater management and responsibility for it have emerged as important environmental issues, particularly given the increased development of subdivisions collectively managed by community associations. These associations are typically responsible for the management of common areas, which includes maintenance of stormwater management practices and sometimes infrastructure modifications. Conventional stormwater management occurs through the current common practice of using curb and gutter infrastructure, which includes conveying flows into storm drains and pipes. Given the out-of-sight, often subterranean, nature of conventional stormwater infrastructure, "residents typically have little or no idea what happens to water after it drops into the storm drain and disappears into an underground system of pipes" (Thompson, 2004). In subdivisions, stormwater ponds are now a common sight, but in some cases these ponds are designed by people not specifically trained in hydrology and hydraulics (Fennessey et al., 2001) and managed by community associations run by residents who often lack expertise in environmental and sustainable management (Austin and Kaplan, 2003). As previously discussed, stormwater ponds require ongoing maintenance, including monitoring and removal of sediment buildup that reduces the capacity and effectiveness of these ponds (Graham and Lei, 2000; Anderson et al., 2002). Community associations will often hire or contract a company that specializes in pond management and maintenance. Although the contractor may be highly experienced, knowledgeable, and proficient in dealing with pond problems on a routine basis, an event that results in a water quality problem in a pond may occur at a time when the appropriate response is not convenient with the next scheduled visit. In a study involving 13 conservation subdivisions, Austin and Kaplan (2003) found that all of the communities that contained a pond had experienced problems with management that did not arise until the problems caused obvious changes in the appearances of the ponds. As examining water quality showed, often because of a lack of knowledge, appearance or perceptions can be just as important as actual results. The findings of Villarreal and Bengtsson (2004) support this observation in terms of stormwater management, with residents expressing that the appearance and aesthetics of the stormwater system was dominant with hydrologic function being an inferior consideration. Although stormwater ponds are common and appear to be effective in controlling runoff quantity, an integrated approach using a combination of best management practices is the best tactic (Anderson et al., 2002; Villarreal and Bengtsson, 2004). Studies have shown that community perceptions and knowledge appear to be challenges to the use of integrated stormwater management, (Austin and Kaplan, 2003; Villarreal and Bengtsson, 2004) but Hottenroth et al. (1999) found that although most residents did





not understand where stormwater went before an integrated system was installed, residents indicated a growing awareness about stormwater quality and a high level of willingness to change behavior following system installation that was accompanied by a public information and education program.

## 1.4 Nonpoint Source Pollution and Stormwater Management

Communities across the United States are becoming more aware of the negative impacts to personal property and environmental impairments resulting from stormwater runoff (Parikh et al., 2005). Increasing urbanization has resulted in an increase in the total amount of impervious surfaces such as roads, parking lots, rooftops, sidewalks, driveways, and compacted soil from land disturbing activities. Urbanization also leads to a decrease in the amounts of forested lands, wetlands and open space that absorb the stormwater and infiltrate and convey it through the natural soil system (Brabec et al., 2002). It has been estimated that runoff from these impervious areas can have up to sixteen times the volume of natural areas (Thurston et al., 2003). Controlling this excess stormwater poses some difficult problems. Stormwater runoff is often not viewed as a source of pollutant loading, and in most watersheds and subwatersheds, the source(s) of polluted runoff is difficult to determine. The typical objective in managing excess stormwater is to provide for drainage from upland communities, to minimize downstream flooding impacts of upstream development, and to balance the environmental and social impacts of the drainage infrastructure. However, these goals often clash (Parikh et al. 2005). This conflict of interests is especially evident in the Lowcountry of South Carolina, where stormwater and its effects are an important issue economically, politically, socially, and environmentally.

Efforts to mitigate the negative effects of stormwater have evolved through the construction of three basic structural alternatives: large centralized conveyance and treatment systems with significant infrastructural investments (treatment plants, sewers, and tunnels), spatially dispersed and smaller scale post-construction techniques known as best management practices (BMPs), or a combination of the two (Thurston et al., 2003). Initially, stormwater management focused on maintaining public hygiene and preventing flooding. This was typically accomplished by the use of pipes and impervious surfaces to convey water from an area directly to a water body or, in limited cases, to a wastewater treatment plant, without allowing natural infiltration to occur (Rauch et al., 2005; Sample et al., 2003). Today, there is rising emphasis on reducing the impacts of stormwater runoff with its elevated loads of sediments, nutrients, and contaminants by providing for a more passive, natural treatment of the runoff before it reaches receiving waters. These treatment practices include vegetated buffers, grassed swales, and created wetland systems.

Typically, stormwater management practices can be divided into two basic categories of strategies: Low Impact Development (LID) and conventional practices. LID strategies are typically considered to be decentralized methods and are less connected than the curb-and-gutter and stormwater pipe infrastructure. These strategies can be implemented at the parcel level and work to minimize the impacts of development on the natural environment. They include rain barrels/cisterns, rain gardens/bioretention areas, greenroofs/roof gardens, vegetated buffer areas, and the use of pervious concrete and similar materials. Conventional methods often include a collection, storage, and treatment approach at the multi-residential or subdivision level that focuses on reducing the quantity and sometimes, but not always, improving the quality of stormwater. These methods are typically dominated by curb-and-gutter and other storm drain collection systems with subterranean piping infrastructure that usually leads to a stormwater pond. In many coastal communities, stormwater is collected and routed directly into a water body such as a creek, river, lake, or marsh.



In November 1990, the United States Environmental Protection Agency issued regulations for the discharge of stormwater runoff. These regulations required municipalities with a population of 100,000 or greater to submit a National Pollutant Discharge Elimination System (NPDES) permit application for their separate stormwater sewer discharges (Hottenroth et al. 1999). The goal of the BMPs discussed above is to keep the runoff from direct sources under certain regulated parameters defined as the Total Daily Maximum Load (TDML) and to regulate stormwater “to the maximum extent practicable” (Rauch et al., 2005). In South Carolina, new stormwater permitting requirements came into effect on March 1, 2006. These NPDES Phase II regulatory requirements are for Small Municipal Separate Stormwater Sewer Systems (SMS4) that now require an urbanized area (UA) with a population greater than 50,000 to be permitted, which includes a stormwater management plan (SMP), among many other requirements, for each SMS4. Prior to the enactment of the Phase II requirements, stormwater plans for new construction projects within a watershed of the South Carolina Coastal zone were reviewed by the South Carolina Department of Health and Environmental Control’s Office of Ocean and Coastal Resource Management (SCDHEC-OCRM) for consistency with Coastal Zone Management Act. Under the new Phase II permitting process, however, counties and municipalities may either take on the responsibility of reviewing plans themselves or opt to delegate authority to SCDHEC-OCRM for stormwater plan review and implementation. Currently there is very little information available on specific best management practice effectiveness in South Carolina, and with limited funding and manpower it is very difficult for one organization to monitor and regulate all stormwater management practices within this large area. Recent guidance produced by SCDHEC includes the development of a BMP Design Manual as well as a Field Manual. Also, several counties and municipalities in coastal South Carolina have developed their own BMP Design manuals with respect to stormwater ordinances and management plans. The individual manual development, and in many cases the stormwater management plan or ordinance development, are usually contracted out to engineering firms or environmental management companies. Such contractual work is often the most efficient way for local governments to prepare for permitting requirements such as ordinance and stormwater regulation development, and the community residents are often not knowledgeable about or unaware of decision-making related to planning for development, guidance for stormwater regulations, and the associated compliance mechanisms.



## 2.0 The Focus Group Approach

In addressing our research question (how do Lowcountry community association members’ perceptions and knowledge about the environment and quality of life affect their attitudes about stormwater management and pollution?), this study was designed to collect and analyze focus group and demographic data. The researchers conducted the focus groups as a needs assessment to determine what types of information homeowners and homeowner associations/property owner associations would like to know about and from which they could most benefit regarding stormwater ponds, their management, and alternative strategies for stormwater management and water quality protection. In addition, document analysis of peer-reviewed journals was used.





## 2.1 Data and Methodology

The researchers conducted three separate focus groups in 2006. These focus groups involved 9 to 14 members, officers, or managers of community associations in the Lowcountry, with the first group (GH) including Georgetown and Horry Counties (10 participants), the second group (BCD) including Berkeley, Charleston, and Dorchester Counties (14 participants), and the third group (BJC) including Beaufort, Jasper, and Colleton Counties (9 participants) (locations provided in Figures 4-6, respectively). The participants were chosen using convenience and snowball sampling, using suggested contacts from the Coastal Training Program (CTP) coordinators of the North Inlet-Winyah Bay and ACE Basin National Estuarine Research Reserves (NERRs). Each focus group lasted approximately two hours and was videotaped and transcribed by research assistants. In addition to exploring topics about stormwater management and water quality, the moderator, who was the same for each focus group, asked questions about views of local and community amenities, neighborhood attributes, community interactions, quality of life, and perceptions about environmental quality in the communities. The focus group, a form of group interview led by a moderator that usually includes 8 to 10 persons brought to a centralized location to reply to and discuss questions about a particular topic, “provides an especially nice situation for revealing variations in perspective and attitude and a ready means, through subtle pitting of one against the other, for distinguishing between shared and variable perspectives” (Frey and Fontana, 1991). In addition, a demographic survey was also given to each of the focus group participants and was quantitatively analyzed to provide information for comparison with the population of the Lowcountry as a whole.

The methodological instrument used for the focus groups was qualitative content analysis. Content analysis is a research method that makes inferences “by systematically and objectively identifying specified characteristics within text” (Neuendorf, 2002). In examining all three focus groups, the researchers followed a progression of steps to identify themes in the focus groups that related to the research question and the ideas recognized in the literature. Researchers analyzed the focus group data by developing a coding scheme or dictionary and “coding the material into analytically distinct segments” (Knodel, 1993). The coding dictionary was based on the topics in the focus group protocol and the themes recognized in the community association/subdivision, environmental perception and quality, and nonpoint source pollution/stormwater management literature.

## 2.2 Assessing the Residential Landscape and Mindset

### 2.2.1 Demographics and Community Representation

Focus group participants were asked a range of questions about their demographics, including occupation, age, education, average house price in their community, household income, community association assessments, length of residency in the South Carolina Lowcountry, whether the Lowcountry was their primary residency, and what they believed to be their most important community amenity. A summary of this information for all three focus groups can be found in Table 1.





**TABLE 1:**  
**Summary of Focus Group Participant Demographics and Representation.**

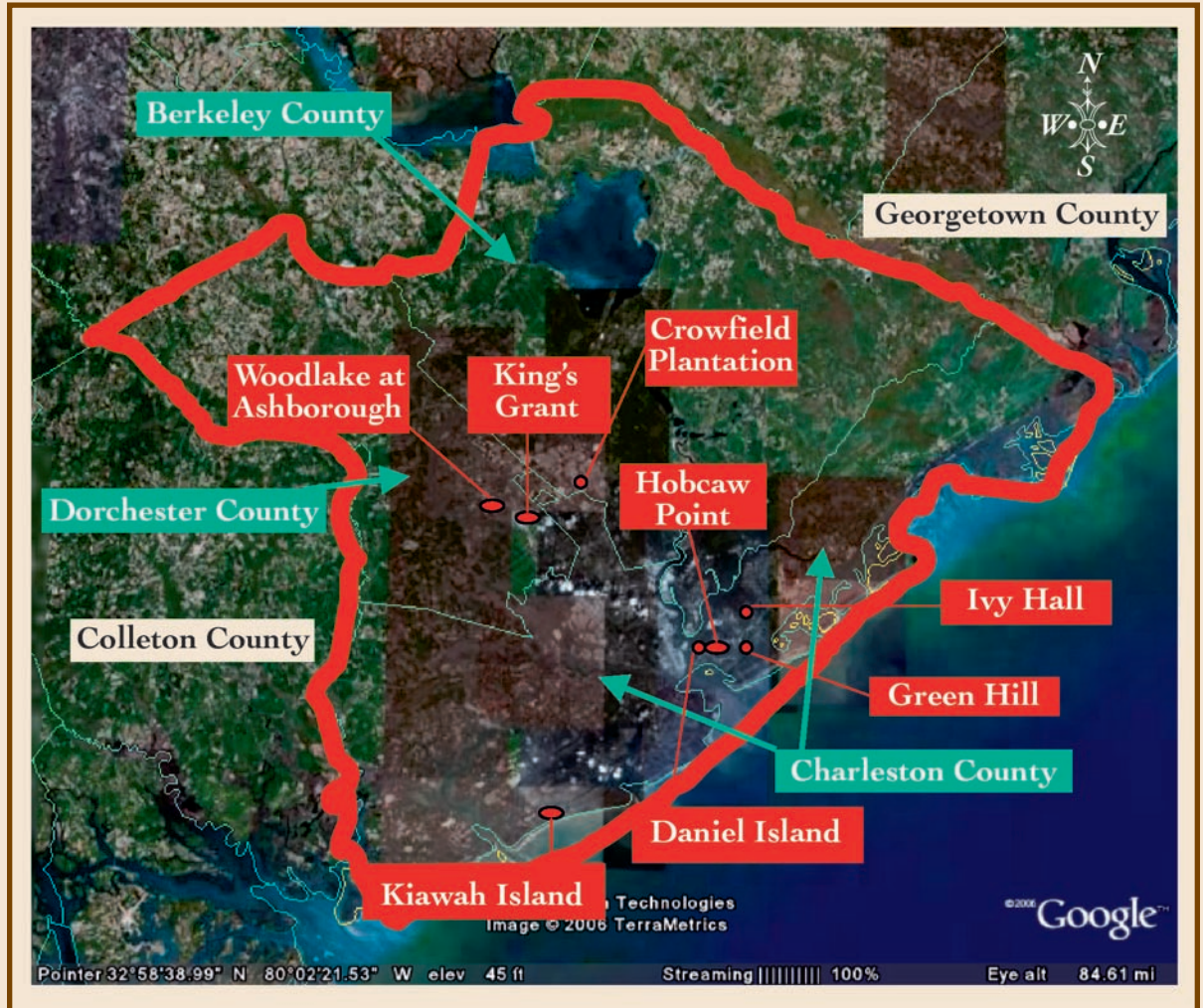
<i>Focus Group</i>	<i>Number of Participants</i>	<i>Age (Mean)</i>	<i>Average House Price (Mean)</i>	<i>Household Income (Mean)</i>	<i>Length of Residency (Mean)</i>	<i>Percent Retired</i>	<i>HOA/POA Dues (Annual Mean)</i>
GH	10	56	\$428,125	\$100,000	21	50%	\$1,099
BCD	14	58	\$485,485	\$85,556	21	50%	\$623
BJC	9	58	\$521,875	\$85,429	11	44%	\$970
Overall	33	57	\$479,587	\$88,142	18	48%	\$843

**FIGURE 4.**  
**Community Associations (with red labels) Represented by Focus Group Participants (GH) from Georgetown and Horry Counties. All locations are approximate.**



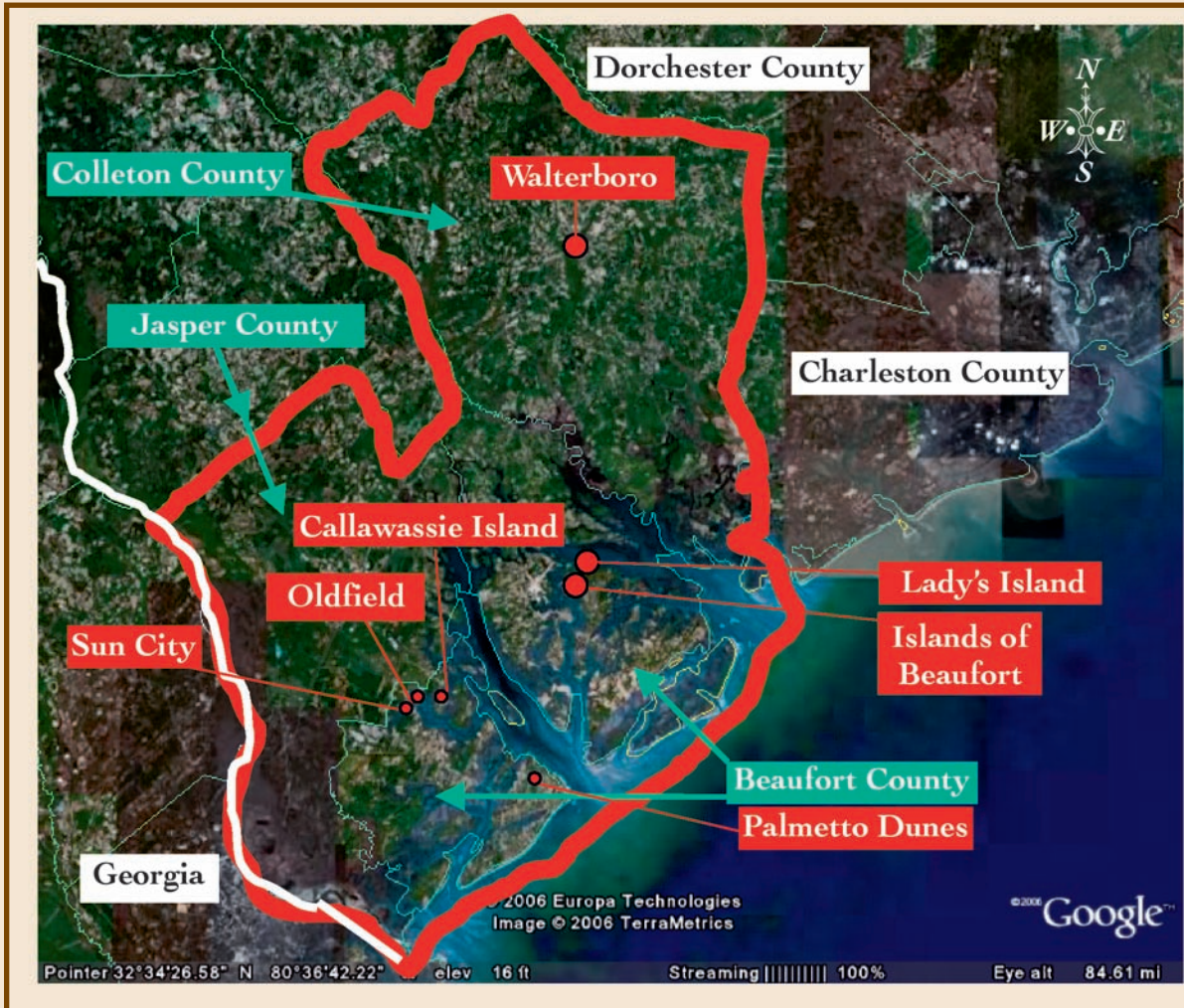



**FIGURE 5.** Community Associations (with red labels) Represented by Focus Group Participants (BCD) from Berkeley, Charleston, and Dorchester Counties. All locations are approximate.



**FIGURE 6.**

**Community Associations** (with red labels) **Represented** by Focus Group Participants (BJC) from Beaufort, Jasper, and Colleton Counties. All locations are approximate.





Concentrating specifically on the Georgetown and Horry County (GH) focus group, of the ten participants, they represented six different communities or subdivisions with the overall house price averaging \$428,125 and the community association assessment averaging \$1098.83 per year, although two of the communities have voluntary dues of less than \$100 per year. Five out of the ten are retired, and of the four participants who provided their household income, all earned \$100,000 or \$100,000 plus. All of the participants were males and the average age of the participants was 55.8 years, and overall their length of residency averaged 20.5 years; however, the mode was only eight years, so the average seems to be a misrepresentation due to two participants who have lived in the Lowcountry almost all of their lives. All reported the Lowcountry to be their place of primary residency. With the exception of one, all of the participants received a college or technical degree or greater. In regard to the most important community amenity, natural or outdoor recreational amenities were reported by all but one of the participants, with the beach/ocean receiving the most recognition.

The community make-up of the Berkeley, Charleston, and Dorchester County (BCD) focus group was more varied than that of Georgetown and Horry County, but many similarities were still evident. The group was slightly larger with 14 participants that represented 10 different subdivisions in the area with the overall house price averaging \$485,385 and the community association assessment averaging \$622.63 per year, although one community has voluntary dues of only \$25 per year and another has no dues at all. As with the first group, fifty percent of the participants are retired, and out of the 11 who responded the average household income is \$85,556. The majority of the participants were males but four females participated. The average age of participants was approximately 58 years with the average length of residency being about 21; however, as seen with the first group, the mode was much lower at 6 years, indicating that the average seems to overestimate the true value due to about three participants who have lived in the Lowcountry most of their lives. All participants reported that the Lowcountry was their primary residence. With the exception of two, all of them received a college or technical degree or greater. In concurrence with the first group, natural or outdoor recreational amenities received recognition as the most important community amenity with the exception of one participant, with trails being the most common.

The demographics of the Beaufort, Jasper, and Colleton County (BJC) focus group appear to share a number of similarities with those of the first two focus groups. The nine participants represented eight different communities with the overall house price averaging slightly higher than the other two focus groups at \$521, 875 and the community association assessment in between the others at \$970 per year, although three of the communities had no dues at all. As with the other focus groups, about half (four out of nine) of the participants are retired, and of the seven who responded the average household income is \$85,429. Once again the majority of the participants were males but three females participated, and the average age of the participants was approximately 58 years with the average length of residency being about 11 years, which unlike the other two focus groups is a more accurate representation since only one participant has lived for more than 30 years in the Lowcountry. All of the participants reported the Lowcountry as their place of primary residency, and all but one received a college degree or higher. In accord with the other two groups, all but two of the participants cited natural or outdoor recreation amenities as the most important community amenity.

The make-up of the three focus groups appears to share many similarities, although the participants are not necessarily representative of the county populations or community associations in each county as a whole. Although most of the participants are older than the average citizen with a larger percentage in retirement, possess a higher socioeconomic status and level of education, and are mostly male, the similarities between the demographic make-up of the three focus groups provides a good source for comparison of similar populations in the three different regions of the Lowcountry.



## 2.2.2 Awareness of Local Issues Associated with Development

### 2.2.2.1 Residential Satisfaction, Quality of Life and the Environment

During the focus group, questions were posed about the participants' thoughts about the South Carolina Lowcountry and quality of life. From the responses, summarized in Table 2, and throughout the focus groups, the importance of the natural features of the area and a laid back way of life became apparent in characterizing the Lowcountry and relating to quality of life. Participants often mentioned the "Lowcountry atmosphere," the "marsh," the "live oaks," the "water" and "the ocean, the beach." This environmental importance is supported by the literature, particularly Stedman's (2003) focus on the significance of the physical environment and social interactions to creating a sense of place, which plays a considerable role in determining quality of life. In addition, increased growth and unplanned growth were cited as a negative influence on the environment of the Lowcountry and the residents' quality of life. The participants recognize the changes in the area that are a result of the increased development of this amenity-rich region, including increased traffic and lack of adequate planning.





**TABLE 2:**  
**Summary of Participant Responses to Questions about the Lowcountry and the Quality of Life.**

Most common response(s) to the following topics or questions:	REGIONS			
	GH	BCD	BJC	Overall
<i>What comes to mind when you think of the "South Carolina Lowcountry"?</i>	beach, drainage issues, laidback lifestyle and government, swamps, trees	water, fishing/shrimping, marshland, beach, historic buildings/areas, relaxed lifestyle, tourism, good-old-boy politics, melting pot	marsh, partly under water, diversity of flora and fauna, water, Gullah, blend of people, history, rice culture, limited economic development, good ol' boys, beach, water, marsh, history/historic	areas, laidback/relaxed lifestyle, good ol' boy politics, blend of people/cultures
<i>Most appealing aspects of the Lowcountry</i>	climate, lack of traffic	not asked	vistas, amount of water	no consensus
<i>Least appealing aspects of the Lowcountry</i>	increased growth and traffic, no see'ums	not asked	traffic, no see'ums, growth and lack of planning	increased growth, traffic, no see'ums
<i>Sprawl in the Lowcountry</i>	McDonalds, definitely occurring	absolutely occurring, cheaper land away from city b/c building w/out planning for infrastructure /schools	unplanned, uncontrolled growth, high density, definitely occurring	definitely occurring, unplanned growth
<i>Defining quality of life</i>	good climate and environment, no traffic, planned growth	good community, environment, and lifestyle, no traffic	no traffic, be around and in nature	no traffic, good environment

Although a majority of the participants expressed some concerns about the environment and environmental quality in the Lowcountry, including loss of wildlife habitat and wetlands and decreased water quality, all of them generally agreed that the environmental quality of the region is "fairly good" (Table 3). Throughout the discussions a theme emerged linking environmental knowledge, perceptions, and action to the presence of, past experience, or perceived risk of environmental problems or degradation. This theme mentioned by a majority of the participants and can also be found throughout the literature on environmental perceptions and behaviors (Smutko et al., 2002; Austin and Kaplan, 2003; Thompson, 2004; de Loë and Kreutzwiser, 2005).

**TABLE 3:**

**Summary of Participant Responses to Questions about Lowcountry Communities and Associations.**

<b>Most common response(s) to the following topics or questions:</b>	<i>REGIONS</i>			
	<i>GH</i>	<i>BCD</i>	<i>BJC</i>	<i>Overall</i>
<i>Range of community associations in this region</i>	property owners associations, homeowner's associations, condominiums	from no covenants to deed restricted, developer controlled to completely independent	gated communities with community associations, apartments and condo developments, family-oriented communities	no consensus
<i>Sense of community</i>	good, presence of community functions, difficulty of part-time vs. full-time residents	good (4 on scale from 1 to 5), presence of community events/gathering places, drawn together to deal with problems	strong, shared amenities and community activities, drawn together to deal with problems, part-time vs. full-time residents	good, community events/activities/functions, drawn together to deal with problems, part-time vs. full-time residents
<i>Natural or outdoor areas in your communities/ community amenities</i>	golf courses, ponds/lake/ocean, beach, bike/nature trails, swimming pools	parks/fields, ponds, walking trails, courts, swimming pools, playgrounds	fields, golf courses, nature trails, fitness centers, courts, ponds/lagoons	golf courses, ponds/bodies of water, courts, fields, trails, swimming pools
<i>Wildlife issues in the communities</i>	too many deer, feral cats, geese	excess deer	deer, racoons, wild hogs, alligators	too many deer
<i>Environmental quality in the communities</i>	fairly good	concerns but good	pretty good overall	pretty good
<i>Environmental concerns in the communities</i>	contaminated ponds, upstream runoff, flooding, wetlands destruction	traffic pollution, water quality of ponds, noise pollution, flooding, litter	clearing of wetlands, impact of runoff on water quality, traffic pollution	traffic (air) pollution, wetlands destruction, polluted runoff, flooding
<i>Environmental management of communities</i>	homeowners association, separate corporation	community association, reactionary,	community association (committees), specialists	community association, professional company
<i>Community level of environmental understanding</i>	low to high depending on community	low to high depending on community	low to high depending on community	low to high depending on community
<i>Best way to distribute environmental information to communities</i>	newsletter/ magazine	newsletter, meeting	newsletter, website, educational program	newsletter
<i>Newcomers vs. Longtimers (locals)</i>	newcomers more involved	longtimers more relaxed lifestyle, feel results of growth more; newcomers have more money	not asked	no concensus
<i>Defining locals and newcomers</i>	depends on your attitude, locals-born and raised here	locals-born here	depends on the individual and appreciation of the way of life, locals-born and raised here	depends on your attitude/individual, locals- born and raised here



### 2.2.2.2 Length of Residency and the Environment

The GH participants, in particular, cited that the length of residency in the Lowcountry also affected environmental perceptions and attitudes about environmental behaviors or action. In the literature, findings showed that newcomers were more likely to perceive development as a threat to environmental quality and quality of life, and these same newcomers were more likely to become involved in their communities and participate in environmental actions (Spain, 1993; Johnston et al., 2003). Comments in the first focus group particularly supported the claim about increased involvement.

The recognition of “newcomers” and locals or “long-timers” were discussed in both the BCD and BJC focus groups, but their differences in environmental concerns and community and government participation were not specifically mentioned in their discussions; however, comments resonated with a newfound sense of ownership of a new arrival to the area, indicating that “now that I am here, I don’t want anyone else to come”. In addition, a larger percentage of participants in the BCD and BJC focus groups had lived in the Lowcountry for a shorter amount of time, and by comments relayed during their participation, their concern about the environment and willingness to be involved was evident.

Although the difference between newcomers and locals was specifically mentioned in the GH focus group and implied in the other two, the definition of a newcomer versus a local was somewhat vague. With the influx of people and development into the Lowcountry area in recent years, a large number of residents in these communities are not necessarily from the area. This tends to blur the line between newcomers and locals. If locals are considered “born and raised here,” then very few residents in these newer subdivisions would meet the criteria; however, a definition suggested in the GH focus group when the question was raised about how long one must live in the Lowcountry to be a local was that “It depends on your attitude.” This suggestion was met with laughter, but the nodding of heads in agreement throughout the room. In the BCD focus group, most participants automatically responded with being born or raised in the Lowcountry or the number of years you have lived there, but with continued discussion, some participants agreed to an idea comparable to that of the GH participants. BJC participants also offered a similar definition to the GH participants: “It’s all relative” and “Oh it depends on the individuals, but a year to a few years till you get comfortable and associate with the climate and the no-see-ums and the differences and from where they are from.” According to most of the focus group participants, in the case of the Lowcountry, newcomers are not necessarily defined based on the number of years of residency but rather their definition is based on their willingness or ability to adapt to and accept the Lowcountry way of life.





**TABLE 4:**  
**Summary of Participant Responses to Questions about Environmental Quality and Stormwater Management.**

<b>Most common response(s) to the following topics or questions:</b>	<i>REGIONS</i>			
	<i>GH</i>	<i>BCD</i>	<i>BJC</i>	<i>Overall</i>
<i>Assessing water quality/ water quality indicators</i>	presence of wildlife, general appearance	presence of wildlife, general appearance, depth of ponds	general appearance (clarity), presence of wildlife,	presence of wildlife, general appearance
<i>Knowledge of nonpoint source pollution (NPS)</i>	relatively low	no knowledge	relatively low	relatively low
<i>Knowledge of harmful algal blooms (HAB)</i>	no knowledge	relatively low	relatively low	relatively low
<i>Knowledge of stormwater management</i>	low unless directly experienced problems	low unless directly experienced problems	low unless directly experienced problems	low unless directly experienced problems
<i>Covenants or rules associated with stormwater management</i>	none, except Architectural Review Board	not asked	some, Architectural Review Board	only Architectural Review Board
<i>Specific HOA fees for stormwater management</i>	not specifically	not specifically	not sure, possibly pond maintenance fee	not specifically
<i>Knowledge of alternative stormwater management strategies</i>	relatively low	relatively low	Some knowledge	relatively low
<i>Knowledge of pervious materials</i>	relatively low	low to mid	mid but not specifics	low to mid
<i>Knowledge of rain gardens</i>	very little	very little	very little	very little
<i>Knowledge of rain barrels</i>	high but not for use in stormwater management	mid to high but not for use in stormwater management	mid to high but not for use in stormwater management	mid to high but not for use in stormwater management
<i>Knowledge of rainwater harvesting</i>	some knowledge, but not used in the area	some knowledge	some knowledge, but not used in the area	some knowledge, but not used in the area
<i>Knowledge of roof gardens</i>	relatively low	low to mid	relatively low	relatively low
<i>Knowledge of wetlands to address NPS</i>	some knowledge	low to mid	high	low to high
<i>Interest in alternative stormwater management strategies</i>	some interest, but worried about expense and feasibility	definite interest with more information	definite interest with more information, some worries about feasibility	definite interest, but some worries about feasibility



### 2.2.2.3 Water Quality Indicators: Perceptions Versus Reality

Perceived risk or a direct negative effect and length of residency can influence environmental perceptions and knowledge, thereby affecting environmental attitudes, but are these perceptions based on reality? Studies have shown that particularly in the case of water quality, which is not usually readily observable, residents' perceptions and knowledge are often misplaced or based on observable but not necessarily reliable information (Parr, 2005; Stedman and Hammer, 2006). Focus group participants cited the use of professional companies to perform water quality tests, reliance on state websites or posted notices of decreased water quality, and testing by the actual community associations; however, the use of more observable phenomena was more commonly mentioned in describing how the participants believed most residents assessed water quality (Table 4). As participants explained and as the literature supports, the use of more observable phenomena can lead to the perception of decreased water quality where none exists (Stedman and Hammer, 2006) or the perception of good water quality without the proper knowledge to support this conclusion (Parr, 2005).

### 2.2.2.4 Community Associations and Collective Action

Touted as the new local governance (Nelson, 2005), community associations have the ability to play a significant role in environmental management; however, problems of collective action such as apathy, failure to understand responsibilities, and lack of knowledge appear to limit their effectiveness (Blandy and Lister, 2005; Austin and Kaplan, 2003). With the exception of three participants whose communities do not have an official organized association, all of the focus group participants are members, officers, or managers of homeowners or property owners associations. Of the 24 communities represented, membership in two of the GH, one of the BCD, and none (three of the communities do not have organized associations) of the BJC community associations is voluntary.

Each community association has its own deed restrictions and rules [commonly known as conditions, covenants, and restrictions (CC&Rs)], although they vary in specificity and stringency from virtually none to almost 1,700 pages worth, as well as responsibilities for certain services and maintenance of the common areas. These responsibilities differ with the communities but include lighting for the streets, maintenance or paving of streets (which is often voted down by residents in accordance with keeping in line with the atmosphere of the Lowcountry), pond and stormwater maintenance, maintenance of recreation areas and open space, and other responsibilities that would normally be provided by the city or county. The sense of community in these subdivisions or neighborhoods appears to be tied directly to community functions, such as cookouts, creek nights, and holiday parties, and the presence of gathering places. The larger communities like Debordieu, Crowfield, and Sun City recognized that their size limited the sense of community as whole, contributing to the impression of separate neighborhoods within the one overall community. In addition, the higher income or resort-like communities noted the difficulty of forming a sense of community between part-time and full-time residents. Only one of the community associations mentioned considerable problems with participation and an apathy among residents, citing only 150 to 200 members out of approximately 850 property owners and dismal attendance at meetings. The focus group participants from this community attributed this to the fact that their membership and dues were voluntary, explaining that "unless they can see that they're going to get something from it, they don't participate." Although the other 20 communities that have associations reported good participation and a strong sense of community, in the case of stormwater management, a majority has experienced or are encountering problems with water quantity (such as flooding), water quality (such as algal growth in ponds), or other stormwater management issues.



### 2.2.2.5 Concerns: Environmental, Political, Social, and Economic

Although the focus groups concentrated more specifically on issues with stormwater management, other issues emerged throughout the discussions, environmental, political, social, and economical. These issues varied with the different regions, but there was some overlap between the three focus groups. The overall threat of development to environmental quality in general, and more specifically water quality, were environmental concerns raised among all three groups; however, air pollution also appeared to be a concern, particularly with the BCD participants. All three groups mentioned traffic problems and the resulting air pollution, but whereas the GH and BJC groups moved on to focus more on water quality, the BCD participants had to be prompted by the moderator to bring the discussion away from traffic pollution and on to other environmental concerns. This single-mindedness may be due to the intensity of urbanization that is unique to the City of Charleston and the surrounding areas as compared to the rest of the Lowcountry. As far as political issues are concerned, all three groups primarily discussed the lack of adequate planning and the absence of communication and cooperation between the “good ole boy” political networks that characterize Lowcountry politics. A majority of the participants mentioned that they believed the government was inexperienced in dealing with the substantial growth of the Lowcountry, leading to inappropriate and damaging policies. The main social issue that emerged in all three focus groups was the difficulty of maintaining the Lowcountry way of life with the influx of people from other parts of the country. Although this issue emerged in all three discussions, further socioeconomic issues surfaced in both the BCD and BJC focus groups. The BCD participants were especially concerned that rising property values would continue to contribute to sprawl in the Lowcountry and stretch the capacity of current schools and roads because developers are not necessarily required to provide for those public services. In addition, the increasing economic gap between the more wealthy newcomers and those locals with lower or more fixed incomes was mentioned by both the BCD and BJC participants. In particular, BJC participants believed that the emergence of more ecologically and environmentally sensitive subdivisions, such as conservation subdivisions, would serve to further this gap. Finally, discussion in the BJC focus group highlighted the increased need for economic development that is compatible with the Lowcountry atmosphere and environmental stewardship “to preserve those beautiful things that makes [the] area...”

### 2.2.3 Knowledge of Solutions

Even though a majority of the communities have encountered difficulties and participants expressed concern with stormwater management, the overall knowledge level about environmental management issues in general and stormwater management strategies in particular appears to be low. All of the participants agreed that community members knew very little about nonpoint source pollution and harmful algal blooms. In addition, a majority of the participants expressed knowledge of where stormwater goes, but as was the case in other studies (Thompson, 2004), the GH focus group estimated that, except for one community, only about 10% of the community members possessed that same knowledge and the BCD and BJC focus groups agreed that except for communities where stormwater runoff and flooding was a major problem, community members did not have a good understanding. At the mention of a number of alternative management strategies, such as the use of pervious materials, rain gardens, rain barrels, rainwater harvesting, roof gardens, and created wetlands, a majority of the GH and BCD participants expressed a lack of knowledge with regard to either the actual technique or the use of the technique to address stormwater issues. The BJC participants appeared to have a higher overall knowledge of the existence of alternative stormwater management strategies, particularly the use of pervious materials, which were already in use in all but one of the communities, and the use of wetlands. One participant even offered two additional strategies: xeriscaping and phytoremediation; however, the group did mention that a majority of their community members did not possess as high and detailed of a knowledge level. In addition to a lack of knowledge, none of the communities had covenants or restrictions that addressed stormwater





management and none of the participants were aware of assessments, other than pond maintenance fees, specifically relegated for stormwater management, although some of the community associations did have Architectural Review Boards (ARBs) that require drainage plans and address drainage problems. Communication and cooperation between communities in the same watershed was also found to be lacking. This deficiency in addressing stormwater management outright through the community associations could be seen as a result of a lack of knowledge in this area and perceptions of high environmental quality.

Despite overall group perceptions of high environmental quality and low knowledge, participants expressed a willingness to learn more and an excitement about being involved in an effort to try to better address these needs. Alternative stormwater management strategies were considered with openness, albeit there were concerns about costs and the ease of installation and maintenance, and participants were in full agreement that more needs to be done to address stormwater issues and other environmental concerns that continue to arise as a result of increased development. In particular, the GH participants revealed concerns that certain alternative strategies would be more expensive or unfeasible in the Lowcountry; however, as the BJC participants pointed out, these reservations may be due to a lack of education and intimate knowledge of the strategies. Despite the stated reservations, according to responses throughout the focus group, this positive attitude appears to be related to maintaining a high quality of life, which is influenced by the natural features and amenities and relaxed lifestyle that comprise the “Lowcountry atmosphere”.

## 2.3 Summary of Findings: A Lowcountry Perspective

The composition of focus group participants may not appear to adequately represent all residents and communities in coastal South Carolina; however, the objectives of this study were meant to specifically represent communal governance in the form of community associations in the Lowcountry region. In most instances, the participants were representative of gated communities and readily identifiable open access subdivisions throughout the coastal South Carolina geographical region.

The research for this document relies on focus group data and qualitative content analysis, a process that collectively has its limitations. Only 33 residents participated in the three different focus groups, representing only 24 communities throughout the entire Lowcountry. This limited number of participants and the fact that they were chosen through convenience and snowball sampling makes it impossible to have a truly representative sample. In addition, although the analysis was performed objectively, the researchers do have some control over the themes that emerge, which is not the case with purely quantitative analysis. Despite these limitations, focus groups and content analysis are the most appropriate tools when investigating perceptions and attitudes (Frey and Fontana, 1991). The research appears to support the assertion that, in the Lowcountry of South Carolina, environmental perceptions and knowledge and perceptions about quality of life influence attitudes about environmental management in general and, more specifically, stormwater management. This finding is important in recommending policies that encourage practical education and that appeal to residents’ concerns about quality of life; however, further study is needed to examine a wider range of residents and additional environmental land use issues. In particular, a typology of conservation subdivisions and an investigation on their effect on pro-environmental attitudes and behaviors would be helpful in contributing to the role of environmental management in policy.





## 3.0 Solutions


In order to provide solutions for nonpoint source pollution at the community association level, the knowledge, attitudes, and behavior of homeowners within these associations have been assessed. Given that the assessment methods and subsequent results have been limited in scope, this document provides a general overview of potential practical solutions that may be implemented by homeowners and community associations to minimize the impact of stormwater runoff based on water quality. As issues with stormwater ponds were expressed repeatedly throughout the focus group interviews, the connection between land use activities, stormwater management strategies, and the health of stormwater ponds must be recognized and addressed. What occurs upstream from a pond directly impacts the long-term storage capacity and water quality, and thus the aquatic health and lifespan, of a stormwater pond.

### 3.1 Knowledge, Attitudes and Behavior

Research findings appear to support the hypothesis that the majority of these community association members will perceive the quality of their environment to be good and that environmental quality is important in having a high quality of life; however a belief in high environmental quality will signify a lack of knowledge in stormwater management, but the importance of the environment to quality of life will indicate a willingness to learn more to address certain existing and possible problems. The natural amenities and qualities of the Lowcountry contribute to the sense of place and quality of life. The importance of these natural features to the Lowcountry way of life contributes to an overall perception of good environmental quality and quality of life, although residents do recognize the full potential impacts of development on environmental quality. Without the increased concern about environmental quality, with a few exceptions, most residents possess little environmental knowledge, especially about environmental management. In the case of stormwater management, the overall level of knowledge is very low with residents. Focus group participants assert that few residents even understand what nonpoint source pollution is and where stormwater goes. This lack of knowledge makes successful community association-administered stormwater management difficult, and perceptions of high environmental quality lead to somewhat of a lack of concern; however, the perception that natural amenities and environmental quality play a key role in influencing quality of life appears to result in a willingness to learn and consider alternative stormwater management strategies.

From the research findings, environmental education, particularly focused on practical knowledge and solutions that can be implemented by homeowners, is critical to successful environmental management. Education has been found to raise awareness of residents, which should help address the trend of apathy found in residents who feel they are not directly affected (Novotny, 1995; Thompson, 2004). “Many people do not realize that yard debris or trash thrown into ditches today will worsen tomorrow’s flooding and pollute surface waters,” (Novotny, 1995,) or that potential sources such as lawn chemicals can lead to increased pollutant loading by moving with stormwater runoff and subsequently can degrade water quality. Further, the connection between nutrient loading and the increased growth of invasive and nuisance plants is often not understood by residents (Thompson, 2004), and the call for increased herbicide application to manage aquatic plant growth is often considered as the primary solution





by community associations. Practical education that focuses on how residents themselves can either potentially degrade or improve environmental quality contributes to positive environmental attitudes and behaviors (Novotny, 1995; Thompson, 2004). A number of the participant comments, especially from the BJC focus group, support the use of environmental education to increase awareness and compliance with an overall environmental management plan. Even if a community association hires a pond management company, members of the association, perhaps in the form of a committee, should be aware of the practices employed by the management company, and the community association representatives should also be knowledgeable enough about pond management practices to be able to understand the options for management and to effectively communicate with the pond management professionals.

## 3.2 Stormwater Education and Outreach Strategies

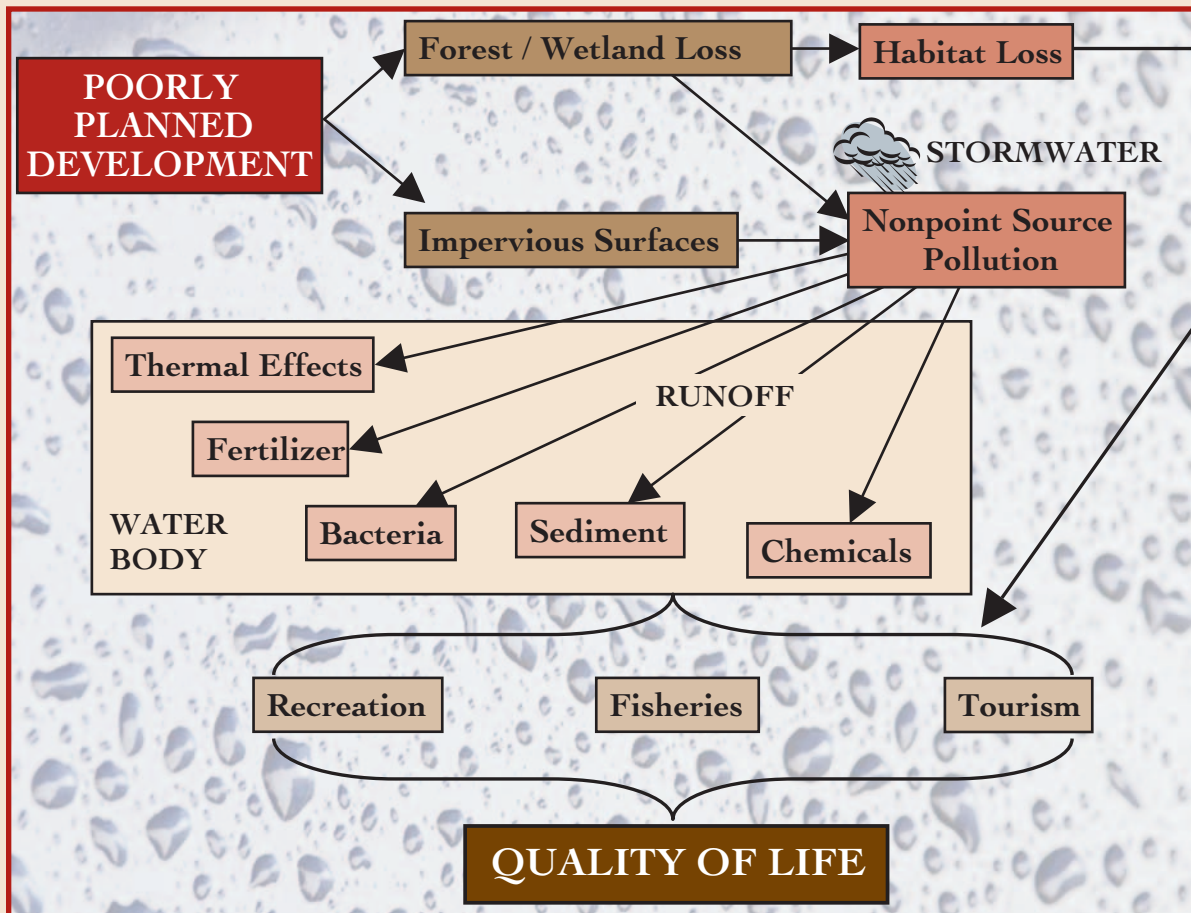
Many of the focus group participants cited the need for education to raise homeowners' awareness about stormwater management, not only in terms of water quantity but also water quality. There are three levels of an education approach that can be implemented to improve homeowner awareness, engagement, and actions regarding stormwater management and water quality improvement.

### 3.2.1 Basic Stormwater Concepts

The first level of information delivered to homeowners associations should be the overarching conceptual relationships between land use practices, stormwater, and the quality of water resources (Figure 7). Often it is difficult to recognize or easy not to be concerned about these relationships until a problem occurs in one's area. The key is for a homeowner or community association to be proactive and preventative rather than reactive and thus attempt to provide a remedy after the problem occurs. Six (6) basic concepts for understanding stormwater are as follows:

1. The more impervious (hard and impermeable to water) surface area, such as rooftops, driveways, parking lots, sidewalks, and even compacted soil, that exists within the landscape, the less of a chance that rainwater (stormwater) can naturally drain into the soil. The result is that there is more of a chance that stormwater will run off into a body of water, such as a creek, pond, stream, lake, or ocean, where individuals may fish or swim.
2. Even stormwater that enters a storm drain or a culvert does not go to a treatment facility, much to the unawareness and surprise of many homeowners – instead, it runs directly into a water body. Not only does this water include stormwater, but irrigation water, wash water, and other human-made runoff also enters the storm drain and is typically directly conveyed to a water body.
3. Many pollutants that exist on the ground before it rains can be collected and carried to a water body when it rains, a result that is known as “polluted runoff” or “nonpoint source pollution.” It is also important to recognize that irrigation and wash water may also collect and carry pollutants from surfaces, especially if these activities are conducted directly on impervious surfaces.
4. If a homeowner applies too much fertilizer onto the lawn or garden, then the rain will carry the excess unused nutrients toward a water body. Because fertilizers make plants grow, the excess fertilizer that reaches the water will make unwanted algae and other nuisance plants grow in the water that fertilizer reaches.
5. Pathogenic bacteria (i.e. from septic systems, pet waste, among other sources), pesticides, oil, gas, and many other pollutants, including sediment, can move during a storm into a water body as described above for fertilizers. These types of pollutants may have different effects than fertilizers, whether in terms of duration and/or severity of impact.





**FIGURE 7.**  
**A Diagram Indicating the Relationship Between Urban Planning, Stormwater Runoff, Nonpoint Source Pollution (or Polluted Runoff), and Quality of Life Impacts.**

6. Blacktop asphalt and other darker colored impervious surfaces tend to heat up drastically during the day. The stormwater that runs off from these surfaces can become very hot, resulting in a flush of thermal pollution from a storm event into a water body. The subsequent increase in temperature can pose serious threats to organisms, such as fish, insects, reptiles, and amphibians, among others, that typically thrive in these aquatic habitats. Minimizing paved surfaces, creating vegetation buffers (grassed or other larger species, especially to increase shaded areas), and using lighter colored surfaces can all decrease the potential for thermal pollution.

### 3.2.2 Engagement: Recommendations for Improving Homeowner Activities

The second level of education is engagement, which involves answering the question of “what of my activities, actions, and behaviors, can I change in order to protect water quality?”. In many cases, a homeowner may be concerned about environmental and water quality, but he or she may not understand how to make lifestyle changes. The message that “we all live downstream” implies that the connectivity of water movement, as well as any associated pollutants carried by that water, exists throughout a watershed. It may be likely that the individual homeowner and the community association are collectively best suited to implement solutions for protecting water resources with the potential for the greatest success. If awareness at the individual and the community level about stormwater and its impacts can be achieved, homeowners and related



associations may recognize the importance of accomplishing day-to-day activities with deliberate, environmentally-minded actions. The following six (6) homeowner activities can be useful in minimizing the impacts on water quality:

### 1. *Irrigate sparingly and deliberately.*

One of the easiest ways to minimize polluted runoff is to minimize the amount of water that is used for irrigation. Irrigate only when absolutely necessary. Manual irrigation is the best way to manage irrigation water; automatic irrigation may be convenient, but it can also be very wasteful. Do not irrigate when sufficient rain has fallen. Be sure to direct irrigation sprinklers to water the lawn, garden, or vegetated landscape, and not to water the sidewalk, patio, driveway, or street. These practices can save water and money! Also, if a homeowner is irrigating from a pond source, water conservation practices can help ensure that the pond water storage is maintained throughout the year (especially summer months), and opportunities for algae and other nuisance plant growth in the pond is minimized. As for irrigation scheduling, it is most effective to irrigate in the morning hours. Afternoon irrigation may result in evaporation before the plants can use the water, while evening irrigation can result in root rot and other problems as plants do not use this water during the evening. These irrigation scheduling recommendations depend, of course, on the time of year, the associated length of day, and the amount of sunshine that the plants and lawn receive. Also, keeping grasses mowed to 3-4 inches can allow for better moisture retention in your lawn, further reducing the need to water. Also, many native plant species require less water than non-natives, so planting smart can allow a homeowner to save money, too! The landscaping concept of “xeriscaping” is often used to minimize irrigation water requirements. For more information, contact the local Clemson Extension County Office (<http://www.clemson.edu/extension/counties1.htm>) or a local nursery for more specific tips on lawn, garden, and other landscaping irrigation requirements, or visit Clemson’s Home and Garden Information Center at <http://hgic.clemson.edu/>. For more information:

Watering Lawns – <http://hgic.clemson.edu/factsheets/hgic1207.htm>

Irrigation Systems – <http://hgic.clemson.edu/factsheets/hgic1705.htm>

Conserving Water in Your Landscape – <http://hgic.clemson.edu/factsheets/hgic1724.htm>



An example of poor irrigation practices and wasted water resources.



## 2. Wash and maintain your car or boat away from storm drains.

If possible, a homeowner should wash one's car or boat on grassed or other pervious areas, not driveway or parking lots, to allow water to drain into the soil. Most importantly, washing near storm drains and other stormwater collection systems, such as street curb and gutter structures, should be avoided. It's usually better to wash a vehicle at the car wash than in your driveway or street where excess wash water can flow into the storm drains; car wash facilities typically have the capability to manage excess wash water. The concept of washing and rinsing away from paved surfaces applies to other items, as well. It is also important to change oil and perform other maintenance activities away from hard surfaces and storm drains to avoid any pollutant runoff from occurring. And if possible, use biodegradable soaps, or no soap at all.

## 3. Apply fertilizers and pesticides sparingly and appropriately.

Use lawn and landscape chemicals only when absolutely necessary and as directed on the label (the label is the law!). This can protect water quality and save money! If fertilizers are to be used, they should be only used as needed. A homeowner can have soil tested for a small fee in advance of fertilizer application by the local Clemson Extension County Office, and then recommendations for lawn management can be made available through Clemson Extension agents. When using chemical fertilizers, a deliberate and careful application includes not only how much fertilizer is to be applied but also where to apply it. Also, make sure that excess fertilizer is swept from hard surfaces and away from storm drains. To minimize the use or negate the need entirely for chemical pesticides, weeds can be pulled by hand. Corn gluten meal, which can be purchased from organic lawn companies and nurseries, can be used to stop weed seeds from germinating. Also, keeping your grasses mowed to 3-4 inches can allow shading of weeds. If you hire a lawn service, make sure that the company specializes in natural lawn care. It is always a good idea to know and understand what yard care practices that a contractor is performing. Finally, the appropriate landscape plant selection can further reduce your need for fertilizers and pesticides. Another option may be to use a native ground cover instead of a lawn. A more elaborate but very effective approach to pest control is Integrated Pest Management (IPM). Contact the local Clemson Extension County Office (<http://www.clemson.edu/extension/counties1.htm>) for specific tips on fertilizer and pesticide applications for your home and garden, or visit Clemson's Home and Garden Information Center at <http://hgic.clemson.edu/>. For more information:

Fertilizing Lawns - <http://hgic.clemson.edu/factsheets/hgic1201.htm>

Soil testing - <http://hgic.clemson.edu/factsheets/hgic1652.htm>

Fertilizers - <http://hgic.clemson.edu/factsheets/hgic1654.htm>

## 4. Collect pet waste as soon as it is left behind.

This is a simple practice that doesn't require much explanation! Poop should be scooped whenever pets are taken for a walk or even in one's own backyard. The poop should be disposed in your outdoor trash container. Not only is this a good practice to preserve the environment, but it also allows for a poop-free area for others to enjoy!



A sign reminds residents to scoop the poop, minimizing any nutrient or pathogenic bacteria loading to our waters.

**5. Use extreme care in handling *hazardous chemicals*, including oil, grease, gasoline, pesticides, paints, solvents, cleansers, and others.**

The proper storage, use, and disposal of chemicals can ensure that leaks or spills do not occur, that harmful chemicals do not go off of one's property and into nearby water bodies. Chemicals should always be used carefully and as directed. Old oil from cars, boats, and lawnmowers, can be recycled. Kitty litter is an inexpensive material that can be used to absorb spills and should be available in areas of high chemical spill potential, such as the garage. The local trash pickup service can provide guidance about the proper disposal of hazardous chemical waste. If a homeowners association has control over trash pickup, directions for managing hazardous waste should be made available for residents.

**6. Do not sweep or blow *yard waste and lawn clippings* into the storm drain or street.**

Yard waste should be collected and managed by either bagging it and taking it to the curb for pickup, composting leaves for later use as fertilizer, or chipping larger limbs and branches to use later for mulch. For more information:

<http://virtual.clemson.edu/groups/psapublishing/pages/hort/il49.PDF>



A result of leaf debris and litter buildup on a storm drain after a storm event. This drain needs to be cleaned as soon as possible.





Leaf debris from streets and sidewalks has accumulated next to a storm drain. This drain needs to be swept before the debris enters the drain and adds to more expensive maintenance efforts.



### 3.2.3 Community Stormwater Management: Landscape Features

The third level of education addresses the question “what types of landscape options can I employ on my property to protect water quality?” or “what types of landscape options can we employ as a community to protect water quality?”.



A disconnected gutter downspout that either needs a splash plate to minimize erosion and foundation moisture, or better yet, be routed into a rain garden with corrugated plastic pipe!





An example of a block paver parking lot. The pavers allow for stormwater to flow into a porous gravel substrate to be collected and routed to a natural treatment area such as a rain garden or created wetland (described later).



Within a watershed, if a majority of homeowners embrace stormwater management techniques and incorporate practical solutions into their residential landscape, then water quality improvement can more readily be accomplished. An overarching strategy for encouraging stormwater infiltration into the soil and minimizing surface runoff is to disconnect the flow from a stormwater source to its destination, allowing for storage and treatment opportunities. The following five (5) landscape features can be installed to provide water quality protection and stormwater management within one's community:

**1. Use *pervious* (permeable or water-penetrating) surface materials.**

In general, the less impervious surface on one's property, the less the amount of stormwater that will be generated from that property. Impervious materials such as brick, stone, concrete, and asphalt are some surface materials that are typically used for paths, sidewalks, patios, driveways, and parking lots. These are hard surfaces that do not allow water to pass through them into the soil; rather, the water collects and runs off from this surface. The installation of alternative pervious or porous materials can allow for water to pass naturally to the soil below, encouraging infiltration and discouraging runoff. Pervious surfaces can be in the form of gravel, block pavers, or more technical porous concrete or asphalt. It is important to recognize that maintenance is critical in preventing clogging of these materials. Furthermore, the use of lighter colored materials will reduce the amount of heat stress from water running off of the surface to a water body. Vegetative alternatives such as turf, sod, and mulch will also provide opportunities for stormwater to drain into the soil rather than to run off. Combinations of various pervious surface materials can result in a unique, attractive, and environmentally-sound landscape feature. Some communities have maximum impervious surface limitations per parcel or plat that are provided in land use ordinances.





An example of a pervious landscape, including a crushed stone walkway, natural buffer areas, and a mulch area. These landscape features allow for stormwater to flow and filter into the soil rather than running off into the street.





An example of a turf driveway, where the grassed areas allow for stormwater to flow and filter into the soil rather than running off into the street. Also, if a car is parked over the turf area, any pollutants from the car during a rain event may be captured and treated by the grassed area.





An example of an attractive paver sidewalk located at the Center for Sustainable Living at 113 Calhoun St. in downtown Charleston, SC. Pavers allow for stormwater to flow and filter into the soil rather than running off into the street.



## 2. Install *rain barrels* or cisterns for storage.

The concept of collecting rainwater or flood waters in cisterns has existed in the Lowcountry of South Carolina for centuries. Today, rain barrels are smaller versions of the cistern concept. Otherwise known as rainwater harvesting, rain barrels typically connect to gutter downspouts and will fill when a rain event occurs. Rain barrel designs and sizes are varied, but the volume of water that you will need to manage will depend on your roof size, the typical amount of rainfall for your area, and the number of downspouts that drain your rooftop. Most rain barrel designs include an overflow mechanism to account for large rainfall amounts. Also, most designs include a spigot that can be used for irrigation or for rinse water. This is a great way to save money on the water bill or to minimize using stormwater pond water to irrigate!! Some communities, such as the Town of Mount Pleasant, have rain barrels available through their municipal or county stormwater program. The local sewer and/or water provider may have more information for area rain barrel dealers, units may be found at the local hardware store, or a multitude of rain barrel companies are available online. See Appendix B for some useful websites.



An example of a rain barrel located at Coastal Carolina University's Burroughs and Chapin Center for Marine and Wetland Studies in Conway, SC. The barrel collects stormwater from a gutter downspout and has an overflow mechanism that activates when the barrel is full.







The rain barrel collects stormwater from the rooftop, which can be controlled to irrigate your yard during dry conditions.



### 3. Create rain gardens.

A rain garden is an appealing landscape feature that can easily be installed by the homeowner to manage stormwater and protect water quality. A rain garden typically receives runoff water from roofs by way of gutter downspouts, or from other impervious (hard) surfaces such as driveways and sidewalks. The rain garden holds water on the landscape so that it can infiltrate (drain) into the ground and be taken up by attractive plants rather than flowing into a street and down a storm drain or drainage ditch. The size for the area of the rain garden depends on the size of the area to be drained and the ability of the soil to drain surface water. A rule of thumb is that the rain garden area should be approximately 20% of the drainage area (including rooftops, driveways, and other impervious surfaces) in well-drained, sandy soils, and between 20-60% of the drainage area in more poorly drained, loamy soils. A suitable area located between the rainwater source and its destination (either a depressed area in your yard or toward one beyond your property) where water flows naturally and is at least 10 feet from the home. Excavation may be required to achieve an appropriate soil mix (50-60% sand, 20-30% top soil, and 20-30% compost). Native plants, such as a hardy mix of grasses, small shrubs, and self-seeding perennials are good choices, especially those that are both wet- and drought-tolerant, and a dense-material mulch that won't float away are also required. It's also important to select a location with a seasonally high water table depth no shallower than 18 inches to ensure proper drainage. These rain gardens may be used along with rain barrels for a uniquely-efficient and cost-effective landscaping irrigation system!! Always try to use native species. Contact the local Clemson Extension County Office (<http://www.clemson.edu/extension/counties1.htm>) for more information. A rain garden plant list is provided in Appendix C.



An example of a rain garden located at the Town Hall of Surfside Beach, SC. Rain gardens store stormwater and treat pollutants. Note that the downspout collects stormwater, which is routed into the rain garden with corrugated plastic pipe. This pipe can be buried to be more visually appealing.





An excellent example of a rain barrel and rain garden tandem located at Coastal Carolina University's Burroughs and Chapin Center for Marine and Wetland Studies in Conway, SC. The disconnected gutter downspout collects stormwater, which can be controlled to irrigate the rain garden during dry conditions.



#### 4. Plant vegetated buffers.

Vegetated buffers are great ways to minimize the pollutants that run off from your property. These attractive landscape features are typically strategically located between upland property and down-gradient water bodies. An excellent example of buffer placement would be along the banks of a stormwater pond or beside a creek, stream, lake, or marsh. These buffers filter and treat pollutants as they move through them along with stormwater. Buffers have been documented to filter sediment, nutrients from fertilizers, pathogens from pets and other sources, pesticides from landscaping activities, and other potentially water degrading contaminants. Buffers can also provide shoreline stabilization and prevent erosion from wind and water from occurring, ultimately preserving your property area and its value! Vegetative buffers have also been shown to reduce the goose population from lawns, as these buffers give the impression of a predator refuge, as opposed to nice lawn areas where geese typically like to congregate. It is also highly recommended that native plant species are used. Contact the local Clemson Extension County Office (<http://www.clemson.edu/extension/counties1.htm>) for more information, and a vegetated buffer plant list is provided in Appendix D. For more information:

Backyard Buffers for the South Carolina Lowcountry  
(<http://www.scdhec.net/environment/ocrm/pubs/docs/backyard.pdf>).  
Critical Line Buffer Ordinances: Guidance for Coastal Communities (Halfacre-Hitchcock and Hitchcock, 2005)  
([http://www.scdhec.gov/environment/ocrm/pubs/docs/Buffer\\_Ord.pdf](http://www.scdhec.gov/environment/ocrm/pubs/docs/Buffer_Ord.pdf)).





Vegetated buffers around ponds allow for sediment to be captured, pollutants to be filtered, and banks to be stabilized for erosion control. Always use native plant species!



### **5. Construct backyard *wetlands*.**

A backyard wetland acts as a combination between a rain garden and a vegetated buffer. These appealing landscape features are typically constructed in locations where soils are poorly drained, such as those that contain more clay than sand or in areas with a shallow water table. Wetlands retain (store) water for a short period of time and allow for plants to treat stormwater. Backyard wetlands can be good attractors for butterflies, dragonflies, and birds. Contrary to popular belief, a properly-sized wetland to allow for short drying periods and with the appropriate plant selection will not result in a mosquito problem. It has been shown that dragonflies and birds that are attracted to wetlands can be potential predators for mosquitoes and their larvae. For more information:

Plants for Damp or Wet Areas - <http://hgic.clemson.edu/factsheets/hgic1718.htm>





Vegetated buffers adjacent to streams allow for sediment to be captured, pollutants to be filtered, and banks to be stabilized for erosion control. These buffers also provide excellent habitat for birds and other wildlife.



### 3.2.4 Community Stormwater Management: Stormwater Ponds

Retention ponds are the most prevalent stormwater management practice in coastal South Carolina, and these structural practices are primarily used for water quantity management with some capacity for water quality improvement. Due to their popularity and the historical occurrence of problems with ponds, these storage areas deserve special consideration for homeowner and community associations. These ponds are, first and foremost, designed and created for stormwater quantity management. Any associated stormwater treatment or water quality improvement is only considered secondary within these systems, with the exception of the collection and management of sediment (total suspended solids) during the construction phase of a development project for which these ponds were originally and intentionally built. Any further associated treatment by the pond is strictly up to the developer, property owner, and homeowner association; that is, the pond management practices and maintenance plan will dictate how well the pond is capable of treating various water quality constituents, such as nutrients, pesticides, pathogenic bacteria, metals, and hydrocarbons from petroleum products, among many others.



Community wetlands adjacent to impervious surfaces, such as parking lots, allow for pollutants to be filtered and for heated runoff water from pavement to be cooled before flowing to a water body. These wetlands also provide excellent habitat for birds and other wildlife.






An example of an algal bloom occurring in a stormwater pond in coastal South Carolina. Algae is typically green in color, but it may also be brown in color such as the example in the photo. Contact the SC Algal Ecology Lab in Charleston, SC, if an algal bloom occurs in a pond in your community, especially if there is a related fish kill: <http://links.baruch.sc.edu/scael/report.htm>

It is imperative for homeowners and community associations to recognize the connection between activities and practices on land within a residential and/or commercial development and pond health. Much of the responsibility for successful pond management depends on effective communication and actions at the time of transfer for responsibility of the development, and successful implementation of pond management strategies relies on the resulting infrastructure for communal governance to take necessary and appropriate actions. Such actions require work on the part of those responsible for environmental amenities within a development, and often these actions may include need for creation of and adherence to a pond management and maintenance plan, as well as the creation and/or modification of codes, covenants, and restrictions (CC&Rs) that provide homeowners and communities associations with guidelines that are meant for protecting water quality and hopefully for extending the lifespans of community ponds. Any associated amenity value of a pond can only be preserved by the successful creation and implementation of plans, rules, and guidance recommendations. Even if the community association hires a pond management company, it is highly recommended that some member(s) of the association, whether by election or appointment, have an understanding of pond issues and related solutions so that communication between the association and the pond management company can result in the successful application of the best available technologies and strategies to protect pond health. An online resource from SCDHEC-OCRM, [Stormwater Pond Maintenance](http://www.scdhec.net/environment/ocrm/pubs/docs/ponds.pdf), can be found at <http://www.scdhec.net/environment/ocrm/pubs/docs/ponds.pdf>. Furthermore, some recommended homeowner tips are described in the previous Section 3.2.2.





Some basic recommendations to ensure pond health follow:

### **Disconnect stormwater flows from various land use activities.**

Practices that can minimize homeowner impacts on pond health are described in the previous Section 3.2.3 and include such ideas as using pervious materials and rain barrels and creating rain gardens. It should be recognized that each homeowner's actions may have an impact on pond health. While understanding that the purpose of a pond is to manage stormwater, it is also in the best interest of the homeowner and the community to pay attention to upland water flows and their connections to the stormwater pond system. By retaining and reusing stormwater on site, polluted runoff into ponds can be managed, minimized, and in some cases, completely retained and treated. If conveyance is necessary, use grassed swales instead of pipe systems to route stormwater. A grassed swale is a very shallow ditch that is vegetated with grass. Swales not only convey stormwater flow, but also remove small quantities of pollutants from stormwater. Swales can reduce flow velocities and minimize the quantity of stormwater over a period of time to be managed downstream. For example, turfgrass has been recognized for high nutrient uptake. A more innovative structural approach to swale design, such as an enhanced bioswale, combines grass swale and rain garden technologies, is a potential alternative for coastal landscapes with shallow water tables. Plants and shrubs may be incorporated into the bioswale design and can add an attractive landscape feature to a yard or community area.

### **Mowing and landscaping activities.**

Many of the activities described in Section 3.2.2 can be used to minimize impacts to pond health, including deliberate and careful irrigation and fertilizer and pesticide application. Also, landscaping features that use stormwater and allow for natural infiltration into the soil can be effective for protecting pond health and water quality. The excessive application of fertilizer is also a potential source of problems for ponds and may lead to algal blooms. It is always a good idea to take soil samples to assess and evaluate the amount and types of fertilizer that need to be applied. Local Clemson Extension County Offices provide soil and water analytical services (<http://www.clemson.edu/extension/counties1.htm>). For more information:  
Soil pH - <http://hgic.clemson.edu/factsheets/hgic1650.htm>  
Soil testing - <http://hgic.clemson.edu/factsheets/hgic1652.htm>  
Creating an Environmentally Responsible Landscape – <http://hgic.clemson.edu/factsheets/hgic1723.htm>

Once soil nutrient levels have been determined, then a nutrient management plan may be implemented to allow for the appropriate fertilizer application strategy. Mowing down to the edge of the pond and allowing for the yard waste to enter the pond can result in reduced oxygen levels which can lead to other pond problems later, including odor and fish kills. As recommended in Section 3.2.3, vegetative buffers can be a great way to protect water quality and promote pond health.

### **Pond irrigation versus water re-use.**

Many coastal South Carolina communities use pond water for lawn and landscape irrigation. If this is the case, over-irrigation can result in low pond water levels, which may in turn lead to a greater chance for algal growth (many algal species like shallow water habitats). If stormwater can be collected (i.e. via rain barrels, see Section 3.2.3) and re-used, then the need for pond water use for irrigation is lessened. If pond water must be used for irrigation, a community should engage the homeowners in an irrigation strategy, especially during high-use summer months and drought conditions. Of course, landscaping ideas that use less water, including planting native and drought tolerant species, could be effective strategies for minimizing the need for pond water irrigation. The practice of xeriscaping, or landscaping with minimal water use, is previously described in Section 3.2.2. For more information:

Watering Lawns – <http://hgic.clemson.edu/factsheets/hgic1207.htm>

Irrigation Systems – <http://hgic.clemson.edu/factsheets/hgic1705.htm>





Low Maintenance Landscape Ideas – <http://hgic.clemson.edu/factsheets/hgic1703.htm>  
Conserving Water in Your Landscape - <http://hgic.clemson.edu/factsheets/hgic1724.htm>

### **Employ aeration strategies to prevent odor and fish kills.**

Increasing pond water oxygen concentrations is one popular way to decrease odor problems, minimize algal production, and protect a pond from fish kills. An understanding of the dissolved oxygen cycle is extremely important for pond health in that dissolved oxygen is a diurnal cycle. High oxygen levels in the afternoon are brought about by photosynthesis. Correspondingly at night, the algae respire using up oxygen and producing carbon dioxide. The lowest level for oxygen during a 24-hour cycle is just before dawn.



An example of a fountain aeration system installed in a stormwater pond.

There are different types of aeration options. One type of aerator is the fountain system, which sprays water into the air and allows for oxygen and mixing. Another type is the bubbler or diffuser aerator, which creates bubbles from below the water surface and encourages oxygenation and mixing. Aeration may be continuous, seasonal, or for emergency situations, depending on the extent of the need for dissolved oxygen increases. One caution for aeration is that mixing of pond water may often allow the resuspension of sediment particles, which can in turn lead to higher nutrient concentrations in the pond water and subsequent algal blooms. Care should be used in deciding which type of aeration is best for certain types of ponds and various scenarios.

### **Herbicide application for nuisance aquatic plants.**

Chemical herbicides are typically used to reduce algal and other nuisance plant growth. Only a licensed applicator can be enlisted for herbicide treatment of aquatic systems. Most pond management companies have licensed applicators and have been trained in determining the herbicide that is appropriate for a given pond type and size as well as the given season and need. However, it is important for some representative of homeowners and/or community associations to be knowledgeable about the types of chemicals that are being applied to ponds. For more information:

Aquatic Weed Control Overview – <http://hgic.clemson.edu/factsheets/hgic1714.htm>

Biological Control of Aquatic Weeds - <http://hgic.clemson.edu/factsheets/hgic1715.htm>

Chemical Control of Aquatic Weeds – <http://hgic.clemson.edu/factsheets/hgic1720.htm>

Aquatic Weed Control Herbicides – <http://hgic.clemson.edu/factsheets/hgic1721.htm>



### **Fish stocking**

Many pond managers have employed the concept of Integrated Pond Management (IPM) for providing ecological solutions to nuisance plant growth. Triploid carp are one type of fish that has been successfully introduced into ponds to feed on certain types of nuisance plants. Other fish, such as bream, largemouth bass, and tilapia, have been stocked into various ponds successfully while providing an ecologically balanced system. Fish stocking can be a complex process and require prior experience and knowledge of stocking rates and various aquaculture techniques. Many pond management companies are using stocking strategies for maintaining ponds. For more information:

Fertilizing Recreational Fish Ponds – <http://hgic.clemson.edu/factsheets/hgic1710.htm>  
Liming Recreational Fish Ponds – <http://hgic.clemson.edu/factsheets/hgic1711.htm>

### **Dredging**

Dredging pond sediments is a costly yet sometimes necessary endeavor. SCDHEC-OCRM recommends that ponds are dredged every 10 years (<http://www.scdhec.net/environment/ocrm/pubs/docs/ponds.pdf>). Proper dredging can allow for pond storage capacity to be restored by removing material that is displacing the potential volume for water storage. If appropriately done, dredging may also provide improved pond water quality by the removal of pollutants within the dredged spoil material. However, dredging may also pose the risk of resuspending pollutants into the water column as the removal activity takes place. Special care must be observed to keep these pollutants from reaching downstream areas where problems may occur. As a final consideration, dredge spoil material must be properly handled and disposed of in order to protect environmental health.

## **3.2.5 Community Stormwater Management: Maintenance!**

In general, maintenance is the most important part of successful and effective stormwater management and performing the necessary and appropriate maintenance on ALL stormwater management practices is critical. By far, the most important component beyond the appropriate selection, design, and implementation of these stormwater management practices is the maintenance requirements associated with each practice. Whether at the community- or individual lot-scale or both, it cannot be stressed enough that frequent and proper inspection and maintenance leads to better performance and avoids problems over time. The first step in performing maintenance is the need for periodic inspections of stormwater practices, including checking storm drains and other inlets for yard debris, litter, or other materials. Landscape features with plants must be trimmed and thinned, but only to encourage and promote healthy growth. Bare areas of soil should be protected from erosion, either by sodding, planting larger plants, or using other erosion control practices. In order to anticipate future problems with stormwater systems, it is essential to understand where water flows when it rains and when irrigation systems are operating. A maintenance checklist is provided in Appendix E.

## **3.2.6 Addressing Stormwater Management: Community Associations**

In addition to education, community associations need to take a more active role in promoting environmental management by raising awareness and changing environmental perceptions. To tackle stormwater management issues, rules and regulations should be included in the CC&Rs that address stormwater management in the ways suggested above, including requirements for the use of vegetated buffers, restrictions on the use of pesticides and water intensive lawns, limits on impervious surfaces, and suggestions for the implementation of management practices (BMPs) in addition to and upstream from stormwater ponds. The designation of a specific portion of the community association's assessments as contributing to stormwater management would also serve to inform residents of the importance and responsibilities of the community associations in managing the common areas and the environmental quality of the community. By increasing communication and cooperation with other



surrounding communities within the watershed, community associations can also address stormwater issues more effectively (de Loë and Kreutzwiser, 2005; Smutko et al., 2003). Also, a very useful guide for community associations by the Kiawah Island Community Association (KICA), entitled “Kiawah Island Land and Lakes Guidelines for Management and Maintenance” can be found at:

<http://homepage.mac.com/kiawahlakes/LakesDepartmentFolder/LakesDepartment/LakeManagementInfo/PolicyInfo/LLGMM.html>

Even though studies have shown that stormwater ponds can be effective in addressing issues with flooding and runoff (Jeer et al., 1997), an integrated stormwater management approach combining BMPs appears to be the most successful (Jeer et al., 1997, Anderson et al., 2002; Villarreal et al., 2004). In new developments, land use planners, landscape architects, and/or stormwater engineers should recommend the installation of the appropriate type and number of BMPs to address stormwater management, and in terms of environmental management in general, “because well-designed conservation subdivisions could create more opportunities for positive interactions with nature than conventional subdivisions, they could become an important factor motivating pro-environmental actions on- and off-site” (Chawla, 2004).

On a final note, stormwater ponds are not exactly an amenity as they are perceived by many homeowners. These ponds are designed primarily for stormwater quantity management and sediment collection. However, if an individual resident or a community association, whichever the case, takes ownership and assumes the responsibility for stormwater that originates on their property, then the overall likelihood of maintaining a stormwater pond as an aesthetically appealing amenity becomes greater. It is imperative that homeowners and community associations recognize the connection between land use activities, stormwater management strategies, and the health of stormwater ponds. Community association-coordinated activities, such as those discussed in this document, may provide mechanisms for protecting water quality within one’s neighborhood.





## 4.0 References Cited

- Anderson, B.C., Watt, W.E., & Marsalek, J. (2002) Critical issues for stormwater ponds: learning from a decade of research. *Water Science and Technology*, 45(9), 277-283.
- Arendt, R. (1996) Conservation design for subdivisions: A practical guide to creating open space networks. Washington, DC: Island Press.
- Arendt, R. (2004) Linked landscapes: Creating greenway corridors through conservation subdivision design strategies in the northeastern and central United States. *Landscape and Urban Planning*, 68, 241-269.
- Austin, M.E. & Kaplan, R. (2003) Resident Involvement in Natural Resource Management: open space conservation design in practice. *Local Environment*, 8(2), 141-153.
- Austin, M.E. (2004) Resident perspectives of the open space conservation subdivision in Hamburg Township, Michigan. *Landscape and Urban Planning*, 69, 245-253.
- Bastian, C.T., McLeod, D.M., Germino, M.J., Reiners, W.A., & Blasko, B.J. (2002) Environmental amenities and agricultural land values: a hedonic model using geographic information systems data. *Ecological Economics*, 40, 337-349.
- Blandy, S. & Lister, D. (2005) Gated communities: (Ne)gating community development? *Housing Studies*, 20(2), 287-301.
- Brabec, E., Schulte, S. & Richards, P. (2002) Impervious surfaces and water quality: a review of current literature and its implications for watershed planning. *Journal of Planning Literature*, 16(4), 499-513.
- Breffle, W.S., Morey, E.R. & Lodder, T. S. (1998) Using Contingent Valuation to Estimate a Neighborhood's Willingness to Pay to Preserve Undeveloped Urban Land. *Urban Studies*, 35(4), 715-727.
- Brody, S.D., Highfield, W. & Peck, B.M. (2005) Exploring the mosaic of perceptions for water quality across watersheds in San Antonio, Texas. *Landscape and Urban Planning*, 73, 200-214.
- Caban, J. (1994) The Belle Hall Plantation Charrette: An Analysis of Stormwater Runoff Difference Between Traditional and Spawl Development Scenarios. SCDHEC-OCRM, Charleston, SC. 17 pp. [http://www.scdhec.gov/environment/ocrm/pubs/docs/tech\\_docs/urbgrth1.pdf](http://www.scdhec.gov/environment/ocrm/pubs/docs/tech_docs/urbgrth1.pdf).
- Chen, S.C.Y. & Webster, C.J. (2005) Homeowners Associations, Collective Action and the Costs of Private Governance. *Housing Studies*, 20(2), 205-220.
- Cho, S., Newman D.H., & Bowker, J.M. (2005) Measuring rural homeowners' willingness to pay for land conservation easements. *Forest Policy and Economics*, 7, 757-770.
- Community Association Institute. (2005) Data on U.S. Community Associations. <http://www.caionline.org/about/facts.cfm>.
- de Loë, R.C. & Kreutzwiser, R.D. (2005) Closing the groundwater protection implementation gap. *Geoforum*, 36, 241-256.
- Elmendorf, W.F. & Luloff, A.E. (1999) Using Ecosystem-Based and



- Traditional Land-Use Planning to Conserve Greenspace. *Journal of Arboriculture*, 25(5), 264-273.
- Environmental Protection Agency. (2005) What is Nonpoint Source (NPS) Pollution?: Questions and Answers. <http://www.epa.gov/owow/nps/qa.html>.
- Fennessey, L.A.J., Hamlett, J.M., Aron, G. & LaSota, D. (2001) Changes in Runoff Due to Stormwater Management Pond Regulations. *Journal of Hydrologic Engineering*, 6(4), 317-327.
- Foldvary, F.E. (2002) Proprietary Communities and Community Associations, Pages 258-288 in *The Voluntary City: Choice, Community, and Civil Society* edited by D.T. Beito, P. Gordon, & A. Tabarrok. Ann Arbor: The University of Michigan Press.
- Frey, J.H. & Fontana, A. (1991) The Group Interview in Social Research, Pages 20-34 in *Successful Focus Groups: Advancing the State of the Art* edited by D.L. Morgan. Newbury Park: Sage Publications.
- Graham, E.I. & Lei, J.H. (2000) Stormwater management ponds and wetlands sediment maintenance. *Water Quality Research Journal of Canada*, 35(3), 525-539.
- Gullah/Geechee Special Resource Study Report (GGSRS). (2003) Lowcountry Gullah Culture: special resource study and environmental impact study: public review draft edited by National Park Service, Southeast Region, Division of Planning and Compliance, Special Resource Study Team. Georgia: National Park Service, Southeast Region.
- Halfacre-Hitchcock, A.C., & Hitchcock, D.R. (2005) Critical Line Buffer Ordinances: Guidance for Coastal Communities. *Water Quality Improvement and Community Enhancement Series*, SCDHEC-OCRM, 72 pp.
- Hottenroth, D., Harper, C., & Turner, J. (1999) Effectiveness of Integrated Stormwater Management in a Portland, Oregon, Watershed. *Journal of the American Water Resources Association*, 35(3), 633-641.
- Johnston, R. J., Swallow, S.K., Tyrrell, T.J., & Bauer, D.M. (2003) Rural Amenity Values and Length of Residency. *American Journal of Agricultural Economics*, 85(4), 1000-1015.
- Kaltenborn, B.P. (1998) Effects of sense of place on responses to environmental impacts: A study among residents in Svalbard in the Norwegian high Arctic. *Applied Geography*, 18(2), 169-189.
- Kaltenborn, B.P. & Bjerke, T. (2002) Associations between environmental value orientations and landscape preferences. *Landscape and Urban Planning*, 59, 1-11.
- Kaplan, R. & Austin, M.E. (2004) Out in the country: sprawl and the quest for nature nearby. *Landscape and Urban Planning*, 69, 235-243.
- Kearney, A.R. (2006) Residential development patterns and neighborhood satisfaction: Impacts of density and nearby nature. *Environment and Behavior*, 38(1), 112-139.
- Kennedy, D.J. (1995) Residential Associations as State Actors: Regulating the Impact of Gated Communities on Nonmembers. *Yale Law Journal*, 105(3), 761-793.
- Knodel, J. (1993) The Design and Analysis of Focus Group Studies: A Practical Approach, Pages 35-50 in *Successful Focus Groups: Advancing the State of the Art* edited by D.L. Morgan. Newbury Park: Sage Publications.
- Lewitus, A.J., L.B. Schmidt, L.J. Mason, J.W. Kempton, S.B. Wilde, J.L. Wolny, B.J. Williams, K.C. Hayes, S.N. Hymel, C.J. Keppler, and A.H. Ringwood. 2003. Harmful



Algal Blooms in South Carolina Residential and Golf Course Ponds. *Population and Environment* 24:387-413.

MacCallum, S.H. (2002) The Case for Land Lease versus Subdivision: Homeowners' Associations Reconsidered, Pages 371-400 in *The Voluntary City: Choice, Community, and Civil Society* edited by D.T. Beito, P. Gordon, & A. Tabarrok. Ann Arbor: The University of Michigan Press.

McCabe, B.C. (2005) The rules are different here-An institutional comparison of cities and homeowners associations. *Administration and Society*, 37 (4), 404-425.

Nelson, R.H. (2005) *Private Neighborhoods and the Transformation of Local Government*. Washington, D.C.: Urban Institute Press.

Neuendorf, K.A. (2002) *The Content Analysis Guidebook*. Thousand Oaks: Sage Publications.

Novotny, V., ed. (1995) *Nonpoint Pollution and Urban Stormwater Management*. Lancaster: Technomic Publishing Company, Inc.

Parikh, P., Taylor, M., Hoagland, T., Thurston, H. & Shuster, W. (2005) Application of market mechanisms and incentives to reduce stormwater runoff. An integrated hydrologic, economic and legal approach. *Environmental Science and Policy*, 8, 133-144.

Parr, J. (2005) Local water diversely known: Walkerton, Ontario, 2000 and after. *Environment and Planning D: Society and Space*, 23, 251-271.

Porcher, R. (1995). *Wildflowers of the Carolina Low Country*. University of South Carolina.

Rauch, W., Seggelke, K., Brown, R. & Krebs, P. (2005) Integrated approaches to urban stormwater

drainage: where do we stand? *Environmental Management*, 35(4), 396-409.

Sample, D., Heaney, J., Wright, L., Fan, C., Lai, F. & Field, R. (2003) Costs of best management practices and associated land for urban stormwater. *Journal of Water Resources Planning and Management*. 129(1), 59-68.

Sleavin, W.J. & Civco, D.L. (2000) Measuring Impervious Surfaces For Non-point Source Pollution Modeling. *American Society of Photogrammetry and Remote Sensing (ASPRS) Annual Convention*.

Smutko, L.S., Klimek, S.H., Perrin, C.A. & Danielson, L.E. (2002) Involving Watershed Stakeholders: An Issue Attribute Approach to Determine Willingness and Need. *Journal of the American Water Resources Association*, 38(4), 995-1006.

South Carolina Budget and Control Board. 2006. "South Carolina Statistical Abstract 2006." Prepared by the Office of Research and Statistics, Columbia, SC. [www.ors2.state.sc.us/abstract/index.asp](http://www.ors2.state.sc.us/abstract/index.asp).

South Carolina Department of Health and Environmental Control-Office of Ocean and Coastal Resource Management (SCDHEC-OCRM). (2001) *A Citizen's Guide to Stormwater Pond Maintenance in South Carolina*. Columbia, SC: SCDHEC-OCRM.

South Carolina Department of Health and Environmental Control (SCDHEC). (2003). *Public Perceptions and Concern about Runoff Pollution*. Columbia, SC.

Spain, D. (1993) Been-Heres Versus Come-Heres: Negotiating Conflicting Community Identities. *Journal of the American Planning Association*, 59(2), 156-171.

Stedman, R.C. (2003) Is It Really Just a Social Construction?: The Contribution of the Physical Environment to Sense of Place. *Society and Natural Resources*, 16, 671-685.

Stedman, R.C. & Hammer, R.B. (2006) Environmental Perception in a Rapidly Growing, Amenity-Rich Region: The Effects of Lakeshore Development on Perceived Water Quality in Vilas County, Wisconsin. *Society and Natural Resources*, 19, 137-151.

The Nature Conservancy. (2005) The Nature Conservancy in South Carolina. <http://www.nature.org/wherewework/northamerica/states/southcarolina/>

Thompson, R.H. (2004) Overcoming Barriers to Ecologically Sensitive Land Management: Conservation Subdivisions, Green Developments, and the Development of a Land Ethic. *Journal of Planning Education and Research*, 24, 141-153.

Thurston, H., Goddard, H., Szlag, D., & Lemberg, B. (2003) Controlling stormwater runoff with tradable allowances for impervious surfaces. *Journal of Water Resources Planning and Management*, 129(5), 409-418.

Tibbetts, J. (2005) "Old Cities, New Life", *Coastal Heritage*, vol. 20, n. 1. (Summer issue), SC Sea Grant Consortium, Charleston, SC.

Van Dolah, R., P. Jutte, G. Riekirk, J. Felber, F. Holland, and J. Scurry. 2004. "An Evaluation of Land Use Patterns Versus Estuarine Habitat in South Carolina's Coastal Zone: Final Report." Prepared for the Office of Ocean and Coastal Resource Management, South Carolina Department of Health and Environmental Control (SCDHEC-OCRM), Charleston, SC. <http://www.dnr.sc.gov/marine/scecap/PDF%20Files/Reports/LandUseReport.pdf>

Villareal, E.L. & Bengtsson, A.S.D.L. (2004) Inner city stormwater control using a combination of best management practices. *Ecological Engineering*, 22(4-5), 279-298.





## Appendix A:

# Glossary of Terms

**Amenities:** tangible or intangible features that enhance and add to the value or desirability of a property.

**Best management practices (BMPs):** practices determined to be the most effective and feasible means of preventing or reducing pollution from point and nonpoint sources in order to protect water quality.

**Biodiversity:** The number and variety of different organisms in the ecological complexes in which they naturally occur. Organisms are organized at many levels, ranging from complete ecosystems to the biochemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, and genes that must be present for a healthy environment. A large number of species must characterize the food chain, representing multiple predator-prey relationships.

**Cluster development (clustering):** Buildings concentrated together in specific areas to minimize infrastructure and development costs while achieving the allowable density. Allows the preservation of natural open space for recreation, common open space, and preservation of environmentally sensitive features.

**Coastal zone (CZ):** the term 'coastal zone' means the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches (from section 304 of the Coastal Zone Management Act).

**Community association:** A community association is an organization comprised of owners of units in a development. The vast majority of

them are incorporated and are therefore governed by a board, which is a private government. They collect fees or assessments from homeowners, maintain the common areas of the development, and enforce the association's governing documents or conditions, covenants, and restrictions (CC&Rs). The association may have one of a variety of names: homeowners association, property owners association, condominium association, cooperative, common interest community, or council of co-owners.

**Conditions, Covenants, and Restrictions (CC&Rs):** The restrictions governing the use of real estate, usually enforced by a community association and passed on to the new owners of property. For example, CC&Rs may tell you how big your house can be, how you must landscape your yard or whether you can have pets. If property is subject to CC&Rs, buyers must be notified before the sale takes place.

**Conservation subdivision:** the term refers to residential developments where half or more of the buildable land area is designated as undivided, permanent open space at a neutral density to existing zoning. This land-use planning approach uses cluster development on relatively small lots to allow for the open space conservation of natural areas or sensitive lands either owned and managed communally by homeowners, land trusts, a private landowner, or a public entity.

**Created wetlands/Constructed wetland:** a wetland that has been created on a site location which historically was not a wetland. This requires establishing wetland hydrology in a nonwetland area. It is usually done by excavating down





to the local water table or by diking a drainageway and compacting soils or bringing in clay for an impervious substrate. It is unlikely that most created wetlands are functionally equivalent or similar to the natural wetlands they are intended to replace. Some resources differentiate between created and constructed wetlands by defining constructed wetlands as being created for the sole purpose of wastewater or stormwater treatment.

**Dry detention pond:** a stormwater pond design with no permanent pool. Stormwater is detained in the practice temporarily to settle pollutants, protect downstream channels, and prevent flooding. These practices typically provide poor pollutant removal.

**Eutrophication:** excessive nutrient enrichment of water bodies, frequently the result of human activities that causes an explosive growth or “bloom” of algae and other aquatic plants. The respiration of the additional plant life depletes the water of dissolved oxygen which can be detrimental to the plant and animal inhabitants of the water body.

**Fecal Coliform Bacteria (FCB):** total coliform bacteria are the group of bacteria that are commonly associated with the digestive tract of warm and cold blooded organisms including humans. A subset of the total coliform bacteria is the fecal coliform bacteria (FCB). This subset is distinguished by its ability to survive at elevated temperatures and are associated only with the fecal material of warm blooded animals.

**Groundwater:** water that is normally located below the ground surface.

**Gullah:** Located on the Sea Islands of South Carolina and Georgia are communities of people who are the descendants of enslaved Africans. They have a unique culture that is directly linked to West Africa. In South Carolina, this group of African-Americans and the language they speak are referred to as Gullah (Gul-luh).

**Harmful algal blooms (HABs):** a harmful algal bloom (HAB) can occur when certain types of microscopic algae grow quickly in water, forming visible patches that may harm the health of the environment, plants, or animals. HABs can deplete the oxygen and block the sunlight that other organisms need to live, and some HAB-causing algae release toxins that are dangerous to animals and humans. HABs can occur in marine, estuarine, and fresh waters.

**Hydrology:** the study of the properties, location, and movement of inland waters both above and below ground. The hydrologic cycle is the cycle of water movement from the atmosphere to the earth and back to the atmosphere through various processes including rain, runoff, infiltration, and evaporation.

**Impervious surface:** ground cover such as roofs, driveways, and roadways that does not allow water to sink into (infiltrate) the soil. Impervious surfaces increase the volume and speed of runoff after rainfall.


**Infiltration:** the penetration of water through the ground surface and into the soil.

**Land trusts:** usually local, state, or regional nonprofit organizations that are involved in conserving land. Land trusts generally focus their efforts on protecting specific natural, historic, scenic, or recreational features in a specific state or geographic region, such as a watershed. This is often done by creating conservation easements that restrict the use of real property.

**Load:** the quantity of a material that enters a body of water over a given time period.

**NIMBY (Not In My Backyard):** an acronym for the phenomenon in which residents oppose a development as being inappropriate for their local area but, by implication, do not have a blanket opposition to such developments elsewhere. It is therefore used to signify protest by people whose major concern about some development or activity is for it not be associated with or developed within their locale.





**Nonpoint source pollution (NPS):** pollution from diffuse sources that cannot be attributed to one identifiable point, such as a discharge pipe.

**NPDES (National Pollutant Discharge and Elimination System):** As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States (EPA).

**Open space:** a portion of a site which is permanently set aside for public or private use and will not be developed. The space may be used for passive or active recreation, or may be reserved to protect or buffer natural areas.

**Ordinance:** a formal legislative enactment by the legislative body which, if not in conflict with any higher form of law, has the full force and effect of law within the boundaries of the municipality to which it applies.

**Outreach:** an effort by an organization or group to connect its ideas or practices to the efforts of other organizations, groups, specific audiences or the general public. Outreach often takes on an educational component (i.e., the dissemination of ideas), but it is increasingly common for organizations to conceive of their outreach strategy as a two-way street. In this case outreach is also framed as engagement, rather than simple dissemination/education.

**Pervious surface:** any material that allows for the passage of liquid through it.

**Phytoremediation:** the use of plants to decontaminate water and soils rich in dissolved nutrients (as phosphates).

**Point source pollution:** pollution from a definable source, such as an outfall pipe.

**Pollution:** the addition of a substance(s) to an environment in greater than natural concentrations as a result of human activity producing a net detrimental effect on the environment.

**Quality of life:** the level of enjoyment and fulfillment derived by humans from the life they live within their local economic, cultural, social, and environmental conditions.

**Rain barrels (cisterns):** a temporary storage device connected to a roof downspout to catch and store rainwater, typically including a hose attachment to allow for reuse of rooftop runoff. Rain barrels slow down run-off into streams and storm drains to reduce erosion, sedimentation, and pollution. They also provide free, soft water for watering plants.

**Rain gardens:** A rain garden is a shallow, constructed depression that is planted with deep-rooted native plants & grasses. It is located to receive runoff from hard surfaces such as a roof via a downspout, a sidewalk, or a driveway. Rain gardens slow down the rush of water from these hard surfaces, hold the water for a short period of time and allow it to naturally infiltrate into the ground.

**Rainwater harvesting:** the collection and storage of rain from roofs or a surface catchment for future productive use. Some of the reasons why rainwater harvesting can be adopted in cities include an ability to provide supplemental water for the city's requirement, to increase soil moisture levels for urban greenery, to increase the ground water table through artificial recharge, to mitigate urban flooding and to improve the quality of groundwater.

**Roof gardens (green roofs):** any garden on the roof of a building. Roof gardens can provide thermal and noise insulation, wildlife habitat, rainwater detention, and/or an extra living space.

**Runoff:** rain water that does not penetrate the ground's surface and therefore flows off into creeks and streams, often carrying with it sediment and sediment bound contaminants.

**Sea Islands/barrier islands:** The Sea Islands are a chain of more than 100 low islands off the Atlantic coast of South Carolina, Georgia, and North Florida, extending from the Santee

River to the St. Johns River. The ocean side of the islands is generally sandy; the side facing the mainland is marshy. A number of the Sea Islands are barrier islands. A barrier island is a long, relatively narrow island running parallel to the mainland, built up by the action of waves and currents and serving to protect the coast from erosion by surf and tidal surges.

**South Carolina Lowcountry:** the coastal area of the state of South Carolina characterized by lowland topography and unique history and culture.

**Stormwater:** water resulting from a rain event that can typically move quickly to water bodies due to impervious surfaces; also known as “runoff.”

**Stormwater management (integrated stormwater management, alternative stormwater management strategies):** Stormwater management is the management of runoff to provide controlled release rates to receiving systems, typically through the use of detention/retention facilities such as ponds. Alternative stormwater management or integrated stormwater management seeks to maximize perviousness throughout the system, providing stormwater with multiple opportunities to soak into the ground. This approach reduces stormwater volume, decreases runoff velocity, and improves water quality.

**Sustainable management:** managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations.

**Total suspended solids:** The total amount of soils particulate matter which is suspended in the water column.

**Urban sprawl:** The unplanned, uncontrolled spreading of urban development into areas adjoining

the edge of a city, traditionally suburbs or exurbs.

**Vegetated buffers:** strips of land that act as filters, removing pollutants from rainfall before it enters waterways.

**Water quality:** the condition of water based on its physical, chemical, and biological integrity in regard to a specific designated use.

**Water quantity:** a term used to refer to the volume or amount of water, as opposed to the quality or cleanliness of the water.

**Watershed:** an area of land that is drained to a common point of surface discharge.

**Wet detention pond:** a stormwater pond design with a permanent pool. Stormwater is retained in the proactive for long periods of time to settle pollutants, protect downstream channels, and prevent flooding. These practices typically provide poor pollutant removal.

**Xeriscaping:** Landscaping that uses drought-tolerant vegetation instead of turf to reduce the amount of water required to maintain a lawn.





## Appendix B: Useful Web Sites

### Appendix B: Useful Web Sites

NOAA Coastal Services Center Alternative for Coastal Development: One Site, Three Scenarios: <http://www.csc.noaa.gov/alternatives/>

National Nonpoint Education for Municipal Officials: <http://nemonet.uconn.edu>

Center for Watershed Protection: <http://www.stormwatercenter.net/> (slideshows are particularly useful) and <http://www.cwp.org/>

Better Site Design:  
[www.stormwatercenter.net/Slideshows/bsd%20for%20smrc/sld001.htm](http://www.stormwatercenter.net/Slideshows/bsd%20for%20smrc/sld001.htm)

Infiltration Practices: [www.stormwatercenter.net/Slideshows/infiltration-rac/sld001.htm](http://www.stormwatercenter.net/Slideshows/infiltration-rac/sld001.htm)

Urban Stream Protection: [www.cwp.org/SPSP/TOC.htm](http://www.cwp.org/SPSP/TOC.htm)

Low Impact Development: <http://www.lowimpactdevelopment.org> and [www.lid-stormwater.net](http://www.lid-stormwater.net)

Residential Uses: [www.lid-stormwater.net/general/general\\_residential.htm](http://www.lid-stormwater.net/general/general_residential.htm)

Rain Garden Network: <http://www.raingardennetwork.com/>

Rain Barrel Guide: <http://www.rainbarrelguide.com>

A Sourcebook for Green and Sustainable Building: Pervious Paving Materials: <http://www.greenbuilder.com/sourcebook/PerviousMaterials.html>

Paver Search: Permeable Pavers: <http://www.paversearch.com/permeable-pavers-menu.htm>

Tennessee Valley Authority Economic Development: Sustainable Development Guide- Design Principles for Parking Lots: <http://www.tvaed.com/sustainable/parking.htm>

Stormwater: The Journal for Surface Water Quality Professionals: <http://www.forester.net/sw.html>

Porous Asphalt Pavement: [http://www.forester.net/sw\\_0305\\_porous.html](http://www.forester.net/sw_0305_porous.html)

Innovative Design: [http://www.forester.net/sw\\_0101\\_innovative.html](http://www.forester.net/sw_0101_innovative.html)

Southeast Cement Association: Pervious Concrete Pavements: <http://www.pervious.info/>

The Concrete Network: Pervious Concrete Pavements: <http://www.concretenetwork.com/pervious/index.html>

Stormwater Authority: <http://www.stormwaterauthority.org>

Environmental Protection Agency: <http://www.epa.gov>

Wetlands and Watersheds: <http://www.epa.gov/owow/wetlands/watersheds/>

Polluted Runoff: <http://www.epa.gov/owow/nps/>

National Management Measures to Control Nonpoint Source Pollution from Urban Areas: [www.epa.gov/owow/nps/urbanmm/index.html](http://www.epa.gov/owow/nps/urbanmm/index.html)



NPDES Phase II ~ Menu of BMPs:

<http://cfpub.epa.gov/npdes/stormwater/menuofbmps>

Water Recycling: <http://www.waterrecycling.com/index.htm>

Bioretention: [www.ence.umd.edu/~apdavis/Bioret.htm](http://www.ence.umd.edu/~apdavis/Bioret.htm)

Urban Small Sites BMP Manual:

[www.metrocouncil.org/environment/Watershed/bmp/manual.htm](http://www.metrocouncil.org/environment/Watershed/bmp/manual.htm)

Managing Stormwater: BMP Videos: [www.greenworks.tv/stormwater/index.htm](http://www.greenworks.tv/stormwater/index.htm)

Low Impact Development Techniques:

<http://www.wbdg.org/design/lidtech.php?print=1>

### *State of South Carolina and Clemson University web sites:*

Charleston Urban Growth Model, Strom Thurmond Institute, Clemson University:

<http://www.strom.clemson.edu/teams/dctech/urban.html#>

Clemson Extension Service fact sheets (from the Home and Garden Information Center):

Fertilizing Lawns – <http://hgic.clemson.edu/factsheets/hgic1201.htm>

Mowing Lawns – <http://hgic.clemson.edu/factsheets/hgic1205.htm>

Watering Lawns – <http://hgic.clemson.edu/factsheets/hgic1207.htm>

Soil pH - <http://hgic.clemson.edu/factsheets/hgic1650.htm>

Soil testing - <http://hgic.clemson.edu/factsheets/hgic1652.htm>

Fertilizers - <http://hgic.clemson.edu/factsheets/hgic1654.htm>

Mulch – <http://hgic.clemson.edu/factsheets/hgic1604.htm>

Composting – <http://hgic.clemson.edu/factsheets/hgic1600.htm>

Low Maintenance Landscape Ideas – <http://hgic.clemson.edu/factsheets/hgic1703.htm>

Irrigation Systems – <http://hgic.clemson.edu/factsheets/hgic1705.htm>

Algae Problems in Water Gardens – <http://hgic.clemson.edu/factsheets/hgic1708.htm>

Aquatic Plant Selection – <http://hgic.clemson.edu/factsheets/hgic1709.htm>

Fertilizing Recreational Fish Ponds – <http://hgic.clemson.edu/factsheets/hgic1710.htm>

Liming Recreational Fish Ponds – <http://hgic.clemson.edu/factsheets/hgic1711.htm>

Aquatic Weed Control Overview – <http://hgic.clemson.edu/factsheets/hgic1714.htm>

Biological Control of Aquatic Weeds - <http://hgic.clemson.edu/factsheets/hgic1715.htm>

Plants for Shade – <http://hgic.clemson.edu/factsheets/hgic1716.htm>

Plants for Dry Areas - <http://hgic.clemson.edu/factsheets/hgic1717.htm>

Plants for Damp or Wet Areas - <http://hgic.clemson.edu/factsheets/hgic1718.htm>

Chemical Control of Aquatic Weeds – <http://hgic.clemson.edu/factsheets/hgic1720.htm>

Aquatic Weed Control Herbicides – <http://hgic.clemson.edu/factsheets/hgic1721.htm>

Creating an Environmentally Responsible Landscape –  
<http://hgic.clemson.edu/factsheets/hgic1723.htm>

Conserving Water in Your Landscape -  
<http://hgic.clemson.edu/factsheets/hgic1724.htm>



The Belle Hall Plantation Charrette, Charleston County, SC:  
[http://www.scdhec.gov/environment/ocrm/pubs/docs/tech\\_docs/urbgrth1.pdf](http://www.scdhec.gov/environment/ocrm/pubs/docs/tech_docs/urbgrth1.pdf)

LUCES web site: <http://www.lu-ces.org>

U.S.E.S web site: <http://www.urbanestuary.org>

The Nature Conservancy in South Carolina:  
<http://www.nature.org/wherewework/northamerica/states/southcarolina/>

Stormwater Education Clearinghouse Web Site:  
<http://www.scdhec.net/water/ms4/index.html>

Coastal Waccamaw Stormwater Education Consortium:  
[http://www.northinlet.sc.edu/training/stormwater\\_education/](http://www.northinlet.sc.edu/training/stormwater_education/)

Carolina Clear program: <http://carolinaclear.clemson.edu/>

SC Coast-A-Syst: <http://www.clemson.edu/sccoastasyst/homepgs/services.htm>

SC NEMO – Nonpoint Education for Municipal Officials:  
<http://www.scseagrant.org/scnemo.htm>

SC Sea Grant Extension Program, Environmental Quality:  
[http://www.scseagrant.org/extension/extension\\_coaenvqua.htm](http://www.scseagrant.org/extension/extension_coaenvqua.htm)

Saluda-Reedy Watershed Consortium: <http://www.saludareedy.org/>

SCDHEC Bureau of Water, Watersheds and Planning:  
<http://www.scdhec.net/environment/water/shed/>

SCDHEC-OCRM: Technical Documents- Water Resources:  
[http://www.scdhec.com/environment/ocrm/pubs/tech\\_docs\\_water.htm](http://www.scdhec.com/environment/ocrm/pubs/tech_docs_water.htm)

SC Algal Ecology Lab, Charleston, SC: <http://links.baruch.sc.edu/scael/>

### ***N.C. State web sites:***

Stormwater Tools at NC State: <http://www.bae.ncsu.edu/stormwater> (available soon)

Backyard Rain Gardens (NCSU): <http://www.bae.ncsu.edu/topic/raingarden/>

Water Harvesting: <http://www.bae.ncsu.edu/topic/waterharvesting/>

Urban Waterways: Designing Rain Gardens:  
<http://www.aces.edu/waterquality/streams/Bill's%20Handouts/bioretention%20areas%20basics.pdf>

Huntersville Web Site – LID Design Example  
<http://www.charmeck.org/Departments/LUESA/Water+and+Land+Resources/Programs/Water+Quality/Huntersville+Ordinance/Home.htm>

***Georgia stormwater web sites:***

Clean Water Campaign (Atlanta-based): <http://www.cleanwatercampaign.com>

Rain Gardens and Barrels: [http://www.riversalive.org/rain\\_gardens.htm](http://www.riversalive.org/rain_gardens.htm)

Georgia Stormwater Management Manual: <http://www.georgiastormwater.com/>

***Community and local government websites:***

Community Associations Institute: <http://www.caionline.org>

Local Government Environmental Assistance Network: <http://www.lgean.org>

Community Associations Network: <http://www.communityassociations.net>

Association Times: <http://www.associationtimes.com/>

National Association of Local Government Environmental Professionals:  
<http://www.nalgep.org>

Kiawah Island Land and Lakes Guidelines for Management and Maintenance, Kiawah Island Community Association (KICA):  
<http://homepage.mac.com/kiawahlakes/LakesDepartmentFolder/LakesDepartment/LakeManagementInfo/PolicyInfo/LLGMM.html>





# Appendix C: Rain Garden Fact Sheet

## *Rain Gardens*

### An Attractive and Easy Way to Protect Our Water Resources

A rain garden is an appealing landscape feature that can easily be installed by the homeowner to manage stormwater and protect the quality of our streams, lakes, wetlands, and oceans. A rain garden typically receives runoff water from roofs and other impervious (hard) surfaces such as driveways and sidewalks. The rain garden holds water on the landscape so that it can infiltrate (drain) into the ground and be taken up by plants instead of flowing into a street and down a storm drain or drainage ditch.

### Rain Garden Requirements

Typical rain garden installation requires:

1. A *suitable area* located *between* the rainwater source and its destination (either a depressed area in your yard or beyond your property) where water flows naturally and is at least 10 feet from the home
2. *Materials*, such as:
  - (a) an *appropriate soil-mix* (50-60% sand, 20-30% top soil, and 20-30% compost) – if your native soil drains well, you may only need to add compost!!
  - (b) *native plants* (a hardy mix of grasses, small shrubs, and self-seeding perennials are good choices, especially those that are both wet- and drought-tolerant), and
  - (c) a *dense-material mulch* that won't float away,
3. *Earth-moving tools* (to excavate about a one foot depth of soil) and planting tools, and
4. A willingness *to manage stormwater on-site and protect water quality*.

More elaborate designs may include the addition of underground corrugated pipes to convey rooftop runoff from downspouts to the rain garden location.

### How to Build a Rain Garden

The size for the area of the rain garden depends on the size of the area to be drained and the ability of the soil to drain surface water. A rule of thumb is that the rain garden area should be approximately 20% of the drainage area (including rooftops, driveways, and other impervious surfaces) in well-drained, sandy soils, and between 20-60% of the drainage area in more poorly drained, loamy soils. It's also important to select a location with a seasonally high water table depth no shallower than 18 inches to ensure proper drainage.





## Plant List for Rain Gardens

Common name	Scientific name	Months in bloom
<b><u>LARGE TREES (over 30' tall)</u></b>		
<i>Deciduous</i>		
Red Maple	<i>Acer rubrum</i>	Feb-Mar
River Birch	<i>Betula nigra</i>	Mar-Apr
Green Ash	<i>Fraxinus pennsylvanic</i>	Apr
Black Gum	<i>Nyssa sylvatica</i>	
Willow Oak	<i>Quercus phellos</i>	
Willows	<i>Salix</i> species	Mar-Apr
Bald Cypress	<i>Taxodium distichum</i>	
Pond Cypress	<i>Taxodium ascendens</i>	
<i>Evergreen</i>		
Southern Magnolia	<i>Magnolia grandiflora</i>	May-Jun
Longleaf Pine	<i>Pinus palustris</i>	Apr
Swamp Laurel Oak	<i>Quercus laurifolia</i>	
<b><u>SMALL TREES (under 30' tall)</u></b>		
<i>Deciduous</i>		
Red Buckeye	<i>Aesculus pavia</i>	Apr-May
Ironwood	<i>Carpinus caroliniana</i>	
Redbud	<i>Cercis canadensis</i>	Mar-Apr
Fringe Tree	<i>Chionanthus virginicus</i>	Jul-Sept
Hawthorn	<i>Crataegus marshalli</i>	Apr-May
<i>Evergreen</i>		
Dahoon Holly	<i>Ilex cassine</i>	
American Holly	<i>Ilex opaca</i>	
Red Cedar	<i>Juniperus virginiana</i>	
Sweet Bay	<i>Magnolia virginiana</i>	Apr-Jul
Wild Olive	<i>Osmanthus americanus</i>	Apr-May
Red Bay	<i>Persea borbonia</i>	
<b><u>SHRUBS</u></b>		
<i>Deciduous</i>		
Beautyberry	<i>Callicarpa americana</i>	Jun-Jul
Sweet Shrub	<i>Calycanthus floridus</i>	Apr-May
Buttonbush	<i>Cephalanthus occidentalis</i>	Jun-Aug
Pepperbush	<i>Clethra alnifolia</i>	Sept-Oct
Witch Alder	<i>Fothergilla gardenia</i>	Sept-Oct
Winterberry	<i>Ilex verticillata</i>	
Swamp Rose	<i>Rosa palustris</i>	May-Jul
Possumhaw	<i>Viburnum nudum</i>	Mar-Apr
<i>Evergreen</i>		
Inkberry	<i>Ilex glabra</i>	
Yaupon	<i>Ilex vomitoria</i>	
Anise Shrub	<i>Illicium parviflorum</i>	
Coastal Leucothoe	<i>Leucothoe axillaries</i>	Mar-May
Wax Myrtle	<i>Myrica cerifera</i>	
Dwarf Palmetto	<i>Sabal minor</i>	



## PERENNIALS

Blue Star	<i>Amsonia tabernaemontana</i>	Mar-Apr
Red Milkweed	<i>Asclepias rubra</i>	Jun-Jul
Climbing Aster	<i>Aster carolinianus</i>	Sept-Oct
False Indigo	<i>Baptisia</i> species	Apr-Sept
Tickseed	<i>Coreopsis angustifolia</i>	Aug-Oct
Joe Pye Weed	<i>Eupatorium fistulosum</i>	Jul-Oct
Swamp Sunflower	<i>Helianthus angustifolius</i>	Jul—frost
Swamp Mallow	<i>Hibiscus moscheutos</i>	May-Sept
Blue Flag Iris	<i>Iris virginica</i>	Apr-May
Seashore Mallow	<i>Kosteletskya virginica</i>	Jun-Oct
Blazing Star	<i>Liatris spicata</i>	Sept-Oct
Cardinal Flower	<i>Lobelia cardinalis</i>	Jul-Oct
Carolina Phlox	<i>Phlox carolina</i>	May-Jul
Black-eyed Susan	<i>Rudbeckia fulgida</i>	Aug-Oct
Goldenrod	<i>Solidago rugosa</i>	Aug-Nov
Ironweed	<i>Vernonia novaboracensis</i>	Jul-Sept
Verbena	<i>Verbena canadensis</i>	Mar-May

## FERNS

Southern Lady Fern	<i>Athyrium aplenoides</i>	
Cinnamon Fern	<i>Osmunda cinnamomea</i>	
Royal Fern	<i>Osmunda regalis</i>	
Marsh Fern	<i>Thelypteris palustris</i>	Jun-Sept

## ORNAMENTAL GRASSES

River Oats	<i>Chasmanthium latifolium</i>	
Muhly Grass	<i>Muhlenbergia capillaries</i>	
Sweetgrass	<i>Muhlenbergia filipes</i>	Oct-Nov
Switch Grass	<i>Panicum virgatum</i>	Jun-Oct

## SEDGES AND RUSHES

Lurid Sedge	<i>Carex lurida</i>	
Fringed Sedge	<i>Carex crinita</i>	
Southern Waxy Sedge	<i>Carex glaucescens</i>	
White-topped Sedge	<i>Rhynchospora latifolia</i>	
Woolgrass	<i>Scirpus cyperinus</i>	

Be sure to contact your Clemson Extension County Office for more information:  
<http://www.clemson.edu/extension/counties1.htm>



# Appendix D: Vegetative Buffer Fact Sheet

## Native Species for Vegetative Buffer Use in Coastal South Carolina

Vegetated buffers are an effective and attractive way to protect water quality and provide wildlife habitat such as that for birds and butterflies. These planted buffers are typically located between upland areas of residential and commercial development and water bodies such as creeks, rivers, lakes, ponds, and marshes. Vegetated buffers filter sediment and take up nutrients and other pollutants as rainfall and other water passes through them while also stabilizing a shoreline for erosion protection. Many communities have buffer ordinances in place. The following is a list of native plants for critical line (marsh) vegetated buffers and for pond buffers. \*Large trees are typically not recommended for planting directly at a pond's edge but do work well along creeks or tidal marshes.

### Plant List for Vegetative Buffers

Common name	Scientific name
<b><u>TREES*</u></b>	
Red Maple	<i>Acer rubrum</i>
Southern Magnolia	<i>Magnolia grandiflora</i>
Slash Pine	<i>Pinus elliottii</i>
Loblolly Pine	<i>Pinus taeda</i>
Southern Red Oak	<i>Quercus falcate</i>
Laurel Oak	<i>Quercus laurifolia</i>
Willow Oak	<i>Quercus phellos</i>
Live Oak	<i>Quercus virginica</i>
Cabbage Palmetto	<i>Sabal palmetto</i>
Bald Cypress	<i>Taxodium distichum</i>
Red buckeye	<i>Aesculus pavia</i>
Eastern Redbud	<i>Cercis Canadensis</i>
Dogwood	<i>Cornus florida</i>
Loblolly Bay	<i>Gordonia lasianthus</i>
Red Cedar	<i>Juniperus virginiana</i>
Cherry Laurel	<i>Prunus caroliniana</i>
Sassafras	<i>Sassafras albidum</i>
<b><u>SHRUBS</u></b>	
Beauty Berry	<i>Callicarpa Americana</i>
Button Bush	<i>Cephalanthus occidentalis</i>
Sweet Pepper Bush	<i>Clethra alnifolia</i>
Inkberry	<i>Ilex glabra</i>
Yaupon Holly	<i>Ilex vomitoria</i>
Virginia Sweetspire	<i>Itea virginica</i>
Leucothoe	<i>Baccharis balmifolia</i>
Salt Myrtle	<i>Leucothoe axillaries</i>



## SHRUBS (cont'd)

Wax Myrtle	<i>Myrica cerifera</i>
Pickernelweed (aquatic)	<i>Pontederia cordata</i>
Wild Azalea	<i>Rhododendron canescens</i>
Dwarf Azalea	<i>Rhododendron atlanticum</i>
Shrub Palmetto	<i>Sabal minor</i>
Saw Palmetto	<i>Sabal repens</i>
Sparkleberry	<i>Vaccinium aboreum</i>
Spanish Bayonet	<i>Yucca aloifolia</i>
Bear Grass	<i>Yucca filamentosa</i>

## PERENNIALS

Cardinal Flower	<i>Lobeilia cardinalis</i>
Butterfly Weed	<i>Asclepias tuberosa</i>
Tickseed Coreopsis	<i>Coreopsis augustifolia</i>
Coreopsis	<i>Coreopsis lanceolata</i>
Cora Bean	<i>Eyrthrina herbacea</i>
Swamp Sunflower	<i>Helianthus angustifolius</i>
Swam Rose Mallow	<i>Hibiscus moscheutos</i>
Blue Flag Iris	<i>Iris virginica</i>
Seashore Mallow	<i>Kosteletzkya virginica</i>
Blazing Star	<i>Liatris spicata</i>
Beach Evening Primrose	<i>Oenothera drummondii</i>
Evening Primrose	<i>Oenothera speciosa</i>
Carolina Phlox	<i>Phlox Carolina</i>
Black-Eyed Susan	<i>Rudbeckia fulgida (hirta)</i>
Scarlet Sage	<i>Salvia coccinea</i>
Lyre-leaved Sage	<i>Salvia lyrata</i>
Seaside Goldenrod	<i>Solidago sempervirens</i>
Pink Verbena	<i>Verbena Canadensis</i>

## GRASSES AND SEDGES

Brushy Broomsedge	<i>Andropogon glomeratus</i>
Broomsedge	<i>Andropogon virginicus</i>
Whitetop Sedge	<i>Dichromena latifolia</i>
Sweetgrass	<i>Muhlenbergia filipes</i>
Seaside Panicum	<i>Panicum amarum</i>
Switch Grass	<i>Panicum virgatum</i>
Sea Oats	<i>Uniola paniculata</i>
Cane	<i>Arundinaria gigantea</i>
Reed Grass	<i>Calamagrostis cinnoides</i>
Foxtail Grass	<i>Setaria ganculata</i>
Green Bristlegrass	<i>Setaria viridis</i>
Indian Grass	<i>Sorghastrum sp.</i>
Salt Hay	<i>Spartina patens</i>
Common Rush	<i>Juncus effuses</i>

Be sure to contact your Clemson Extension County Office for more information:  
<http://www.clemson.edu/extension/counties1.htm>



The following plants are species native along the southeastern coastline of the United States, and have been used in an urban native species garden on the College of Charleston campus (<http://www.cofc.edu/~greenbuilding>) at Coming and Wentworth St. in downtown Charleston, SC.

*Asclepias tuberosa* (Butterfly Weed)  
*Aster concolor* (Eastern Silver Aster)  
*Aster carolinianus* (Climbing Aster)  
*Aster cordifolius* (Common Blue Wood Aster)  
*Baptisia australis* (False Blue Indigo)  
*Baptisia australis* (Yellow Wild Indigo)  
*Cercis Canadensis* (Eastern Redbud)  
*Chelone glabra* (White Turtlehead)  
*Coreopsis lanceolata* (Lanceleaf Tickseed)  
*Coreopsis rosea* (Rose Coreopsis)  
*Chrusogonum virginicum* (Green and Gold)  
*Chasmanthium latifolium* (Fish-on-a-Pole)  
*Equisetum hymale* (Scouring Rush)  
*Eupatorium fistulosum* (Joe-pye Weed)  
*Eupatorium dubium*  
*Gaillardia pulchella* (Fire-wheel)  
*Helianthus angustifolius* (Narrowleaf or Swamp Sunflower)  
*Helenium flexuosum* (Southern Sneezeweed)  
*Iris virginica*  
*Itea virginica* (Virginia Willow)  
*Juncus effuses* (Common Rush)  
*Kosteletzkya virginica* (Seashore Mallow)  
*Liatris spicata* (Mountain Blazing Star)  
*Lobeilia cardinalis* (Cardinal Flower)  
*Lonicera sempervirens* (Coral Honeysuckle)  
*Macbridea caroliniana* (Carolina Birds-in-a-Nest)  
*Monarda punctata* (Spotted Horse Mint)  
*Muhlenbergia filipes* (Sweet Grass)  
*Parthenium integrifolium* (Wild Quinine)  
*Pycnanthemum incanum* (Mountain Mint)  
*Sabatia dodecandra* (Larger Marsh Pink)  
*Sarracenia flava* (Yellow Trumpet or Biscuit Flower)  
*Sarracenia minor* (Hooded Pitcher Plant)  
*Sarracenia purpurea* (Frog's Breeches or Hunter's Cap)  
*Sarracenia rubra* (Sweet Pitcher Plant)  
*Tradescantia rosea* (Rosey Spiderwort)

More information can be found in the following references:

*Backyard Buffers for the South Carolina Lowcountry:*

<http://www.scdhec.net/environment/ocrm/pubs/docs/backyard.pdf>

*Critical Line Buffer Ordinances: Guidance for Coastal Communities*

[http://www.scdhec.gov/environment/ocrm/pubs/docs/Buffer\\_Ord.pdf](http://www.scdhec.gov/environment/ocrm/pubs/docs/Buffer_Ord.pdf)





## Appendix E:

# Maintenance Checklist for Homeowners and Community Associations

- ✧ Ensure downspout connections are intact and that erosion is not occurring at downspout outlet. Install or upgrade the splash plate if necessary. (inspection frequency: during or after storm events)
- ✧ Ensure that pervious materials are not clogged due to silt or weeds, that pervious landscape features are not compacted by overuse, and that rain gardens are not clogged. Some pervious materials may need to be vacuumed based on manufacturers' specifications. (inspection frequency: monthly)
- ✧ Monitor irrigation systems to ensure water amounts, timing, and direction are properly set. (inspection frequency: weekly during irrigation periods)
- ✧ Check storm drains and other inlets for yard debris, litter, or other materials and remove as necessary. (inspection frequency: as needed, but especially after storm events)
- ✧ Trim, thin, or harvest planted landscape features (rain gardens, buffers, etc.) as needed to encourage and promote healthy growth. Be sure to compost or properly dispose of yard waste (inspection frequency: as needed, especially during summer months of heavy growth)
- ✧ Identify and protect bare areas of soil from erosion either by sodding, planting larger plants, or using other erosion control practices (as needed).
- ✧ Mow lawns and grassed swales as needed, composting or properly disposing of yard waste. If adjacent to a pond, marsh, creek or other water body, maintain a buffer by not mowing to the edge. Planted buffers with larger vegetation work well, too. (inspection frequency: as needed, especially during summer months of heavy growth).
- ✧ Report problems with community stormwater infrastructure (drains, pipes, inlets, outlets, ditches, swales, ponds, buffers, rain gardens, etc.) to the appropriate contact. Every community association should make this information available to residents and homeowners. (inspection frequency: always)
- ✧ Report problems with other individual lot-scale or community residential and golf course irrigation systems to the appropriate contact. Every community association should make this information available to residents and homeowners. (inspection frequency: always)
- ✧ Report algae blooms to the SC Algal Ecology Lab in Charleston, SC, at <http://links.baruch.sc.edu/scael/>

