Chapter 5: Local Case Studies

5.1 Charleston National Floating Wetlands and Pond Buffers

*Project Fast Facts:*

- Location: Mt. Pleasant, SC
- Land Use: Residential
- Number of Lagoons: 23
- Unique LID Components:
  - Shoreline blankets
  - Floating wetlands

*Figure 5.1-1. Floating treatment wetland and pond buffer (Photo: Diane Smith)*

*Introduction*

Charleston National is a residential golf community located north of Charleston in suburban Mount Pleasant, SC. The development was built in the late 1980s and, until recently, has not had any major pond maintenance issues or activities. The stormwater ponds (also referred to as “lagoons” in the community) serve as a water source for the golf course irrigation in addition to meeting stormwater treatment requirements. The Community Association determined that the majority of the nearly 25-year old ponds in Charleston National were in some degree of disrepair and in need of restoration. The impetus to address the erosion problems around the edges of the lagoons arose after an incident when a homeowner on a riding lawnmower fell into a lagoon. The area where the homeowner had been mowing the turfgrass had suffered erosion damage and was unstable. The Charleston National Community Association knew they had to find a solution. They formed a Lagoon Committee (“The Goonies”) and worked with a civil engineer to prepare plans for lagoon cleaning and depth...
restorations. Additionally, members attended the 2012 Charleston Area Stormwater Pond Management Conference and were inspired to find a natural alternative.

**Project Description**

Pond renovations have been broken into several phases. The first three renovated lagoons were located in the Westchester neighborhood at Charleston National. Subsequent projects were installed in the Egret’s Point neighborhood and lagoons adjacent to holes 7 through 8 along the golf course. Charleston Aquatics provided the wetland carpets and floating wetlands. Plant selection included powdery alligator-flag (*Thalia dealbata*), swamp rose mallow (*Hibiscus moscheutos*), red stem thalia (*Thalia geniculata*), bog lily (*Crinum americanum*), soft rush (*Juncus effuses*), golden canna (*Canna flaccida*), blue flag iris (*Iris virginica*), and pickerelweed (*Pontedaria cordata*).

**Costs and Project Funding**

The cost of the project, including design, labor, and materials was approximately $20,000 for the first three ponds. The funding came from existing HOA funds; a future regime fee may be implemented to help pay for additional ponds to be planted, but has not been established at this time.

**Obstacles to Implementing LID**

The main constraints for retrofitting the ponds with buffers and floating wetlands involved homeowner education and funding. There was support within both the residential community and golf course amenity to make the necessary changes to improve the ponds – the challenge was to identify funding.

**Maintenance Program**

Charleston Aquatics has a maintenance agreement with the Charleston National HOA to perform routine maintenance on the wetland blanket plantings on the lagoon embankments and the floating wetlands anchored to the middle of the larger lagoons. This involves harvesting plant material in the fall, thinning plant material on the floating wetlands, and transplanting the thinned plant material to the shoreline buffer plantings.
**Education and Outreach**

The Lagoon Committee produced and distributed an informational flyer for the residents of Charleston National about the retention pond project. In addition to describing the cost and work to be completed, the flyer also provides homeowners with certain guidelines for the renovated lagoons (Figure 5.1-4).

**Acknowledgements**

Ron Hanson, Charleston National Community Association Lagoon Committee
Bob Horner, PE, Weston & Sampson Engineering
Stu Schuck, Charleston Aquatics

**References**


**Figure 5.1-4. Informational brochure provided to Charleston National residents**
5.2 Horry County Recycling Center Bioretention

**Unique Features**

This project used a recycled glass product provided by the Horry County Solid Waste Authority. The Horry County Stormwater personnel will monitor the site to assess the performance of this product as the main component of the soil media. An early observation and lesson learned is that the product may have benefitted from a thorough washing before installation to remove fine particulates.

In addition to Bermuda sod used on the slopes and forebay, the vegetation used in the bioretention cell included:

- 9 Muhly grass (*Muhlenbergia capillaris*),
- 12 Sweet flag (*Acorus gramineus*),
- 6 Joe Pye weed (*Eupatorium fistulosum*),
- 12 Cardinal flower (*Lobelia cardinalis*), and
- 6 Goldenrod (*Solidago rugosa*).

**Cost Information**

Clemson University Extension Service’s Carolina Clear program contracted North Carolina State University partners in the Biological & Agricultural Engineering Department to provide the design, survey, site visits, construction oversight, and bioretention workshop. The project was funded by a USDA NIFA grant. NCSU estimated that the cost for these services was approximately $18,000 for two sites (the second site at the Longs Recycling Facility has not been built yet).

- Equipment\(^1\) = $4,095.36
- Materials\(^1\) = $1,477.71
- Plants\(^1\) = $444.42
Permitting
Because the project was a retrofit of an existing site with no stormwater detention, and because the disturbed area was under one-half acre, the Loris project was exempt from stormwater permitting requirements. However, the site did need an encroachment permit from SC DOT for the bioretention outfall to the state highway ditch.

Maintenance
Horry County Stormwater and Horry County Solid Waste share maintenance responsibilities for this project. Table 5.2-1 outlines the frequency of the various maintenance tasks associated with the bioretention basin.

<table>
<thead>
<tr>
<th>Task</th>
<th>Frequency</th>
<th>Responsibility</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection</td>
<td>Quarterly</td>
<td>Stormwater</td>
<td>Look for erosion, dead plants, ponding for 2-3 days</td>
</tr>
<tr>
<td>Weeding</td>
<td>Monthly during growing season</td>
<td>Solid Waste Authority</td>
<td>Remove unwanted weeds</td>
</tr>
<tr>
<td>Mowing</td>
<td>Monthly, or as needed</td>
<td>Solid Waste Authority</td>
<td>Desired centipede grass height</td>
</tr>
<tr>
<td>Mulching</td>
<td>Annually or as needed</td>
<td>Stormwater/Solid Waste</td>
<td>Rake and fill bare spots</td>
</tr>
<tr>
<td>Watering</td>
<td>Immediately after planting and during drought</td>
<td>Stormwater</td>
<td>Use hose behind compactors</td>
</tr>
<tr>
<td>Replace dead plants</td>
<td>As needed</td>
<td>Solid Waste</td>
<td>Adjust species if warranted</td>
</tr>
<tr>
<td>Clean build up at forebay entrance</td>
<td>As needed</td>
<td>Solid Waste</td>
<td>Clear by hand as needed</td>
</tr>
<tr>
<td>Clean out forebay sediment accumulation</td>
<td>As needed</td>
<td>Stormwater</td>
<td></td>
</tr>
<tr>
<td>Clean out underdrains</td>
<td>As needed</td>
<td>Stormwater</td>
<td>Vactor truck – spray into clean-outs or pump from outlet</td>
</tr>
<tr>
<td>Miscellaneous upkeep</td>
<td>Monthly</td>
<td>Solid Waste</td>
<td>Trash removal</td>
</tr>
</tbody>
</table>

1prepared by Horry County Stormwater for the Loris Solid Waste Authority Convenience Center Bioretention cell

Acknowledgements
Andrew Anderson, Extension Associate, NCSU of Biological and Agricultural Engineering
Dave Fuss, Watershed Planner, Horry County Stormwater
Katie Giacalone, Director, Clemson University Center for Watershed Excellence
5.3 Fox Hollow Low Impact Development

**Project Fast Facts:**

- Location: James Island, SC
- Gross Acreage: 2.65 acres
- Open Space Acreage:
  - 0.44 acre park/bioretention
  - 0.08 acre wetlands
- Number of lots: 9
- Net Density: 4.22 homes/acre
- Zoning: Charleston County

![Figure 5.3-1. The larger of two bioretention/wetland cells in Fox Hollow (Photo: Kathryn Ellis)](image)

**Project Description**

At Fox Hollow, the developer (New Leaf Builders) wanted to create a low impact development that protected the trees, wetlands, and topography of the site. Unlike conventional development, where mass grading is common, at Fox Hollow the land has been highly conserved – only enough land for the houses and roadway were cleared. Narrow streets and driveways reduce impervious cover in the development. Rather than relying on pipes, a bioswale system conveys stormwater. Bioretention cells replace stormwater ponds.

**Project Awards**

Named “Best New Community of 2013” by the Charleston Homebuilders Association, Fox Hollow was specifically recognized for its low impact development approach.

**Acknowledgments**

Engineer: Josh Robinson, PE – Robinson Design Engineers

![Figure 5.3-2. Site plan for Fox Hollow (Source: Robinson Design Engineers)](image)
5.4 Moore Farms Botanical Garden Green Roof & Rainwater Harvesting

Project Fast Facts:

Location: Lake City, SC
Green Roof Size: 6,000 square feet
Rainwater Harvesting Practices:
- 12,000 gallon cistern to irrigate green roof
- 3,100 gallon cistern for greenhouse
- 4,800 gallon cistern on Fire Tower

Project Description

Completed in December 2011, the Moore Farms Botanical Garden’s 6,000 square foot green roof is situated on top of the Maintenance Facility building with the intention of using it as a research plot to conduct plant performance trials. Moore Farms’ goal for the research is to expand the current palette for the warmer zones of the southeast, including Zones 8 and 9.

Additionally, the research aims to increase creativity in the design of green roofs through varied texture and contrast, with “natives and exotics colliding in explosive displays.” The roof has 6” of media and is planted with over 130 different species of native and ornamental plants, including grasses, perennials, bulbs, and even vegetables. Plant selection criteria included full sun and drought tolerance. The vegetation is irrigated by drip and spray irrigation. The source of the irrigation water comes from a 12,000 gallon cistern buried under the parking lot by the maintenance building. This system should be large enough to provide sufficient water for nearly a month without any additional rain inputs.

Irrigation varies by season, with the peak demand occurring during the hottest part of the year. During the summer, the irrigation system will run for a few minutes on an hourly basis. The roof is slanted, at a 4:12 slope, and the runoff from the irrigation or rainfall is collected in a large gutter at the bottom of the slope. The staff has observed that it takes a few hours for any runoff to be generated from the roof after a storm event. Then, the water is channeled from the gutter into the cistern collection system.
The green roof can be viewed easily from the ground, but for an up-close exploration there are winding staircases leading to a roof-level catwalk. Serving as an extension of the vegetated space on the roof of the maintenance building, the catwalk is covered in a layer of turfgrass.

Although the maintenance building was designed with multiple green features in addition to the green roof and cistern, such as the 400 square foot green wall and south-facing windows, it does not have any official “green” designation. The temperature is monitored with probes in the green roof, and staff members have made note of the insulating effect the green roof provides: even in the hottest part of the day, the roof stays about ten degrees cooler than the ambient temperature. Anecdotally, the roof provides enough insulation that the maintenance building has a reduced use of air-conditioning and heating.

Adjacent to the maintenance building is the greenhouse facility, where another 3,100 gallon cistern system is used to harvest rainwater for irrigation. The bog garden at the entrance to the gardens has a 4,800 gallon cistern water source located on the iconic Fire Tower. The botanic garden staff prefers to use rainwater because it is a better quality than their groundwater source due to the lower levels of sulfur and other undesirable minerals. Young plants, started from seed or rooted from cuttings, are in a delicate stage and require more precise conditions to ensure their success. The only alternative to harvesting rainwater would be to amend the groundwater, such as changing the pH. Once the seedlings and cuttings have matured sufficiently, they will be able to tolerate the groundwater as an irrigation source, but in this stage it is preferable to irrigate them with rainwater whenever possible.

**Designers/Manufacturers of Record**

Building Architect: Joe Rogers  
Building Construction: Coastal Structures  
Growing Media: ERTH Products  
Green Roof Consultant: Emilio Ancaya, Living Roofs Inc.  
Waterproofing Membrane: Owens Corning  
Drainage Mat: Enkadrain  
GardNet Soil Confinement System: American Hydro-tech

**For more information**

http://www.moorefarmsbg.org/the-garden/research/  
5.5 Trident Technical College Campus LID Initiatives

Project Fast Facts:

Location: North Charleston, SC  
Land Use: Higher Education
Unique LID Components:
♦ Pervious parking  
♦ Bioswale  
♦ Rainwater harvesting  
♦ Pond buffer & floating wetland  
♦ Possible green roof
Project Awards:
♦ LEED silver certification

Figure 5.5-1: Pervious parking spaces and bioswale in the TTC Bookstore parking lot. (Photo: Kathryn Ellis)

Project Description

The campus at Trident Tech is home to a series of low impact development demonstration projects. The Civil Engineering Technology program contracted Forsberg Engineering to redesign an existing parking lot adjacent to the college bookstore in 2011. The design incorporated pervious parking and bioswale to intercept and treat stormwater runoff, prior to discharging into the Goose Creek Reservoir.

The Horticulture Technology department also has been pursuing green practices in horticulture. The Sustainability in Horticulture elective class offered by the program emphasizes basic issues affecting sustainability in horticultural environments, such as water retention, harvesting, pesticides, noise pollution, and energy. Some projects the horticulture program has installed in recent years include two 3,000-gallon cisterns, floating wetlands, and stormwater pond buffer vegetation. The cisterns collect rain water from the roof of the greenhouse; the water is filtered and disinfected to supply the cool pads in the greenhouse as well as keep an ornamental pond filled. Currently, the pad system is supplied by potable water so the use of rain water will help offset the costs of maintaining the temperature inside the greenhouse during the hot summer months. Through grant money provided by TTC Green – an initiative that expands Trident Technical College’s energy efficiency and sustainability efforts – the Horticulture program was able to install three floating wetland panels and a section of wetland carpet in a stormwater pond adjacent to two large parking lots on campus.

Another interesting project in progress on the TTC main campus is the new nursing building, which will be LEED certified and make use of several LID BMPs. The new facility will incorporate rain-
water capture/reuse (via underground cistern), pervious pavement, and potentially a green roof. The building was completed in spring 2014.

Acknowledgements

Nursing Building Project

✦ Landscape Architect: Bryant Stowe, ADC Engineering
✦ Engineer: Jeff Webb, ADC Engineering
✦ Architect: Richard Bing, LS3P Associates

Bookstore Parking Lot Pervious Parking & Bioswale:

✦ Engineer: Gray Lewis, Forsberg Engineering

Pond Buffer, Floating Wetland, and Greenhouse Cooling System:

✦ TTC Horticulture Program: Tony Bertauski
✦ Charleston Aquatics: Stu Schuck

TTC Green: http://www.tridenttech.edu/TTCGreen.htm

Figure 5.5-3: Demonstration green roof and rain barrel (including a bog garden on top) at the TTC Horticulture building. (Photo: Kathryn Ellis)
5.6 Goodwill Store Bioretention and Pervious Paving

**Project Fast Facts:**

Location: Johns Island, SC  
Land Use: Commercial/Retail  
Installation: 2012  
Project Size: 1.89 acres  
Unique LID Components:  
- 4 bioretention cells  
- Pervious concrete parking spaces  
Other: featured in *Post and Courier* article (see sidebar)

![Figure 5.6-1. Aerial image of Johns Island Goodwill Store (Image: Google 2014)](image)

**Project Description**

Located on a flat property with a large building and parking lot contributing to impervious area, creative and attractive techniques for stormwater treatment were necessary for the Goodwill Store on Johns Island. One solution was to include 41 pervious concrete parking spaces (out of a total 73 spaces on site) in the parking lot. Additionally, curbing was not installed through much of the parking lot, which allowed runoff to flow directly into the four vegetated stormwater treatment facilities on site: one swale, two rain gardens, and one pond. These stormwater management practices intercept and infiltrate the runoff through a special soil media mixture that promotes drainage. After most storm events, the depressions are dry within 24 hours.

![Figure 5.6-2. The parking lot at the Johns Island Goodwill store incorporates bioswales and pervious concrete. (Photo: Kathryn Ellis)](image)

Plants native to the Lowcountry are used exclusively in the ornamental landscaping and stormwater practices on site. The vegetation was selected for aesthetics and its ability to survive with a minimum amount of maintenance, which is an asset to the property’s managers. Unlike typical grassed ponds, bioretention does not require constant mowing. Additionally, using native vegetation in the stormwater BMPs allowed the City of Charleston to grant a variance from standard procedures and allow the bioretention cells to be placed in required buffer spaces. It was the first project in the City of Charleston that was granted this allowance.
Lessons Learned and Advice

✧ Communication with contractors before installation will help prevent problems with grading the paving.

✧ Educate property owner on proper landscape maintenance activities. Once the plants become established, they will require little additional hands-on care after the initial irrigation and regular weeding.

✧ Use shredded hardwood mulch (not pine nuggets or pine straw) to prevent mulch floatation and clogging of outlet structures.

Acknowledgements

JR Kramer, Remark Studio Landscape Architecture

Giles Branch, Earthsource Engineering

Sandra Cashion, Piedmont Companies Incorporated

Figure 5.6-3. Bioretention, pervious concrete, and no curb facilitate infiltration of runoff (Photo: Kathryn Ellis).
The new Goodwill Outlet Store on Johns Island shows how thoughtful landscape architecture not only pleases the eye but also can tackle more mundane tasks. The 1758 Main Road property is flat, and much of it is covered with a sizable building and a parking lot. That posed a challenge as far as dealing with the stormwater runoff. Landscape architect J.R. Kramer of Remark says the solution was to design a series of rain gardens. "We've actually engineered these to perform as if they were wetlands," he says. "Instead of your typical detention pond, we tried to make it look a lot better." The site includes four rain gardens, also referred to as "bioswales." They're essentially carefully designed ditches. "It's all about celebrating rain," he says. Each has a special soil mix underneath to ease their drainage. Kramer says most are dry 24 hours after the rain stops. That's important because standing water would invite mosquitoes to breed. Goodwill's rain gardens also have assorted native plants, such as yucca and sabal minor. There's also a bioswale in the middle of the parking lot planted with scouring rush and flanked by parking spaces with permeable concrete, meaning the rainwater can seep through. It's the first project in Charleston to allow bioswales in the required buffers, Kramer says. "This is a big step forward for the city," he says. "You always have these requirements. How do you design something within the requirements and still be creative with it?"

The landscape changes with the seasons and looks like a set of wetlands that might have existed there long before someone decided to build. That's a clear contrast from a typical detention pond that always looks manmade, even when there's no sprinkler jet in the middle. "The whole thing was designed to keep its rural character," Kramer says. It complements the simple vernacular design of the brick building, with its metal roof and storm shutters. The choice of plants was driven partly by what would look good and partly by what would thrive with minimum maintenance. "We're treating aesthetics and ecology as equals," he says. While rain gardens require regular weeding at first, that eases after the native plants grow large enough to crowd out weeds. "It doesn't require nearly as much maintenance as mowing the grass all the time," he adds. In the rear, the Goodwill site features an appealing "living fence," a screen of yellow jessamine and coral honeysuckle instead of wood or masonry. A line of deciduous trees completes it.

The Goodwill project was developed by Piedmont Companies Inc. and designed by Dennis Williams of Williams Design in Lincolnton, N.C. The contractor was David E. Looper & Co., while the civil engineer was by EarthSource Engineering of Mount Pleasant.
5.7 Jarvis Creek Park Stormwater Pond & Wetland Project

Project Fast Facts:

Location: Hilton Head, SC  
Land Use: Public Park  
Drainage Project Completed: 2001  
Park Opened to Public: 2003  
Watershed/Catchment Area: 1,136 acres  
Watershed Imperviousness: 19%  
Treatment Volume: 988 acre-feet per year  
Unique LID Components: Stormwater pond and wetland combination  
Project Awards:  
♦ SCDNR Stewardship Development Program (2000)  
♦ Municipal Association of SC Municipal Achievement Award, public works category (2000)  
♦ SCDNR/FEMA Flood Hazard Mitigation Assistance Grants (1998 -1999, $528,000)

Project Description

The Jarvis Creek Project is a combined drainage improvement project and community park at the Town of Hilton Head Island’s Jarvis Creek Tract. The tract is approximately 50 acres, of which roughly half are wooded. Historically, the remainder of the property was cleared for pasture as part of the antebellum Honey Horn Plantation. The 1,136 acres of land that drain to the pond and constructed wetlands originate from the nearby Hilton Head Island school complex, a small portion of Honey Horn Plantation residential development, and the commercial development along Main Street.

The drainage project involved construction of a borrow pit on the cleared portion of the tract into which pumps deliver stormwater from upstream the drainage area. The borrow pit forms the central feature of a passive park that was constructed in 2003 following the drainage project. The pond covers 13 acres with about 4,200 linear feet of vegetated shoreline. The pond was originally excavated to a maximum depth of 30 feet and the excavated soil was used to construct the Cross Island Parkway. Additional design elements of the park include interpretive trails, observation piers, and picnic areas (Figure 5.7-2).

As a result of the construction of the pump station, 0.468 acres of wetland were filled. To compensate, the Town constructed a one acre transitional wetland at the outfall of the borrow pit, and a wetland littoral shelf within the borrow pit. It was this innovative wetland mitigation, along with the unique design of the project as a whole, which earned this project a Stewardship Development Award through the South Carolina Department of Natural Resources.

This project represents a creative solution to a difficult problem. In 1995 the Town of Hilton Head Island conducted an Island Wide Drainage Study to identify upcoming stormwater improvement
The study recommended upgrading the stormwater outfall under US 278 and enlarging the natural freshwater creek upstream of tidal Jarvis Creek to reduce problematic flooding in the Main Street commercial areas and Hilton Head Plantation residential areas.

The original drainage plan included widening the natural freshwater creek adjacent to the Jarvis Creek Tract (at that time privately owned) to a bottom width of 35 feet and a depth of approximately 6 feet. The sloping bank would create a 100 foot wide canal. Enlarging the freshwater creek would destroy a large and unique area of upland habitat and over 4 acres of freshwater wetlands.

Work began in fiscal year 1996/7 on the conceptual design and topographic survey of the Jarvis Creek Ditch Project. Significant wetlands and trees were found within the proposed project location. Therefore, the Town began to pursue an option that minimized the wetland impact by rerouting the ditch. Rerouting also meant lengthening the ditch, which in turn increased the amount of excavation and loss of trees and wildlife habitat. Estimated costs increased from $1.6 million to $3.0 million.

It was also during the summer of 1996 that the Town was negotiating the purchase of the Jarvis Creek Tract adjacent to the existing Jarvis Creek ditch. The 50 acre Jarvis Creek tract was purchased by the Town and Town staff began to explore additional design options to solve the drainage problem. A 13-acre lake, capable of storing and conveying the necessary stormwater was envisioned. A pump station was needed in order to move the water from the ditch to the lagoon. From the lake, water would flow through a vegetated spillway that discharges into the headwaters of Jarvis Creek. This alternative plan was adopted, and the site was ideal for creation of the lake because a majority of the site had been previously cleared and used for cattle grazing. The selection of the Jarvis Creek Tract resulted in the protection of 3.5 acres of valuable freshwater wetlands, and the reduction in upland habitat and tree loss.

To accomplish the goal of stormwater improvement, the Town needed to construct a pump station near Hwy 278, which would pump the stormwater through four 48-inch pipes to the lake. The layout of the pipes was a particularly critical decision, given the abundance of specimen size live oaks and pine trees. The pipes were laid out in such a way that the entrance road to the park would eventually be paved on top of the pipes, requiring that only one swath be cleared through the parcel.

In addition, during the construction of the wetland mitigation areas, and during plant selection for the remainder of the parcel, only plants native to Hilton Head Island were used. This selection
improved the quality of the parcel for native wildlife by providing their indigenous food and cover sources. The selection of native plants also reduced the need for pest management, irrigation, and long-term maintenance.

The change from a 100-foot wide canal to a stormwater retention lake with wetland filter has had profound impacts on water quality. The stormwater is designed to flow into the lake, through the vegetated wetland mitigation site, into an existing bottomland hardwood wetland, and then into the freshwater creek (Figure 5.7-3). The detention time in the lake and the filtering effect of the wetlands is designed to improve the quality of water flowing into Jarvis Creek. A monitoring station has been installed to monitor the effluent into Jarvis Creek. The data is being collected to address any problems as they arise and to establish a baseline to compare post-drainage project water quality.

The wetland mitigation area is perhaps the most exciting aspect of the project. In designing the wetland, Town staff visited existing reference wetlands in the watershed to determine appropriate plant species. Because the mitigation area is a transitional wetland moving from the saturated lake edge to a higher site, plant species change from aquatic species such as pickerel weed to red maples and cypress on the spillway. In addition to the wetland at the spillway, a littoral shelf on the northwest corner of the lake was constructed in spring 2001.

The design for the Jarvis Creek Park ensured this valuable tract of land remains in the public’s trust in perpetuity. The park was designed as a passive recreation area, with trails and picnic areas. Walking trails have been designed around trees, and little vegetation was removed for park infrastructure. A boardwalk guides visitors through the constructed wetland to teach them about wetland mitigation. The majority of the site has been left in its natural state as a haven for wildlife. Because the site is first and foremost a drainage improvement project, the lake and spillway are designed to be functional, while accommodating recreation and educational opportunities.

**Stormwater Monitoring:**

This project has generated interest and has been studied locally, and there are several plans in place to continue monitoring the project. Because the water quality aspect of the project is fairly innovative, the Town has been evaluating the progress since its inception. Bi-weekly water quality monitoring is conducted at the pump station site near Hwy 278, and at the freshwater creek behind the outfall. This monitoring checks for 10 different water quality parameters including nitrogen, phosphorous, and fecal coliform bacteria. The intention was to get a good baseline of data before the pump station was operational to use as a comparison once the stormwater is actively pumped through the system. This monitoring has been going on since September 1999, and will continue indefinitely. The data collected and the lessons learned at Jarvis Creek Park have been used to influ-
ence other stormwater improvement projects in the Town.

In addition to water quality, the Town actively monitors the progression of the created wetland. Three permanent vegetation plots have been established to monitor plant growth, and quarterly soil samples are taken to ascertain hydric characteristics and measure nutrient levels. Additionally, all observed wildlife species are recorded as the lake evolves from a barren pit into a diverse wildlife habitat. As previously mentioned, the site is protected as open space and the wetlands are protected through restrictive covenants.

Public Education:
The Jarvis Creek project presents a great opportunity for public education about natural resources. Town staff members have conducted several field trips with school children to teach them about wetlands and wetland mitigation. The park design includes interpretive trails (Figure 5.7-4) that educate the public about the native species in the park and about the unique wetlands. The Town arranged a cooperative partnership with the local Hilton Head Island School complex to use the park as an outdoor lab for nature study. Also, the Hilton Head Coastal Discovery Museum provides guided tours through the interpretive trails. Additional creative uses of the park include local track teams and water search and rescue training held by the fire department.

Maintenance Program:
The park itself requires very little maintenance. The four pumps at the pump station are inspected on a yearly basis; real-time monitors were installed in 2007-08 so that pump wear could be monitored and adjusted to decrease maintenance needs. The sump area, ditches, and lake have not received any maintenance since installed.

Miscellaneous:
This project is one of the most innovative in the Town’s Capital Improvements Program. Its unique design has been recognized as outstanding by the Association of State Floodplain Managers, and the Town was invited to present the project at their 1998 national conference. In addition, because of its ability to mitigate upstream flooding, the project was awarded the DNR Flood Mitigation Assistance Grant two years in a row. The drainage and pump station portion cost approximately $3.1 million. It was paid partly with Flood Hazard Mitigation Grant monies; the rest was bonded, and the debt service is now being paid by Stormwater Utility fees.

The Town of Hilton Head believes it has created “an exciting project that makes the best of our natural resources, while providing an innovative solution to a complicated problem.”

Acknowledgements
Sally Krebs, Sustainable Practices Coordinator, Town of Hilton Head
5.8 Moss Park Constructed Wetlands

Project Fast Facts:
Location: Murrells Inlet, SC
Land Use: Commercial
Installation: 2004
Project Size: 40 acre tract
Unique LID Components:
  2 constructed wetlands

Figure 5.8-1. 2009 Horry County Natural Color aerial image of Moss Park constructed wetlands site.

Project Description
The two constructed wetlands in Moss Park are situated in a commercial land use area in Horry County, SC. The EARTHWORKS Group evaluated several stormwater treatment options for their client; ultimately they created a land plan utilizing stormwater wetlands that met the regulatory requirements, while maximizing natural resources and visually enhancing the commercial development. Furthermore, by using stormwater wetlands, the client was able to maximize useable developable space on the property because wetlands count toward open space requirements and wetlands were more space efficient than a pond.

Constructed wetlands provide stormwater retention and water quality benefits. The system was designed to achieve high removal rates of particulate and soluble pollutants through gravitational settling, wetland plant uptake, absorption, physical filtration, and biological degradation. Additionally, wetlands can provide reduction of bacteria and oxygen demanding substances from stormwater runoff.

Cost information
Constructed wetlands are often less expensive and require less maintenance than traditional pipe-and-pond systems due to reduced excavation costs, less materials, and fewer structures to maintain. An additional cost-benefit aspect of constructed wetlands is that they save space through natural site integration, thus providing additional room for site development. This system in particular was more cost effective than other treatment options. Table 5.8-1 gives the itemized cost list (in 2004 dollars) for this project.
## Table 5.8-1. Itemized cost information for constructed wetlands at Moss Park

<table>
<thead>
<tr>
<th>ITEM</th>
<th>ITEM DESCRIPTION</th>
<th>UNITS</th>
<th>AMOUNT</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Construction Entrance</td>
<td>LS</td>
<td>1</td>
<td>$900.00</td>
<td>$900.00</td>
</tr>
<tr>
<td>2</td>
<td>18” RCP</td>
<td>LF</td>
<td>120</td>
<td>$20.00</td>
<td>$2,400.00</td>
</tr>
<tr>
<td>3</td>
<td>Fill Existing Ditch</td>
<td>CY</td>
<td>500</td>
<td>$9.50</td>
<td>$4,750.00</td>
</tr>
<tr>
<td>4</td>
<td>Check Dam</td>
<td>EA</td>
<td>4</td>
<td>$300.00</td>
<td>$1,200.00</td>
</tr>
<tr>
<td>5</td>
<td>Hay Check</td>
<td>EA</td>
<td>20</td>
<td>$25.00</td>
<td>$500.00</td>
</tr>
<tr>
<td>6</td>
<td>Rock Outfall</td>
<td>EA</td>
<td>2</td>
<td>$200.00</td>
<td>$400.00</td>
</tr>
<tr>
<td>7</td>
<td>Swale Lotline</td>
<td>LF</td>
<td>1700</td>
<td>$3.00</td>
<td>$5,100.00</td>
</tr>
<tr>
<td>8</td>
<td>Pond/Wetland Excavation</td>
<td>CY</td>
<td>9355</td>
<td>$3.00</td>
<td>$28,065.00</td>
</tr>
<tr>
<td>9</td>
<td>Wetland Plants</td>
<td>LS</td>
<td>2</td>
<td>$1,000.00</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>10</td>
<td>Grassing</td>
<td>AC</td>
<td>4</td>
<td>$3,000.00</td>
<td>$12,000.00</td>
</tr>
<tr>
<td>11</td>
<td>Hydric Soils Backfill</td>
<td>CY</td>
<td>1000</td>
<td>$6.00</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>12</td>
<td>Rock Trench, Rock Outfall, Pipe</td>
<td>LS</td>
<td>1</td>
<td>$1,200.00</td>
<td>$1,200.00</td>
</tr>
<tr>
<td>13</td>
<td>Silt Fence</td>
<td>LF</td>
<td>3256</td>
<td>$2.50</td>
<td>$8,140.00</td>
</tr>
<tr>
<td>14</td>
<td>Grassing Dressup Moss Creek Rd.</td>
<td>AC</td>
<td>1.2</td>
<td>$3,000.00</td>
<td>$3,600.00</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$76,255.00</strong></td>
</tr>
</tbody>
</table>

**Figure 5.8-2. Plans for Moss Park constructed wetlands (courtesy of The EARTHWORKS Group)**
Incentives and Benefits

✧ There is a strong desire from the regulatory community for this type of project; SCDHEC-OCRM and Horry County were enthusiastic to see a progressive approach adopted for this project and were eager to see it succeed.

✧ Maintenance costs are more manageable with the constructed wetland than with catch basins, pipes, and ponds. Generally, no maintenance of the constructed wetland system is required. Because the sediments are trapped close to the source due to the plants, sediment removal is not as pronounced. Also, the vegetation is intended to grow naturally, so vegetation maintenance and removal is not required.

✧ This project was less expensive than the typical pipe and pond and provided flexibility within the useable property which benefitted the client.

✧ The wetlands provide enhancement of localized vegetative diversity and create excellent wildlife habitat.

✧ The wetlands add beautification and vegetative screening to the commercial site, which the tenants appreciate.

Lessons Learned

✧ Select plant species that are less desirable to local vegetarian consumers (wildlife). For example, mast-producing oaks were particularly susceptible to deer foraging, but cypress seemed to have better survival rates.

✧ Remove invasive species early on so that planted species have a greater chance for survival.

Acknowledgements

Stephen Williams, The EARTHWORKS Group