

Element E: Murrells Inlet Shellfish and Marsh Assessment



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The ultimate goal of this plan is to not only reduce fecal coliform loads, improving water quality in Murrells Inlet, but to also take a broader view of the existing shellfish resources in the estuary and pursue strategies ensuring the long-term viability of harvesting activities. **Element A** provided a general overview of the ecological role of oysters in tidal estuaries. This element focuses more specifically on the long-term management of these resources.

SC Department of Natural Resources- Shellfish Management and Data Trends

The role of regulating and managing shellfish harvesting activities in the state of South Carolina is shared by SC DHEC and SC DNR. Collecting monitoring samples for the purpose of regulating shellfish harvesting activities to protect public health is the responsibility of SC DHEC. The responsibility for the long-term health of the oyster populations by managing commercial and recreational harvesting activities falls under the auspices of SC DNR. The protection and restoration of shellfish habitats is also a primary responsibility of SC DNR. The shellfish harvesting season is established by SC DNR and currently extends from October 1st to May 15th.

Presently, there are eight commercial Culture Permit areas in Murrells Inlet. There are also three designated State Shellfish Grounds and two designated Recreational Grounds. **Exhibit E-1** displays the boundaries of all of the designated shellfish grounds in relation to the SC DHEC monitoring sites and adjacent subwatershed land areas. A map of each of the individual shellfish areas is provided in **Appendix E**.

Below is a brief description of the pertinent regulations that apply to each type of shellfish grounds:

Culture Permits: Harvesting in these areas is essentially limited to the permit holder or to others that are explicitly allowed by the permit holder. Culture Permit holders pay an annual rental fee to SC DNR and must replant 50 bushels of shell or approved cultch per acre of permitted area on an annual basis. Acreage is calculated based on the actual intertidal resource.

State Shellfish Grounds: Harvesting in these grounds is allowed by commercial harvesters and recreational license holders. SC



Figure E-1 Murrells Inlet has shellfish areas designated for both commercial and recreational harvesting. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)

DNR manages these lands by opening and closing them on a rotational basis depending on the available shellfish stock.

Recreational Grounds: These shellfish grounds are only open to recreational license holders. In season, recreational harvesters are allowed to take up to two bushels of oysters and one half bushel of clams per day, twice in a seven day period. SC DNR manages these grounds by routinely replanting the shellfish beds as funding allows. Shells from the SC DNR shell recycling program are used for this purpose usually does not meet the annual demands. SC DNR typically purchases 40,000 or more bushels from out-of-state sources to use for replenishing recreational grounds.

Table E-1 summarizes the breakdown of the number of acres available for shellfish harvesting by the type of designated shellfish ground. The table also indicates the percentage of acreage within these designated shellfish grounds that are closed due to non-attainment of the fecal coliform water quality standard based on SC DHEC’s monitoring data.

Table E-1 Murrells Inlet Shellfish Acreage Summary						
	Culture Permits	Recreational Grounds	State Shellfish Ground	Total	Closed by DHEC	% closed
<i>Current shellfish acres</i>	68.7	11.4	26.8	106.9	20.8	19.4%
<i>Potential shellfish acres</i>	1308.1	243.9	660.2	2212.2	498.8	22.5%
Source: SC DNR, Nancy Hadley						

The designated shellfish grounds in Murrells Inlet are an important cultural and natural resource to the community. Recreation Grounds R351- Clambank Flats and R355- Lachicotte Oyster Creek are the only two shellfish grounds limited exclusively to recreational harvest in Horry and Georgetown counties. There are a total of twenty designated Recreational Shellfish Grounds statewide. In terms of economic value, commercial harvesting activities have been steady on an annual basis in both the culture permit areas and in the state shellfish grounds. Due to permit holder proprietary restrictions, the annual volume and estimated dockside value is not available from SC DNR. However, the market demand for local shellfish resources is significant as indicated by the ten-year dockside harvest values for clams and oysters, summarized in **Table E-2**.

Table E-2 Ten-year Murrells Inlet Dockside Harvest Values		
	Quantity- Number of Bushels	Dockside Value
<i>Clam</i>	10,064	\$277,642.51
<i>Oyster</i>	36,611	\$523,304.91
Total	46,675	\$800,947.42
Source: SC DNR, Nancy Hadley		

Economic Value of the Murrells Inlet Salt Marsh

It is important to assess the true economic value of the local shellfish resources in the broader context of the entire Murrells Inlet marsh. Oysters and other marine life have an integral cultural association with the Murrells Inlet estuary. Coastal Carolina University's Center for Economic and Community Development recently conducted a study to examine the economic activity within the 29576 Zip Code boundary area, which consists principally of the greater Murrells Inlet/Garden City Beach area. Another primary focus of the study was to assess the inherent economic valuation of the Murrells Inlet marsh, which the study estimates exceeds \$720 million.

In addition to a long cultural history of shellfish harvesting, Murrells Inlet is known as being a very popular destination for recreational sports fishing. In fact, SC DNR estimates that 98 percent of spot, 30 percent of flounder, and 23 percent of all snapper caught statewide were in the Murrells Inlet area. Boating is another industry with major economic benefits to the Murrells Inlet community. Horry and Georgetown County records indicate that there are 2,802 registered boats in the 29576 Zip Code. Murrells Inlet is also known to have the busiest boat ramp in Horry and Georgetown counties and one of the top five busiest public boat launches in the entire state. In total, the study estimates that the marsh holds an economic value of \$35,035,000 to boat owners collectively.



Figure E-2 *Murrells Inlet annual 4th of July Boat Parade is just one of many water-based events that boosts the local economy (Photo courtesy of Murrells Inlet 2020)*

The study examines several other economic sectors including real estate, the restaurant industry, and visitor spending, which all contribute to the total economic value of the Murrells Inlet marsh. The marsh, waterfowl, shellfish, and other natural features of Murrells Inlet attract people who desire to live and recreate in this area.

The study clearly illustrates that the marsh is a tremendous economic asset to several industries, subsequently generating substantial tax revenues for both counties.

The economic value of the marsh should be one of the main criteria considered when evaluating any new watershed management projects or initiatives in Murrells Inlet. Investing in efforts to protect water quality and preserve the aesthetic beauty of the estuary, not only has several environmental and public health benefits, but very likely has substantial indirect economic benefits to the community as well.

Long-term Shellfish Habitat Management: Goals and Strategies

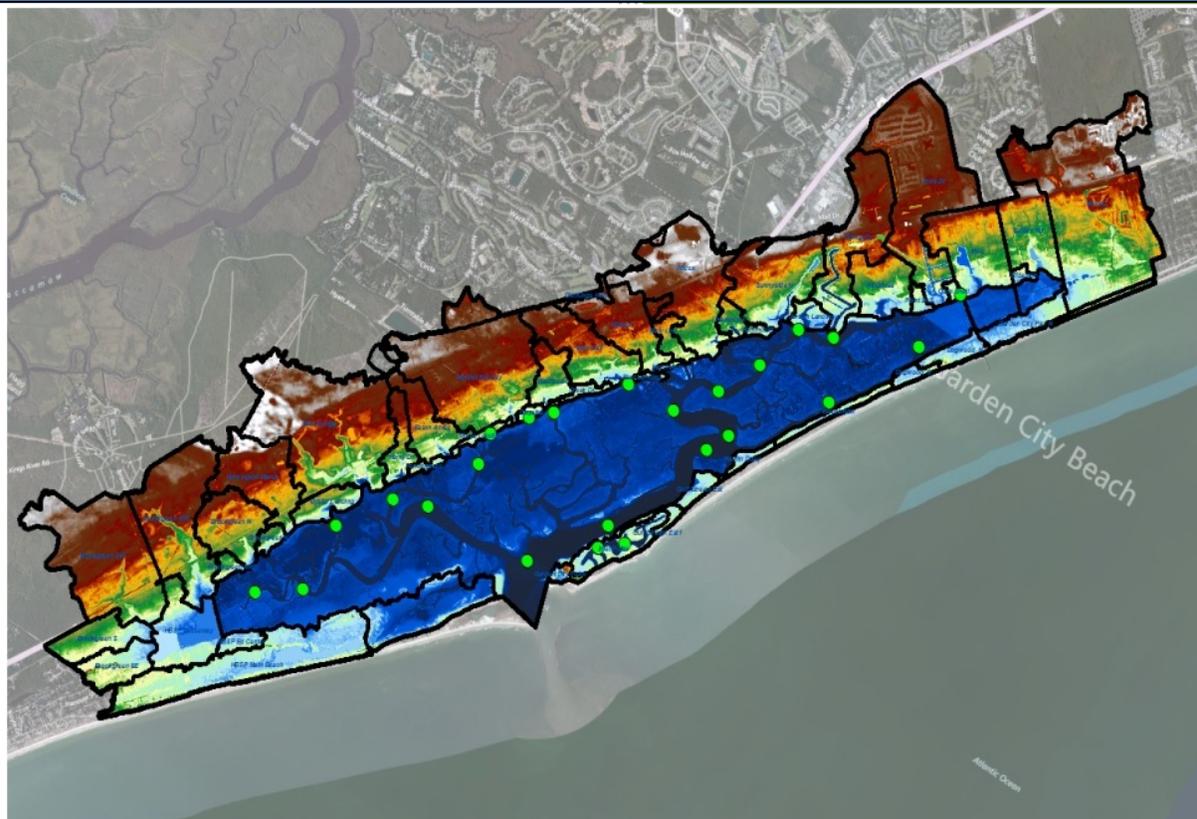
According to SC DNR's Marine Resources Research Institute, the limiting factor to the sustainability of oyster populations is the availability of hard substrate for oyster attachment. In most areas of the state, including Murrells Inlet, oyster larvae are abundant, therefore much of the current restoration efforts are focused on oyster shell replanting. The success of replanting efforts can be affected by erosion of unprotected shorelines, which can be exacerbated by boat wakes. As discussed throughout the plan, siltation has major water quality implications as well; therefore minimizing the impacts of erosion is a major priority area in the plan's recommendations.

Below are some general goals as they relate to the sustainability of shellfish habitat in Murrells Inlet. Specific shellfish management recommendations are outlined in **Element H, Watershed Management Measures:**

- Oyster reefs and other shellfish species habitats are integral components of a healthy estuarine ecosystem. An overarching goal is to replenish shellfish grounds that are regularly harvested and protect other shellfish habitats that help stabilize shorelines and other environmentally sensitive areas within the estuary. In addition shellfish are filter feeders, therefore water quality improvements is another benefit that can be expected from restoring oyster reefs.
- Work with all relevant stakeholders to ensure that shellfish harvesting remains economically viable in Murrells Inlet. This encompasses efforts to meet the fecal coliform water quality standards in as much of the designated shellfish grounds as possible. As stated above, it also requires that the existing shellfish habitat areas remain ecologically sustainable. Therefore restoration work should be pursued as resources are available and sites are needed.
- Educate the public on the economic and ecological value of local shellfish resources. The oyster and other shellfish stocks are limited therefore public awareness regarding the effects of boat wakes, overharvesting, and bacteria contamination is vital. Engaging the public in oyster shell recycling and restoration projects is an excellent way to directly encourage long-term stewardship of Murrells Inlet's natural resources.

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Element F: Targeted Subwatershed Load Reductions



ELEMENT F: Targeted Subwatershed Load Reductions

A review of the historical monitoring data in Murrells Inlet led the steering committee to prioritize monitoring stations to focus resources to address fecal coliform loads. Through this analysis it was recognized that several monitoring stations have remained consistently below the Shellfish Fecal Coliform water quality standard, suggesting that direct intervention is not needed in those areas. For areas determined to be of concern, the steering committee categorized the priority stations by tier.

Table F-1 outlines each of these monitoring stations listed as Tier One. Tier One sites are those that have not met the 90th Percentile nor Geometric Mean standard for the entire period of analysis. It was acknowledged by the steering committee that given the historic fecal coliform levels it will be very difficult to meet the water quality standards for site 04-01. Therefore the initial goal is to begin decreasing fecal coliform levels and establish several realistic and intermediate water quality milestones.

SC DHEC's TMDL modeling staff assisted the steering committee by providing load reduction estimates needed to meet the water quality standard using a cumulative probability statistical method based on sampling data collected from January 2007 through December 2012. These load reduction estimates are also included in the tables below.

Table F-1, Tier One SC DHEC Monitoring Stations for Fecal Coliform Load Reduction

Monitoring Sites	Adjacent Subwatersheds	Nearest Shellfish Area(s)	Cumulative Probability Load Reduction Estimate
04-01	#1 Point Dr #2 Pine #3 Melody	C372	95.3%
04-08	#1 Mariner/ Wesley #2 Morse Landing #3 Coquina	C359	83.8%
04-16	#1 Mariner/Wesley #2 Coquina #3 Wachesaw	C359	93.1%

Source: This list of priority SC DHEC monitoring stations was developed by the Murrells Inlet Watershed Plan Steering Committee based on a review of the water quality baseline assessment conducted by Coastal Carolina University and watershed maps produced by The Earthworks Group, Inc. The load reduction estimates were calculated by SC DHEC's TMDL Section based on sampling data collected between January 2007 and December 2012.



Figure F-1 The northern portion of the watershed which drains into SC DHEC site 04-01 is heavily developed and has experienced the highest levels of fecal coliform in Murrells Inlet. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)

Table F-2 outlines each of these monitoring stations listed as Tier Two. These sites have been designated as Tier Two because they either periodically exceed the 90th percentile of Geometric Mean standard in the period of analysis or have recently shown an increase in fecal coliform levels. Site 04-28 is of particular concern because prior to the 2011 SC DHEC Shellfish Management Area 04, the samples were within the Approved water quality standard. Site 04-28 is located in the southern end of the watershed surrounded by natural undeveloped areas owned by Huntington Beach State Park and Brookgreen Gardens.

Table F-2, Tier Two SC DHEC Monitoring Stations for Fecal Coliform Load Reduction

Monitoring Sites	Adjacent Subwatersheds	Nearest Shellfish Area(s)	Cumulative Probability Load Reduction Estimate
04-06	#1 Morse Landing #2 Mariner/ Wesley #3 Coquina	C359	43.8%
04-26	#1 Dogwood S #2 Dogwood N #3 S Waccamaw	C372	59.4%
04-02	#1 Sunnyside N #2 Rum Gully #3 Jordan Landing	C372	59.2%
04-27	#1 Rum Gully #2 Mt. Gilead #3 Sunnyside N	C372	52.4%
04-28	#1 Brookgreen N #2 HBSP Causeway #3HBSP Main Beach	R351	Not analyzed for the purposes of this report

Source: This list of priority SC DHEC monitoring stations was developed by the Murrells Inlet Watershed Plan Steering Committee based on a review of the water quality baseline assessment conducted by Coastal Carolina University and watershed maps produced by The Earthworks Group, Inc. The load reduction estimates were calculated by SC DHEC's TMDL Section based on sampling data collected between January 2007 and December 2012.



Figure F-2 The southern end of the watershed is mostly undeveloped. Sites 04-28 and 04-18 can affect shellfish closures in one of the public recreational shellfish grounds in Murrells Inlet. These factors led the steering committee to consider them priority monitoring sites for management purposes. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)

Table F-3 outlines each of these monitoring stations listed as Tier Three. These sites have been designated as Tier Three because they fluctuate between meeting and exceeding the shellfish fecal coliform standard. The steering committee determined that with timely intervention, these sites could easily meet and continue to stay below the water quality standard.

Table F-3, Tier Three SC DHEC Monitoring Stations for Fecal Coliform Load Reduction			
Monitoring Sites	Adjacent Subwatersheds	Nearest Shellfish Area(s)	Cumulative Probability Load Reduction Estimate
04-17A	#1 Vaux Hall #2 Mariner/Wesley #3 Boat Landing	C359, C362	8.8%
04-18	#1 HBSP Main Beach #2 Brookgreen N #3 HBSP Causeway	R351, S354, C352	Not analyzed for the purposes of this report
04-07	#1 Bike Bridge #2 Horry Dr. #3 Eason Acres	S357, R355	Not analyzed for the purposes of this report
04-31	#1 Wachesaw #2 Mariner/Wesley #3 Creek Dr.	C359	No reduction needed

Source: This list of priority SC DHEC monitoring stations was developed by the Murrells Inlet Watershed Plan Steering Committee based on a review of the water quality baseline assessment conducted by Coastal Carolina University and watershed maps produced by The Earthworks Group, Inc. The load reduction estimates were calculated by SC DHEC's TMDL Section based on sampling data collected between January 2007 and December 2012.

Element G: Existing Infrastructure and Management Programs



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Existing Infrastructure

As the Murrells Inlet population grew and associated development increased in the surrounding area, basic utility services such as sewer and drinking water infrastructure became increasingly more important to protect the public health and the environment. The multijurisdictional nature of the Murrells Inlet watershed has required ongoing coordination between the Georgetown County Water and Sewer District (GCWSD) and Grand Strand Water and Sewer Authority (GSWSA) who operate and maintain sewer infrastructure in their respective designated service areas. An overview of the existing infrastructure, preventive maintenance measures, and long-term improvement needs for each district is provided below.

Georgetown County Water and Sewer District

The Georgetown County WSD owns and operates the Murrells Inlet Wastewater Treatment Plant (WWTP) (NPDES permit# SC0040959), which provides sewage treatment services in the Georgetown County portion of Murrells Inlet. The treatment facility is located on 1441 Pond Road, Murrells Inlet, SC. The wastewater treatment site is located outside of the Murrells Inlet estuary watershed boundaries and final treated effluent is discharged to the Waccamaw River. Flows from the Garden City Beach portion of Georgetown County are collected by GCWSD but are treated at the Schwartz WWTP facility operated by Grand Strand WSA. The Murrells Inlet WWTP was originally permitted in 1987 and currently has a treatment capacity of 2.0 Million Gallons Per Day (MGD). Based on monthly Discharge Monitoring Reports submitted to the EPA from October 2011 to September 2012, this facility currently treats an average of 0.90 MGD. Due to greater sewer demand associated with the summer tourism season, the peak month over this twelve month period was 1.129 MGD in July 2012.

The district conducts capacity studies on a regular basis to plan long-term capital improvements. A recent study in 2007 indicated that currently the Murrells Inlet WWTP facility and the principal force main sewer network are able to handle the peak wastewater loads. However, if future development occurs at a pace similar to the late 1990's to early 2000's, some sewer lines would need to be replaced to increase the flow capacity within the service network (Georgetown County WSD 2007).

Grand Strand Water and Sewer Authority

Wastewater flows from residences and commercial properties on the Horry County side of Murrells Inlet are treated at Grand Strand WSA's Schwartz WWTP. This regional facility is located in the Burgess Community of Horry County and discharges treated

effluent to the Waccamaw River. In addition to the Murrells Inlet area, the Schwartz WWTP receives wastewater from a service area extending to Coastal Carolina University/ Carolina Forest, Surfside Beach, Forestbrook, and Socastee. Grand Strand WSA also has an interlocal agreement with Georgetown County WSD to receive up to 325,000 GPD of flows from the Garden City Beach portion of Georgetown County. Presently, the Schwartz WWTP has a treatment capacity of 19.35 MGD and has a current average daily flow rate of 10.9 MGD.

Both Georgetown County WSD and Grand Strand WSA institute several preventive maintenance measures to ensure the system is running efficiently and sanitary sewer overflows and other infrastructure problems are minimized. The major forcemain pump stations are equipped with auxiliary generators to ensure continued operation during a power outage event. Each of the secondary pump stations are monitored via a network wide Supervisory Control and Data Acquisition (SCADA) system. This enables district managers to spot inconsistencies in flow measurements at a pump station and deploy maintenance personnel to inspect and repair the station as needed. The major pump stations are inspected multiple times weekly, while all secondary pump stations are typically inspected at least once per week. All pump stations are regularly inspected during storm events.



Figure G-1 Georgetown County WSD force main pump station equipped with the SCADA monitoring system. (Photo courtesy of Dr. Dan Hitchcock, Clemson University)

Both districts also utilize routine smoke testing and camera inspection as part of their Capacity, Management, Operations, and Maintenance (CMOM) program. The CMOM program is commonly utilized by most sewer utility providers and is essentially a comprehensive routine preventive maintenance program to ensure a highly functional sewer system. As public utility providers, Georgetown County WSD and Grand Strand WSA must coordinate their construction activities with other entities in the area that share the utility right of way. The Palmetto Utility Protection Service, authorized by the Underground Facility Damage Prevention Act is an information service that ensures that all relevant utility providers are notified when a construction project is occurring in their jurisdiction. Collective participation by all utilities and homeowners is vital in reducing the occurrence of underground utility damage. The Palmetto Utility Protection Service operates SC 811, a telephone line that property owners must call if they plan to dig.

Another important aspect of effective sewer system maintenance is educating sewer

customers on proper maintenance of their sewer connections and preventing inappropriate wastes, such as fats and grease, from being disposed via the sewer system. Improper grease disposal from restaurants, and to a lesser extent residences, can cause blockages in the sewer line and malfunctions at pump stations, increasing the potential for a sanitary sewer overflow (SSO). Recycling of cooking oils and proper operation and maintenance of grease traps are two effective BMPs that restaurants can implement.

Although the area's sewer treatment facilities currently have adequate capacity, if large amounts of stormwater enter the sanitary sewer system during a heavy storm, the collection system can become overloaded and possibly overflow to the inlet. Residents should do their part to minimize stormwater infiltration and should never open their sewer cleanout pipe as a way to quickly drain standing stormwater from their yards following significant rainfall. This additional water flowing into the wastewater system also increases the costs of wastewater treatment.

While sanitary sewer overflow events have been infrequent in the Murrells Inlet area, when they occur they have the potential to contribute significant bacteria loads to the Murrells Inlet estuary. Specific management strategies to reduce the risk of SSO events are outlined further in **Element H: Watershed Management Measures** and **Element J: Public Education and Outreach Resources** of this plan.

Georgetown County and Horry County Stormwater Management

Another critical aspect of protecting water quality is to reduce non-point sources of pollution from entering upstream tributaries and drainage ditches. This can be challenging as potential pollution sources can exist from a multitude of locations across a large drainage area. Unlike wastewater treatment facilities, non-point sources of pollution do not necessarily occur at specific and discrete locations, but rather enter local waterways from adjacent land surfaces via stormwater runoff.

The stormwater management profession has matured over time and regulations and management practices have continued to evolve to better address non-point source pollution. As part of the NPDES permitting program, the US EPA has developed regulations requiring municipalities and counties to manage stormwater runoff in designated urbanized areas within their jurisdictions. There are two main permits that focus on stormwater related concerns that apply to activities in both Horry County and Georgetown County. The first is referred to as the NPDES Construction General Permit and the other is the Municipal Separate Storm Sewer System General Permit (MS4). A brief overview of the main objectives and scope of each permit program is provided below.

Construction General Permit

This permit regulates stormwater discharges generated from construction sites and other land disturbing activities. Without proper mitigation, runoff from construction sites can cause erosion and downstream siltation. Although, fecal coliform bacteria is not a common pollutant associated with construction sites, bacteria can bind to sediments and be transported from construction sites during stormwater runoff events. Sediments can also negatively harm aquatic habitats, including oyster reefs. Over time, sediment accumulation can impact the hydrology of Murrells Inlet and reduce the tidal flushing that naturally occurs in Murrells Inlet. Tidal flushing helps maintain a proper salinity balance, which tends to moderate fecal coliform levels from freshwater flows. Sediments also have been shown to have properties that favor pathogenic bacteria survival and propagation. The Construction General Permit is designed to mitigate these types of stormwater and erosion impacts.



Figures G-2 and G-3 *Construction site activities that disturb soil can cause sedimentation problems in nearby waterways. Storm drain protection devices shown on the right can help prevent downstream water quality problems. (Photos courtesy of Horry County Stormwater Department and US EPA.)*

The permit applies to construction sites over one acre and over $\frac{1}{2}$ acres if the site is within $\frac{1}{2}$ mile of a coastal receiving water. Specific provisions apply to “small” construction sites between one and five acres and to “large” construction sites, which are bigger than five total acres. Permittees are not only required to control stormwater discharges from active construction sites, but must also incorporate measures to address post-construction site discharges. A major component of the permit approval process is the submission of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP identifies potential sources of stormwater pollution on the construction site with corresponding control measures to address those pollution sources. Permittees must gain approval of the SWPPP from the county and SC DHEC before initiating construction and sites are inspected regularly throughout construction to ensure compliance with the approved SWPPP.

Municipal Separate Storm Sewer System General Permit

The focus of the MS4 permit is to address stormwater discharges that drain through a permitted jurisdiction's storm sewer network, consisting of stormwater ponds, ditches, catch basins, pipes, and other conveyances. Permit conditions are based on population thresholds determined by decennial Census counts. Horry and Georgetown Counties are two of seventy small regulated MS4s areas in the state of South Carolina. The main provisions within the MS4 permit revolve around six minimum control measures. They are listed below with a short description:



Coastal Waccamaw Stormwater Education Consortium

*Helping local governments meet requirements
for stormwater education & public involvement*

- *Public Outreach and Education:* MS4 jurisdictions must educate residents on stormwater related issues and the influence of land activities and individual behaviors on the quality of nearby water resources. Horry and Georgetown Counties fulfill their obligations for this minimum measure through active participation in the Coastal Waccamaw Stormwater Education Consortium (CWSEC), which organizes public workshops, media advertising campaigns, and many other activities.
- *Public Participation/ Involvement:* This measure entails efforts to engage residents in local stormwater program development and activities. Both counties fulfill this requirement through initiatives such as the Murrells Inlet Volunteer Monitoring program, cleanups, and storm drain marking activities.
- *Illicit Discharge Detection and Elimination:* Illicit discharges constitute a wide variety of pollution sources including chemical spills, failing septic systems, illegal dumping, etc. all which can enter local waterways untreated. MS4 jurisdictions must enact ordinance provisions to detect and eliminate illicit discharges. This measure also entails a reporting and response mechanism so that the public can contact the respective stormwater department if they identify water pollution incidents.
- *Construction Site Runoff Control:* This requirement focuses on sediment and erosion control from construction sites disturbing one or more acres, or more than one-half acre when the site is located within one-half mile of a receiving waterbody. To fulfill this measure, each county has adopted a design manual with best management practices, reviews construction site plans, and conducts site inspections to ensure compliance with approved plans.
- *Post-construction Stormwater Management:* New developments generally

speaking increase the amount of onsite impervious surface area on a land parcel, which in turn results in less infiltration and a higher volume and flow rates of stormwater runoff. This measure gives each MS4 the authority to require developments to meet standards to mitigate stormwater impacts by implementing practices designed to treat, store, and infiltrate runoff onsite. New techniques such as Low Impact Development are encouraged and becoming more widely utilized.

- *Pollution Prevention/ Good Housekeeping:* The final measure focuses on implementing initiatives and strategies that reduce the potential of stormwater pollution from public facilities and public services activities, including employee training.

As mentioned in **Element B**, the SMS4 General Permit was renewed on January 1st, 2014 and entails new requirements pertaining to addressing waterbodies with an adopted TMDL. Specifically, the new permit requires permittees to develop a monitoring plan and BMP implementation schedule. Needless to say, identifying and mitigating causes of non-point source pollution entering Murrells Inlet to achieve MS4 permit compliance is a major priority for both Horry and Georgetown Counties. Since this watershed spans across both counties, ongoing collaboration is essential to protecting this natural resource. Both counties have fully supported the Murrells Inlet Volunteer Monitoring program, participate in the regional Coastal Waccamaw Stormwater Consortium, along with many other initiatives that benefit the Murrells Inlet community. This watershed-based plan includes several recommendations to build on this partnership to effectively invest in resources to protect the Murrells Inlet estuary.

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Element H: Watershed Management Measures



ELEMENT H: Watershed Management Measures

The ultimate purpose of this watershed management plan is to outline a framework for implementing management strategies that will help improve water quality and sustain productive shellfish habitats in Murrells Inlet. The recommendations detailed in this element were developed after performing an extensive examination of historical water quality and existing land uses in the watershed, as well as site visits within specifically targeted subwatersheds as prioritized in **Element F, Targeted Subwatershed Load Reductions**. The long-term aim is to utilize an adaptive management approach in Murrells Inlet where multiple strategies will be pursued. Post-implementation monitoring will serve to guide the effectiveness of each BMP and where they should be replicated in other areas of the watershed.

The first section of this element discusses best management practices that have previously been implemented in Murrells Inlet. It is important to be able to evaluate the effectiveness of various BMPs that are already in place as well as those that have been previously utilized and may or may not have been effective. Projects that have shown water quality benefits may be appropriate to apply in other portions of the watershed. The next section of the element is a list of the recommended best management practices for future implementation in Murrells Inlet. An explanation of the purpose and expected benefits of each strategy is provided. The recommendations are organized based on whether the proposed management strategies can and/or should be applied across the entire Murrells Inlet watershed such as a pet waste disposal campaign or if the recommendation is a structural BMP that is being targeted in a specific subwatershed. This element also discusses potential barriers to the implementation of these BMPs. Some common barriers include financial constraints, land availability, and community acceptance.

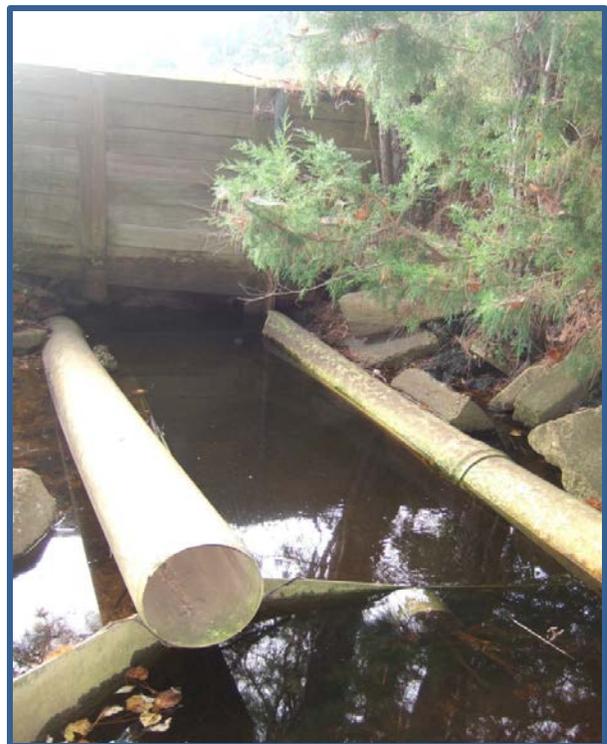


Figure H-1 A wide variety of stormwater management concepts have been tried in the past. This is the remnants of a chlorine contact chamber designed to treat water draining upstream of the Bike Bridge in Georgetown County. (Photo courtesy of Dr. Dan Hitchcock, Clemson University)

Existing or Previous Best Management Practices

This section summarizes some notable watershed management projects and initiatives that have already been implemented in Murrells Inlet. All of the following BMPs outlined in the section below serve as good demonstration projects and should continue to be encouraged moving forward.

Low Impact Development Implementation

Low Impact Development (LID) is an emerging site design approach that focuses on mimicking natural hydrological processes and preserving the ecological services of residential and commercial developments. Low Impact Development can focus on several different environmental principles, with one of the main targeted goals being the onsite management of stormwater. Several features can be employed on a development site to achieve the desired runoff reduction outcomes. They include rain barrels, green roofs, permeable pavements, strategic tree plantings, rain gardens, engineered or restored wetlands, and bioretention facilities.



Figure H-2 Example of a constructed stormwater wetland. (Photo courtesy of Dr. Dan Hitchcock, Clemson University)

There are examples in the Murrells Inlet area where Low Impact Development design techniques have been installed as a functional part of the landscape. Clemson's Carolina Clear program and South Carolina Sea Grant maintain an LID atlas, which profiles sites throughout the state where LID is being utilized. It is an effective outreach tool which highlights the location of LID applications and provides information on the type of LID practice that was incorporated at each site. This website is also a helpful way for water resource managers to become more familiar with LID techniques that other communities are implementing. In addition, the SC LID atlas is linked into a national database of LID projects through the Non-point Education for Municipal Officials maintained by the University of Connecticut

Table H-1 below provides a brief description of the LID projects in Murrells Inlet that are highlighted on the Carolina Clear website or are other examples mentioned by the project steering committee:

Table H-1- Existing Low Impact Development Sites in the Murrells Inlet Community

Location	Type	Date of Installation	Notes
Morse Landing Park- 4911 Hwy 17 Business	Bioretention/ Rain Garden	2009	Captures parking lot runoff adjacent to popular boat landing and park.
Bike Path near intersection of US Hwy 17 Business and US Hwy 17 Bypass	Pervious Pavement	2008	300 ft section of bike path is paved with permeable concrete.
Brookgreen Gardens entryway: 1931 Brookgreen Dr	Pervious Pavement	-	Decorative use of pervious concrete at the main entryway into Brookgreen Gardens.
Garden City (Azalea St.) Pervious Paving	Pervious Pavement	2012	Horry County used pervious pavement in the construction of a new public parking lot.
Inlet Sports Lodge	Pervious Pavement		
Boathouse Run Subdivision	Pervious Pavement/ Underground Storage and Infiltration		
SC DNR Murrells Inlet Boat Ramp	Constructed Wetland, Parking Pavers	2006	Studied as part of the Murrells Inlet Special Area Management Plan.
Jetty View Walk	Pervious walkway	2013	
Source: Clemson University, Carolina Clear Program- http://www.clemson.edu/public/carolinaclear/lidmap/			

SC DNR SCORE Program

As emphasized in previous sections, from a shellfish habitat management standpoint one of the critical needs is to maintain suitable oyster reefs established for juvenile

oyster larvae recruitment. Through the SCORE program, SC DNR restores shellfish harvesting areas with recycled and purchased oyster shell. The SCORE program has initiated two restoration sites in Murrells Inlet. One is located near the education center pier at Huntington Beach State Park. The second site is at Oyster Landing. SC DNR relies on the support of volunteer groups to accomplish the program's goals, making it another excellent public outreach opportunity. The SCORE program will continue to be an important shellfish restoration initiative in Murrells Inlet.

Public Education and Outreach Initiatives

The Murrells Inlet community has been very proactive in initiating environmental education and awareness events and campaigns. The Spring Tide cleanup event is one of the longest standing events throughout the entire state. The “Litter Makes Us Crabby” campaign has also been very effective. Murrells Inlet 2020 has been a leading organization in these efforts and maintains active engagement with regionwide initiatives through their participation in the Coastal Waccamaw Stormwater Education Consortium (CWSEC). Murrells Inlet 2020 with the assistance of CCU spearheaded the establishment of the volunteer monitoring program which has provided critical water quality data to the county stormwater departments. These public outreach programs and initiatives provide a great foundation to address other watershed management efforts that require public support or participation. Additional information about these existing programs is included in **Element J: Public Education and Outreach Resources**.

The next two sections outline considerations regarding implementation timeframes and potential barriers for each of the proposed BMP recommendations listed at the end of this element.

Implementation Timeframes

Accomplishing all of the goals outlined in this plan takes time, financial and personnel resources, and coordination between several management entities, especially given the multijurisdictional nature of Murrells Inlet. This element establishes near-term, mid-term, and long-term time frames for each recommendation. Below is a brief overview of each timeframe and some of the factors that could influence the suggested period of time.

- **Near-term-** projects that could be initiated within two years. These are typically projects that could be implemented with the coordination of existing resources and minimal capital costs.
- **Mid-term-** projects that could be initiated within three to five years. These projects may have most of the components needed for implementation but need to address one or more of the implementation barriers listed in the next section. Another factor could be the sequencing of other project recommendations based on prioritization.

- **Long-term-** projects that are anticipated to be implemented on a ~5-10+ year time horizon. These are typically projects that will require a significant allocation of capital costs, private property acquisition, extensive agreements between local governments and external agencies, and further engineering or water quality study.

Two other timeframe considerations should be made when evaluating each potential management strategy. They relate to the administrative and/or maintenance requirements associated with each project or initiative.

- **Ongoing-** Some management strategies entail more frequent administrative responsibilities, more routine inspections, or onsite maintenance. Projects that entail an ongoing commitment can include public education initiatives where the targeted stewardship message needs to be communicated on a regular basis in order to be effective. Another example of a recommendation outlined below which requires ongoing administrative responsibilities is the proposed inlet-friendly business program. While overseeing the program is not expected to be overly burdensome, a designated point of contact needs to be available to encourage new participants, answer questions, and review applications.
- **Periodic-** These management strategies typically only need annual maintenance work or inspection, or some other designated timeframe. A good example of this is shellfish restoration efforts. Restoration projects can be planned well in advance and the efforts can shift to different locations from year to year as the need is identified. Other examples of projects with periodic maintenance requirements include catch basin insert replacement, drainage ditch and retention pond maintenance, and septic system maintenance.

Possible Barriers to Implementation

The decision process for implementing watershed management projects requires an in-depth evaluation of resource constraints that may affect the timing or scale of a particular project. Below is a list of common considerations that must be factored into the feasibility of all proposed projects. Identifying these potential implementation barriers and addressing them in a coordinated way can significantly improve the success and timeliness of achieving the plan recommendations.

- **Construction Costs:** Many structural stormwater devices can entail significant capital costs. High cost projects must provide substantial water quality and other community benefits in order to justify the expense. Structural BMPs must be strategically located and be well supported by available water quality data that clearly demonstrates the need. All available design alternatives should also be evaluated to weigh other factors such as lifespan, maintenance costs, property acquisition, etc.
- **Maintenance Burden:** Often, the biggest challenge once a BMP has been implemented is ensuring that the project is working effectively. Sometimes the maintenance burden falls on the private property owner or homeowners

association. In that case, appropriate training should be provided at the outset of project implementation. Other projects require additional personnel and equipment resources from the county's public works or stormwater departments. An understanding of all necessary resource commitments in advance of project implementation is critical for long-term success.

- **Land Availability:** As emphasized throughout the plan, there are distinct land use differences across the Murrells Inlet watershed. The southern end of the Georgetown County portion of the watershed is largely protected open space owned and managed by Brookgreen Gardens and Huntington Beach State Park. The northern portion of the watershed is noticeably more urbanized, with fewer areas of undeveloped land. Some potential management options include drainage ditch modifications, construction of vegetated wetlands or retention ponds, and the encouragement of shoreline buffers. Each of these strategies requires varying acreage of available land for proper BMP design and siting. The implementation of structural BMPs on other suitable private properties will require clear communication of the purpose and expected benefits of the proposed project. Incentives should be explored to encourage participation from private landowners.



Figure H-3 *Structural BMP practices such as stormwater retention ponds and constructed wetlands require available land. This property owned by Murrells Inlet 2020 could potentially be utilized for this purpose. (Photo courtesy of Dr. Dan Hitchcock, Clemson University)*

- **Public Acceptance:** Meeting the goals of this watershed plan will require the ongoing support and cooperation of the general public. The primary objective is educating the public on the water quality and shellfish habitat issues in Murrells Inlet. Effectively conveying the economic, environmental, and cultural benefits of protecting these natural resources is vital in gaining public support for watershed management efforts. **Element J** outlines in great detail the various population groups, such as pet owners, tourists, landowners, etc. that project partners need to educate and gain support from on various BMP strategies. Similarly, encouraging local developers, architects, and engineers to incorporate new site design concepts, such as LID, needs to remain a priority.
- **Partnership Commitments:** This plan is the result of a shared desire from several local stakeholders to help improve water quality and protect shellfish habitat areas. The effort put forth by each project partner has led to a better understanding of the existing environmental conditions in Murrells Inlet and the coordination that will be needed to achieve the desired outcomes of the plan. Adaptive watershed management is an iterative and ongoing process. For each of the projects and initiatives recommended in this plan, local stakeholder entities will have different roles to play in the implementation process. As plan implementation proceeds, additional partners should be sought depending on the nature of each specific project.
- **Site-specific Considerations:** Some locations within the Murrells Inlet watershed may be suitable for certain stormwater management strategies, while others may not. For example, stormwater infiltration practices may not be appropriate at sites with poorly drained soils unless an underdrain installation is feasible, which requires sufficient elevation grade for the drain to work. Also, locations that have shallow groundwater may also inhibit these types of practices, while retention-based practices such as wet basins or constructed wetlands may prove to be more hydrographically and hydraulically effective.

For each of the proposed best management practices listed at the end of this element, an assessment of potential implementation barriers is included.

Proposed Watershed Best Management Practices

This section outlines Best Management Practices that are recommended to enhance water quality and protect shellfish habitat in Murrells Inlet. A description of the project or initiative is provided. Suspected implementation barriers, if any, are mentioned for each BMP recommendation. Finally, an implementation timeframe for each recommendation is included. Watershed-wide management strategies are listed first, followed by strategies focused on a specific subwatershed near one of the prioritized SC DHEC monitoring stations.

Watershed-Wide BMP Recommendations

The following list of BMP recommendations are designed to address bacteria sources that potentially exist throughout the entire watershed.

A. Pet Waste- One of the bacteria sources that should be the easiest to reduce is pet waste. The responsibility for eliminating this common bacteria source lies directly with individual pet owners. Watershed managers can initiate public education campaigns to remind people about the water quality impacts of pet waste and provide amenities such as pet waste stations to make pet waste disposal as convenient as possible for residents and visitors.

Recommendation A1: Continue public outreach efforts encouraging proper pet waste disposal.

Potential Barriers: The Murrells Inlet community with the assistance of many entities continues to proactively address the pet waste issue. Resources are in place and it is likely to remain a priority focus for the foreseeable future. One challenge is that Murrells Inlet has a very transient population, particularly during the peak tourism season in the summer months. Targeted outreach to these population groups is needed and cooperation will be sought from the vacation rental companies. A comprehensive overview of proposed public outreach initiatives addressing pet waste and other water quality issues is the focus of

Element J: Public Education and Outreach Resources

Implementation timeframe: *Near-term and ongoing*

Recommendation A2: Review existing ordinances pertaining to pet waste disposal in Horry and Georgetown Counties to determine amendments that may be needed to address the issue. Evaluate strategies to improve the enforcement of existing ordinances.

Georgetown County has the following ordinance that addresses pet waste in public areas:

Sec. 4-1. - Responsibility of owner for removal of excreta deposited by animal on public property.

The owner and/or persons having custody or control of an animal or pet shall be responsible for the removal of any excreta deposited by the animal on public property, including the beachfront. Any person who violates the provisions of this section shall be fined not more than two hundred dollars (\$200.00) for each offense, or sentenced to not more than thirty (30) days in jail.

Potential Barriers: Having similar ordinance language for both counties would help to address the issue across the entire watershed. The ordinance will also have its limitations as it is impractical to enforce pet waste disposal ordinances pertaining to private property.

Implementation timeframe: *Near-term and ongoing*

B. Waterfowl and Nuisance Wildlife- The salt marsh and the natural areas that extend inland throughout the Murrells Inlet community are an attractive habitat for waterfowl and other wildlife species such as raccoon, fox, opossum, and coyote. An observation by several stakeholders and residents is that wildlife and feral cats are assimilating into the residential neighborhoods and near restaurants often relying on human food. Below are some recommendations to help minimize problems associated with nuisance wildlife, feral cats, and resident waterfowl:

Recommendation B1: Create a campaign targeted at homeowners, business owners, and county government departments to properly secure their garbage cans and dumpsters. Unsecured dumpsters can attract small mammals such as raccoons and bird species such as crows and sea gulls. Each county should inspect and secure all dumpsters and garbage cans located in public areas. At public boat landings and other sites near the inlet, dumpsters should be setback as far from the shoreline as possible. Public trash cans should have secured lids and be emptied regularly (daily in the summer) to prevent overflowing, especially near shoreline areas, where wind can blow litter into the estuary.



Figure H-4 *Unsecured dumpsters can attract raccoons and feral cats. Dumpsters located near the inlet or upstream drainage ways should always be carefully secured. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)*

Potential barriers: It would be very difficult to be able to reach all residents and businesses, especially part-time residents that occupy weekly or seasonal vacation properties. This type of campaign would likely require yearly reminders. The campaign and business participation could become a component of the proposed Inlet-friendly business program.

Implementation timeframe: *Near-term and ongoing*



Figures H-5 and H-6: *Trash cans should have secured lids and be regularly emptied, especially along waterfront areas. (Photos courtesy of Murrells Inlet 2020)*

Recommendation B2: Discourage feeding waterfowl and wildlife by strictly enforce waterfowl and wildlife feeding ordinances. Feeding encourages wildlife to congregate in residential and commercial areas instead of more suitable natural habitats. Signage can be used to inform the public of existing ordinances and educate the public on the importance of this issue as it relates to water quality in Murrells Inlet.

Potential Barriers: In order to be effective, a two-prong approach is needed. First, public awareness is essential to discouraging this activity. Second, enforcing the policy across the community can be difficult.

Implementation timeframe: *Near-term and ongoing*



Figure H-7 *Feeding ducks and geese has been frequently observed throughout the community. Feeding waterfowl and wildlife should be avoided especially near stormwater ponds. (Photos courtesy of Daniel Newquist, Waccamaw Regional COG)*

Recommendation A3: Identify areas of known feral cat colonies and begin working with the counties' animal control divisions, local animal shelters, businesses, and residents to reduce the population numbers and find suitable homes for these animals. Promote the organization of a county level cat adoption or neutering/relocation campaign. Pet Smart has recently developed a grant program to support community adoption and spay/neuter programs. More details about the grant program are provided in **Element I: Potential Funding Source Evaluation**.

Potential Barriers: This type of effort requires public cooperation and ongoing coordination between the counties and local veterinary clinics and animal shelter. A direct and sustained initiative must be implemented.

Implementation Timeframe: *Mid-term*

C. Inlet-Friendly Business Program: A key long-term partner and stakeholder in protecting Murrells Inlet's natural resources is the business community. This includes restaurants, outdoor excursion companies, hotels and vacation rental agencies, among others. Many of these businesses are located directly on the

Murrells Inlet shoreline and they interact daily with both residents and visitors alike. They can serve as leaders on many water quality initiatives and can play a significant role in making the general public aware of the importance of protecting the local natural resources.

Recommendation C1: Create an Inlet-Friendly Business Program. Businesses can be designated as “Inlet-Friendly” by engaging in various Best Management Practices such as recycling, the use of environmentally friendly products, restaurant employee training on the proper disposal of Fats, Oils, and Grease (FOGs), making public educational materials available, investing in Low Impact Development retrofits, etc. In return, the business receives recognition for their stewardship efforts including advertising space on a dedicated “Inlet-Friendly” Business program website. A good example of a similar program in the Grand Strand area is the City of Conway, which has established a “River-Friendly Business Program”.

Potential Barriers: The outreach effort to promote the program and generate initial participation could be significant. While the program does not entail too much time and effort, a firm commitment from an appropriate entity to oversee the program is necessary.

Implementation Timeframe: *Near-term and ongoing*

D. Stormwater Runoff Volume Reduction: As noted at the beginning of this element, Low Impact Development has become a more widely used approach to manage stormwater runoff. The fundamental principle and ultimate goal is to mimic pre-development hydrology and retain runoff and any potential pollutant loadings as close to the site as possible. There are multiple LID practices that can be implemented to accomplish this objective. Below are LID strategies and other stormwater runoff reduction practices that should be encouraged across the Murrells Inlet community. Other specific structural BMP practices that are intended to address stormwater management in a specific subwatershed are outlined later in the element.

- **Rain Harvesting:** One simple strategy is to capture and reuse rainwater for irrigation purposes in periods between storm events. Rain barrels are easy to install and are applicable on residential homes, public facilities, and commercial buildings. Larger rain cisterns have the capacity to capture greater volumes of runoff and could be



Figure H-8 *Typical rain barrel adjacent to a flower garden. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)*

appropriate for larger public and commercial building sites. In addition to community wide benefits, homeowners can realize water utility bill savings by using less water for irrigation. A 55-60 gallon rain barrel is generally suitable to capture the runoff generated from a 1000 sq ft roof during a 0.4" storm. A rain barrel of this size costs as low as \$50 or cheaper if constructed and installed on your own (Clemson University 2011). Given the minimal expense and relative ease of installation, rain barrels are one of the most feasible retrofit stormwater management practices to implement.

Recommendation D1: Encourage homeowners to utilize rain harvesting techniques such as rain barrels to help reduce stormwater runoff rates and volumes in the watershed. An effective way to increase participation is to have a dedicated campaign to donate or sell rain barrels at discount to interested homeowners. As part of the initiative the county stormwater departments with the support of other entities such as Carolina Clear or the Coastal Waccamaw Stormwater Education Consortium could host workshops to provide instruction on proper siting, installation, and utilization of the rain barrel. These initiatives are often great public outreach and awareness opportunities to explain the watershed protection benefits of these and other stormwater management practices.

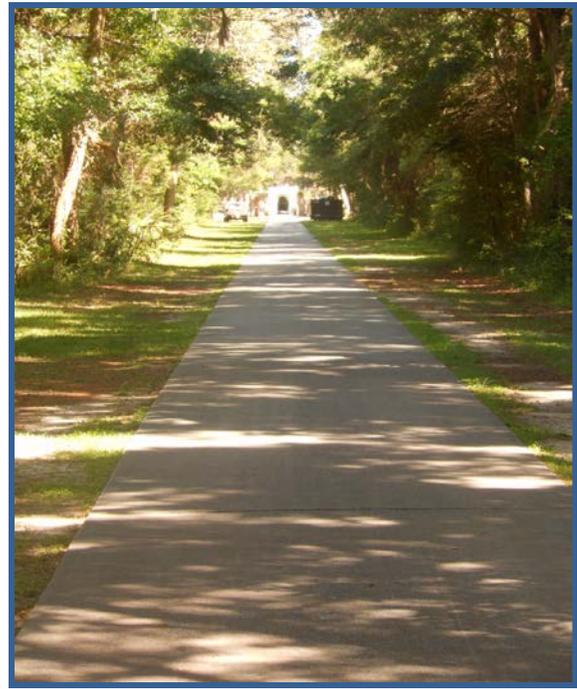
Potential Barriers: The greatest obstacle is securing a grant or sponsor to help offset the costs of rain barrel purchase to homeowners. It is also important to ensure that rain barrels are within the aesthetics guidelines of each of the homeowners associations in the Murrells Inlet area.

Implementation Timeframe: *Near-term and periodic.*

- **Tree Planting:** Murrells Inlet, just like many other communities throughout coastal South Carolina has hundreds of majestic live oak trees and other distinct palm and pine tree species, which add tremendous aesthetic, cultural and ecological value to the community. One of the main community scale benefits of tree planting is as a stormwater management amenity. Below is a short list of stormwater benefits that trees can provide in developing communities (USDA Center for Urban Forest Research 2002).
 - **Interception:** Trees with large canopies tend to have high interception capacities. Interception is the ability to briefly retain precipitation from reaching the ground surface thereby mitigating the intensity and duration of peak flow. Mature trees that hold their leaves throughout the year, such as live oaks and magnolias can intercept as many as 4000 gallons annually, depending upon the density of the tree and the occurrence and nature of rainfall events.
 - **Evapotranspiration:** Tree root systems draw moisture from the ground surface and underlying soil and then transpire water vapor through the tree's leaf canopy back into the atmosphere. Herbaceous vegetation or smaller plants other than trees are also responsible for

evapotranspiration, but usually at a lesser scale. As a result this process helps reduce runoff volumes, particularly in moderate storm events.

- **Infiltration:** Roots also play a role in increasing a soil's infiltration capacity. Infiltration is an important process in groundwater storage and recharge. Poor infiltration capacity generally results in greater runoff volumes, requiring other stormwater retention controls.
- **Minimize soil erosion:** Healthy tree canopies and root systems also help to stabilize soils, thereby reducing erosion rates.



Figures H-6 and H-7 *Maintaining tree canopies along roadways and stormwater ponds can help reduce stormwater volumes and runoff rates. (Photos courtesy of Dr. Dan Hitchcock, Clemson University, and Daniel Newquist, Waccamaw Regional COG)*

Recommendation D2: Develop a community urban forestry program. Work with arborist Rick Bauman and the local non-profit Trees for Tomorrow- A Lowcountry Legacy, founded in 2012, which has distributed hundreds of trees free of charge to residents of the Murrells Inlet area. The organization has successfully partnered with Palmetto Pride and the SC Forestry Commission to secure tree donation. More information about their projects can be found at www.lowcountrytrees.org.

Potential Barriers: Some ongoing coordination may be necessary to prioritize subwatershed areas within Murrells Inlet to plant trees. Also consideration should be given to maintaining a mapping inventory of trees that are planted through the Trees for Tomorrow program.

Implementation Timeframe: *Near-term and ongoing.*

Recommendation D3: Participate in recognizable events such as Arbor Day. These events are great opportunities to bring partners together and to engage interested citizens. These events are also opportunities to educate the public on all of the benefits of tree planting including the positive impacts on water quality.

Potential Barriers: Initial effort to organize the event

Implementation Timeframe: *Near-term and periodic, (at least one event annually)*

E. Shoreline Buffers: As expressed in the Murrells Inlet Economic Activity and Marsh Valuation Study produced by Coastal Carolina University, property values immediately adjacent to the marsh are significantly higher than similar properties away from the marsh. Therefore, development pressures will always need to be a long-term management consideration in Murrells Inlet. Encouraging the establishment and maintenance of shoreline buffers is an effective BMP that removes bacteria and sediments prior to final discharge into the estuary. Buffers also help to detain and slow down runoff from developed upstream areas.

This practice can be especially beneficial to Murrells Inlet as there is a significant area of shoreline considering the size of the Murrells Inlet watershed. The subwatershed delineations indicate that out of the 51 subbasins that drain into the inlet, 25 of them are along the immediate shoreline and drain directly into the estuary via overland sheet flow. These 25 subbasins comprise a drainage area of 842.09 acres. **Exhibit H-1** highlights the subwatersheds along the immediate Murrells Inlet shoreline.

Recommendation E1: Develop an incentive program to encourage waterfront property owners to establish and maintain a shoreline buffer. Incentives could include a stormwater utility fee reduction or a property tax credit. Workshops could be held to train homeowners on suitable native plants to establish in the buffer zone and long-term maintenance recommendations that may be needed. Local nurseries could be invited to these events to sell preferred native plants and answer questions on

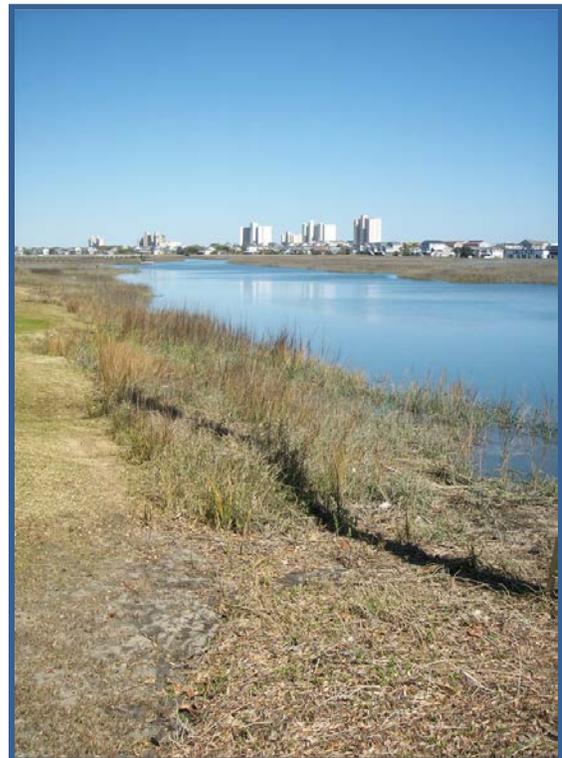


Figure H-8 *This watershed plan encourages waterfront property owners to establish a wider vegetated buffer along the immediate shoreline. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)*

various landscaping techniques.

Potential Barriers: Due to property constraints and varying levels of property owner willingness it is essentially impossible to establish a shoreline buffer along all waterfront properties. Therefore incremental and targeted goals should be established, perhaps by subwatershed. This could be incorporated into a targeted neighborhood/ subwatershed outreach approach recommended below.

Implementation Timeframe: *Mid-term to long-term and ongoing. Periodic assessment is recommended.*

F. Targeted Neighborhood/Subwatershed Outreach Programs: As discussed throughout the plan, despite the relatively small size of Murrells Inlet, the landscape diversity from the northern to the southern end varies considerably. Utilizing the information of the subwatershed delineations, targeted outreach messages should be crafted to each neighborhood based on landscape and drainage characteristics, suspected sources of bacteria, water quality trends, and BMP possibilities that are feasible in that particular subbasin.

Recommendation F1: Develop a distinct public awareness campaign highlighting individual action items residents can take to improve water quality in Murrells Inlet. The following content and design considerations should be considered:

- The overarching goals of the Murrells Inlet Watershed Plan to improve water quality in designated Shellfish Harvesting Areas should be consistently communicated in all neighborhood scale outreach efforts.
- Share positive examples of effective residential scale management strategies instead of merely pointing out negative existing conditions in any particular subwatershed.
- Be specific but concise in the messages that are conveyed. An example of a targeted outreach effort could be to encourage property owners in a subwatershed with extensive shorelines to extend vegetated buffers adjacent to the inlet. Specific guidance on buffer width, landscaping maintenance considerations should be included.
- Gain input from residents on the most appropriate means to distribute outreach materials and solicit ideas on community-scale projects that might require additional support or coordination.

Potential Barriers: The initial steps of developing specific and appropriate outreach messages are important and can take time as there may be several distinct focus areas within Murrells Inlet. A reasonable objective is to establish a designated representative within each target neighborhood or homeowners association to help develop and distribute materials and increase resident participation in neighborhood level projects and initiatives.

Implementation Timeframe: *Near-term and ongoing*



Legend
 Direct Discharge Sub Watersheds
 Sub Watersheds
 Approx. Hydrology

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MAP TITLE:
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 SMALL DIRECT
 DISCHARGE SUB WATERSHEDS
 Exhibit H-1

PROJECT TITLE:
 MURRELLS INLET WATERSHED
 MANAGEMENT PLAN

DATE:
 01/07/2014
 TEG PN:
 121108.000.E
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 Murrells Inlet, SC 29576



SCALE:
 1:36,000
 0 1,500 3,000
 FEET

PROJECT LOCATION:
 MURRELLS INLET
 GEORGETOWN COUNTY
 SOUTH CAROLINA

Recommendation F2: Build upon existing regional and statewide outreach programs where guidance and support resources may already be available. Suggested resources to consider include Clemson’s Carolina Yard program and initiatives organized by the Coastal Waccamaw Stormwater Education Consortium. Below is a brief description of the Carolina Yard program:



The Carolina Yards program is designed to provide guidance to homeowners and commercial landscapers to incorporate sustainable lawn care maintenance practices on their properties. The program follows twelve core principles focusing on several elements including plant selection, appropriate water and fertilizer use, and methods to reduce onsite runoff. Program participants can receive Carolina Yard certification for following these watershed friendly landscape practices. The Carolina Yard program is an additional opportunity for residents to minimize their individual impact on water quality in Murrells Inlet. If the program becomes well established and participation grows, the neighborhood and watershed scale impact could be substantial.

Potential Barriers: The biggest hurdle could be public acceptance, especially with property owners who are used to maintaining their lawns a certain way. Education on native plant options and the importance of water conservation and stormwater runoff control are vital initial steps.

Implementation Timeframe: *Near-term and ongoing.* One timeframe consideration is to initiate public outreach efforts and host training workshops in the late winter or early spring when many homeowners are preparing their lawns and gardens for the spring season.

G.Water and Sewer Districts: The water and sewer districts maintain an extensive network of sanitary sewer infrastructure in the Murrells Inlet watershed. This infrastructure is critical in protecting the environmental and public health of the community. Closer partnerships with the MS4 jurisdictions would be beneficial for both entities and ultimately lead to more effective and coordinated water resources management.

Recommendation G1: In addition to reporting Sanitary Sewer Overflow (SSO) incidents to SC DHEC, Grand Strand WSA and Georgetown County WSD should report these occurrences to the respective MS4 jurisdiction, Horry or Georgetown County. This ensures that the county stormwater departments are aware of the incident and avoid expending unnecessary resources to detect and eliminate suspected illicit discharges. The Volunteer Monitoring Program can help assist the water and sewer districts by identifying the extent of any water quality impacts and the ability to track water quality conditions following a SSO incident.

Potential Barriers: There should not be any problems incorporating this as part of the respective agency’s SSO reporting procedures

Implementation Timeframe: *Near-term and ongoing*

Recommendation G2: Conduct a microbial source tracking study of the pump station inventory to ensure that they are not a contributing source of bacteria to the inlet. Prioritize camera sewer line inspections based on data provided during microbial source tracking initiatives. Other trends observed by the volunteer monitoring program could also be useful in prioritizing sewer line or pump station inspections.

Potential Barriers: This will entail initial coordination to reach a mutually agreeable commitment between all of the entities that need to be involved.

Implementation Timeframe: *Near-term and periodic.* This will depend on how often the county's conduct microbial source tracking monitoring studies.

H.Transportation and other Capital Improvement Projects: Given the orientation of Murrells Inlet, the main transportation network consisting of US Hwy 17 Bypass and US Hwy 17 Business, along with many of the secondary roads, serve as corridors that extend across multiple subbasins in the Murrells Inlet watershed. Therefore roadway upgrades present opportunities to incorporate best management practices that can have positive long-term hydrological and water quality impacts on the inlet. There have been many roadway repair projects which were improperly stabilized and led to significant erosion.

Recommendation H1: Work with SC DOT and all other roadway maintenance entities in the initial phases of roadway improvement projects to identify opportunities to incorporate stormwater BMPs into the project design.

Potential Barriers: Establishing commitments to invest in stormwater BMPs above and standard design criteria to address water quality concerns specific to the Murrells Inlet watershed.

Implementation Timeframe: *Long-term and periodic.*

I.Administrative BMPs: In order for many watershed management practices to be effective they need to be supported through governmental policies or through the context of existing regulatory programs. The following list of recommendations are administrative level action items that will help to manage the Murrells Inlet watershed iteratively and comprehensively.



Figure H-9 *Example of a poorly stabilized roadway construction project resulting in significant erosion directly into one of Murrells Inlet's tidal creeks. (Photo courtesy of Dr. Dan Hitchcock, Clemson University)*

Recommendation I1: Encourage SC DHEC to consider updating the 2005 Murrells Inlet Fecal Coliform TMDL. As discussed in **Element B**, new monitoring data and other information about the Murrells Inlet watershed has been analyzed that warrants an evaluation of revised load reductions for Murrells Inlet. The following is list of findings and recommendations to justify an updated TMDL:

- As **Element C** discusses, after a thorough analysis of all available monitoring data and other information, the steering committee concludes that wildlife is the predominate source of bacteria in Murrells Inlet. The Commonwealth of Virginia adopts the following policy pertaining to addressing wildlife sources:

In some waters for which TMDLs have been developed, water quality modeling indicates that even after removal of all the sources of bacteria (other than wildlife) the stream will not attain standards under all flow regimes at all times. However, neither the Commonwealth of Virginia, nor EPA are proposing the elimination of wildlife to allow for the attainment of water quality standards. This is obviously an impractical and wholly undesirable action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL.

The project steering committee supports this type of policy regarding wildlife contributions. The committee does acknowledge that efforts can be made to reduce the transport of wildlife bacteria loads through stormwater management best management practices. However, realistically wildlife contributions will likely remain a background bacteria source in the Murrells Inlet watershed indefinitely.

- Utilize newly available data from the Murrells Inlet Volunteering Monitoring Program and other county level monitoring initiatives to allocate percentage contributions from various sources including wildlife. Use microbial source tracking as necessary to validate assigned percentage source contributions.
- Utilize newly available hydrodynamic water quality models recommended by EPA to determine the transport and fate of bacteria in estuaries.
- Determine the survival and loads of bacteria in sediments and to what extent they become resuspended during storms and high winds.

Recommendation I2: Work with SC DHEC's Shellfish Program to evaluate the potential of instituting Conditionally Approved Shellfish Classifications in Murrells Inlet. SC DHEC has previously used this classification to manage shellfish harvesting in Murrells Inlet. Based on water quality data, areas that are normally below the fecal coliform standard expect during infrequent occurrences such as heavy rain events, may be suitable for this type of classification.

Recommendation I3: Work with both counties to ensure that recommendations included in this watershed plan are incorporated into each respective county's Comprehensive Plans and other relevant planning initiatives.

Recommendation I4: Consider the establishment of a Estuary Protection Overlay Zoning District that includes provisions and incentives that encourages land use and stormwater best management practices. Provisions focused on reducing impervious coverage, tree preservation, shoreline buffer establishment, and other types of BMPs should be evaluated.

Recommendation I5: Organize an environmental law and ordinance enforcement coalition. There are many state laws and local ordinances designed to protect water quality and natural resources. They include proper pet waste disposal, wildlife feeding, illicit boat discharges, illegal dumping, illegal shellfish harvesting, etc. There are many entities responsible for enforcing these environmental regulations. A coalition consisting of Horry and Georgetown County Police, SC DNR, SC DHEC, Huntington Beach State Park, US Coast Guard, and local watershed managers could meet semiannually to discuss priority areas of enforcement and ensure that resources and responsibilities are allocated appropriately to achieve community-wide enforcement objectives.

Potential Barriers: Each of these administrative BMP recommendations will entail significant coordination with SC DHEC and county governments.

Implementation Timeframe: *Near-term and ongoing. Periodic review of existing policies is an important aspect of adaptive watershed management.*

Shellfish and Marsh Habitat Best Management Practices

Most of the best management practices recommended in this plan address land-based bacteria sources and their stormwater transport pathways. This section outlines best management activities to pursue in the estuary to address several issues including marsh and shellfish habitat protection and restoration, tidal flushing, and boating activities.

J.Marsh and Shellfish Habitat: The salt marsh and shellfish resources are among the main focal points of Murrells Inlet's cultural heritage and local economy. These natural resources provide critical habitat for other aquatic and shorebird species, attracting sports fisherman and wildlife enthusiasts from around the country and abroad. Coastal Carolina University Economic Activity and Marsh Valuation study indicates that across all sectors, the economic value of the marsh exceeds \$720 million. One of the main goals of this watershed plan is to invest in management projects and activities that will help sustain the long-term economic value of the marsh to the Murrells Inlet community. Below are a few specific habitat management activities to help protect these resources.

Recommendation J1: Continue to encourage residents and local restaurants to recycle oyster shells. Currently, SC DNR reports that they purchase imported shell substrate to meet the demand gap for shellfish ground restoration. A worthy goal would be to recycle as many bushels of oyster shell as are harvested in a given year. Also work with SC DNR and other oyster shell recycling programs to ensure that all

recycled shell remains utilized in the Murrells Inlet estuary for shellfish habitat restoration purposes. One way to encourage participation is to include recycling on the list of credited activities in the proposed Inlet-friendly business program. Ongoing education on the need for recycling and the process of habitat restoration is also important for long-term success.



Figure H-10 Oyster shell recycling efforts have been very successful in Murrells Inlet. Clambank Landing drop-off site. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)

Currently, there are two oyster shell recycling drop off locations in the Murrells Inlet area.

- Garden City Fire Department Station near US Hwy 17 Business and Eden Ave.
- Clambank Landing on US Hwy 17 just north of the main entrance to Huntington Beach State Park.

Potential Barriers: Sustaining the partnerships needed to promote recycling, properly quarantine shells, and then replant them at needed locations is critical and requires ongoing coordination.

Implementation Timeframe: *Continue to build off of existing programs. Periodically evaluate effectiveness of local efforts.*

Recommendation J2: Work with SC DHEC, SC DNR, and other relevant management agencies to establish a permanent shellfish habitat restoration site in the North end of the Murrells Inlet. As is well documented in Element D, the water quality particularly at SC DHEC monitoring site 04-01 has exceeded the fecal coliform water quality standard for several years. Local watershed stakeholders view this area best being served as a long-term oyster reef and marsh habitat restoration site, off-limits to shellfish harvesting. The purpose would be to restore the ecological services and benefits of a healthy estuary system. It is hoped that a sustained restoration effort would help improve water quality, stabilize the shoreline, and provide habitat for other aquatic and waterfowl species. I

Potential Barriers: A management plan may need to be developed to determine the extent of the restoration site boundaries, the roles and responsibilities of all relevant partners, long-term management activities and associated costs, etc.

Implementation Timeframe: *long-term and ongoing.*

Recommendation J3: Explore the possibility of developing a local Oyster harvester apprenticeship program. Oyster harvesting has long been a way of life in Murrells Inlet

and is a unique aspect of the local culture. The long-term sustainability of this trade is dependent upon having an economically viable industry.

Potential Barriers: The biggest obstacle to facilitating an apprenticeship program of this nature is securing the commitment from a suitable sponsoring entity. Some research should be conducted to identify similar programs in other parts of the country to get a better understanding of the resources needed to organize and potentially accredit this type of program.

Implementation Timeframe: *Mid-term to long-term*

K.Inlet Hydrology: Natural processes and human activities have progressively altered Murrells Inlet waterways and upstream hydrology. The lasting effects have been pronounced siltation in several areas of the inlet limiting boat navigability and diminishing natural tidal flushing. From a shellfish habitat standpoint the concern is two-fold. First, the sediments settling into the estuary provide suitable conditions for bacteria survival and reproduction. Second, the reduced tidal flushing alters the estuary salinity composition. Salinity is critical in moderating bacteria loads present in freshwater draining into the inlet.

Recommendation K1: Work with both counties and other state and federal agencies to secure a dredging spoils site designated for the Murrells Inlet area. Two of the proposed goals stated in Georgetown County's Comprehensive Plan related to dredging in Murrells Inlet are:

- *A plan for maintenance dredging of the creek should be developed to include known "hot spots" or areas that are prone to silting in the creek*
- *Encourage appropriate agencies to secure necessary dredge spoil sites, including offshore sites, that are needed for maintenance of marinas and channels.*

Potential Barriers: The biggest obstacle is identifying and securing an appropriate spoils site that will accommodate dredging activity for the next 50-100 years.

Implementation Timeframe: *Mid-term and ongoing*

Recommendation K2: Evaluate and prioritize the need for spot dredging in Murrells Inlet to improve navigability and restore the natural tidal hydrology. One of the stated goals of Murrells Inlet 2007 (now known as Murrells Inlet 2020) is to dredge Murrells Inlet.

Potential Barriers: Dredging projects entail a long-permitting process. These projects must be carefully studied to understand the potential environmental impacts and all of the associated cost-benefits of the project. These projects should be coordinated with the local marinas based on their scheduled dredging needs.

Implementation Timeframe: *Long-term*

Best Management Practices for Specific Subwatersheds

Given the landscape contrasts across the Murrells Inlet watershed, many management strategies are best suited for specific locations depending on land cover, drainage patterns, water quality trends, and land accessibility. The subbasin delineations

provided in **Element D** enabled the steering committee to assess the feasibility of various BMP options on a neighborhood scale. This local scale level of analysis is an effective means of prioritizing BMP siting, design criteria, and ultimate selection.

Most of the BMPs outlined below address stormwater related sources. The primary objective with this approach is to reduce stormwater runoff volume and flow rates. Another focus area is to decrease erosion rates, thereby reducing the impacts of downstream siltation. Below is a profile of the common types of BMPs that are recommended for implementation.

Engineered Filter Strips: These devices are most commonly utilized for construction site sediment control but can be designed with a flocculent additive which binds to bacteria. The devices can be adapted to various lengths and sizes, therefore they serve as a potential BMP along roadside and other drainage ditches where bacteria loads are suspected to be high. Two demonstration sites for installation have been designated for the BHR and the Bike Bridge subwatersheds. The effectiveness of the filter strips will be evaluated and future sites will be identified based on the results.



Figure H-11 *Bacteria removal media can be inserted into these engineered filter strips, which can then be installed along roadside ditch and other retrofit projects. (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)*

Catch Basin Filter Inserts: One of the main components of a typical stormwater infrastructure system is a storm drain inlet. The catch basin portion of the storm drain is designed to allow stormwater to flow through the structure while allowing debris and sediment to settle into the catch basin reservoir. Catch basins do require

some routine maintenance to remove the debris and sediments in order to retain adequate storage capacity. Catch basins can be retrofitted with media filter inserts to enhance bacteria and other pollutant removal efficiency. According the EPA, catch basin insert costs range considerably, starting around \$400 for a typical drop-in retrofit device to as much as \$10,000 for a more permanent retrofit entailing more elaborate engineering and design.

Estimated Water Quality Benefits: Studies have indicated Total Suspended Solids removal rates of 60-97 % (US EPA National Menu of BMPs). Similar to engineered filter strips, the long-term effectiveness of bacteria removal will be assessed for future application in Murrells Inlet.

Wet Stormwater Pond: These structures detain stormwater runoff for extended periods of time creating a permanent wet pond. During the detention time, pollutants suspended in the stormwater runoff are allowed to settle out. Sunlight exposure also allows UV light to kill bacteria in the stormwater. One of the major maintenance needs of these structures is the removal of accumulated sediments at least every 10 years in order to retain the designed pond volume. To minimize the frequency of pond dredging a sediment forebay can be installed, which is designed to trap larger particles before the stormwater enters the main pond. Wet stormwater ponds are widely used BMPs for the reduction of many pollutants, including bacteria and already exist in several locations throughout the Murrells Inlet watershed.

The EPA estimates that the construction costs for a typical one-acre foot stormwater pond facility is approximately \$45,700. The annual routine maintenance costs are estimated to be about 3-5% of the construction costs of the pond.



Figure H-12 *An existing stormwater pond in the Point Dr. subwatershed (Photo courtesy of Daniel Newquist, Waccamaw Regional COG)*

Estimated Water Quality Benefits: Typical bacteria removal rates expected from wet stormwater ponds are ~65% (US EPA National Menu of BMPs)

Vegetated Pond: Stormwater ponds that remain vegetated along the shoreline have shown additional water quality benefits. A vegetated buffer can help reduce erosion along the bank of the pond and provide some pollutant removal before runoff enters the pond via overland flow. Heavily vegetated buffers also discourage the congregation of many types of waterfowl such as Canada Geese near ponds, thereby reducing their direct bacteria loads.



Figure H-13 *An example of a vegetated stormwater pond in Murrells Inlet, which has been effective as reducing bacteria loads. (Photo courtesy of Murrells Inlet 2020)*

Estimated Water Quality Benefits: Based on post BMP implementation monitoring as part of the Murrells Inlet SAMP project, vegetated ponds are even more effective than traditional stormwater ponds at removing bacteria, ~70- 80 % removal rates.

Stormwater Wetlands: This type of stormwater management device removes pollutants by multiple means, primarily by physical filtration and settling of solids, and by the biological uptake of wetland plants. The greatest difference in the design of a stormwater wetland and a wet pond is the deliberate establishment of vegetation growth. This is accomplished by creating varying depth zones which can support emergent wetland species. Stormwater wetlands are commonly used BMPs and have been installed in coastal South Carolina. A suggested constructed wetland plant list for this region is provided in **Table H-2** below. The selection of plants is critical to avoid the establishment of invasive species, such as cattails and phragmites, which would require significant maintenance resources to monitor and fully remove. Other routine maintenance needs include annual inspection of the inlet and outlet

structures, along with long-term inspection of sediment accumulations, particularly in the forebay structure.

Estimated Water Quality Benefits: Typical bacteria removal rates from constructed stormwater wetlands is ~76-78% (US EPA National Menu of BMPs)

Table H-2: Suggested Plant Selection For Constructed Wetland Installation	
Low Maintenance Species	
Reeds (<i>Juncus effuses</i>)	Iris (<i>Iris spp</i>)
Umbrella Palms (<i>Cyperus alternifolius</i>)	Bulrush (<i>Scripus californicus</i>)
High Maintenance Species	
Canna lily- Red or Yellow (<i>Canna spp</i>)	Daylily (<i>Hemerocallis fulva</i>)
Elephant ear (<i>Colacasia esculenta</i>)	Iris- Blue Flag (<i>Iris versicolor</i>)
Iris- Louisiana (<i>Iris hexagonae</i>)	Iris- Yellow Flag (<i>Iris pseudacorus</i>)
Woolgrass (<i>Scirpus cyperinus</i>)	Thalia- Powdery (<i>Thalia dealbata</i>)
Source: USDA Natural Resources Conservation Service	

The EPA estimates that the construction costs for a typical one-acre foot constructed stormwater wetland is approximately \$57,100. The annual routine maintenance costs are estimated to be about 3-5% of the construction costs of the wetland.

Floating Wetlands: Another structurally engineered stormwater BMP is the installation of floating wetlands. Similar to filter strips, floating wetlands have flexible design options. Floating wetlands can be a potential retrofit opportunity for conventional wet stormwater ponds as well as tidally influenced streams as well.



Figure H-13 Example of a floating wetland

Estimated Water Quality Benefits: Floating wetlands are known to efficiently remove Nitrogen and Total Suspended Solids by up to 90%. It is suspected that the same biological processes can efficiently remove bacteria as well.

Bioretention Systems: These stormwater management practices utilize low lying areas with suitable soils to retain and filter stormwater runoff. They can be designed and installed at various scales and are commonly utilized to treat runoff from parking lots or they can be incorporated into the landscaping of residential properties or along

roadway corridors. The most significant benefit of bioretention systems is their ability to reduce stormwater volume and flow rates. The flexibility of their design and their aesthetic appeal make this BMP a suitable option for interested homeowners as well as on a neighborhood scale. Bioretention systems do require initial watering to establish plants, and periodic maintenance such as mulching and the removal of litter and dead vegetation. Selecting native plants species that can tolerate both wet and dry conditions is important for long-term effectiveness. Bioretention systems are infiltration-based practices that should only be installed if the site conditions are appropriate, including sufficient depth to groundwater, suitably drained soils, and sufficient elevation if an underdrain system must be installed.

Estimated Water Quality Benefits: Typical bacteria removal rates expected from bioretention areas are ~10-60% (SC DHEC Stormwater Management BMP Handbook)

Pervious Pavement: On a watershed scale; roadways, sidewalks, driveways, and parking lots comprise a significant proportion of the impervious surface footprint that exists in developed areas. These landscape features alter the natural hydrology of watersheds and increases volume and rates of stormwater runoff. In addition these surfaces accumulate a number of pollutants including bacteria, hydrocarbons, and debris, which get transported to nearby waterbodies following the first flush of a rain event. Pervious concrete and asphalt have become viable solutions for communities trying to reduce stormwater runoff volumes and rates. Pervious pavement products are designed to allow precipitation to seep through the pavement surface and infiltrate into the subsurface soils beneath. Pervious pavement is another infiltration-based practice that may only be appropriate in sites with suitable depth to groundwater and reasonably well-drained soil conditions.

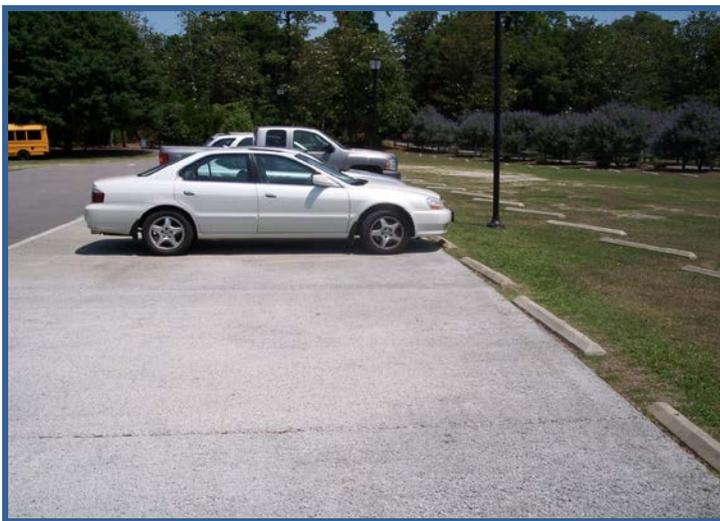


Figure H-14 and H-15 Pervious Pavements can be installed at various scales. To the left is an example of a parking lot. To the right is the sidewalk approached the pedestrian bridge on Atlantic Ave. towards Garden City. (Photos courtesy of Daniel Newquist, Waccamaw Regional COG)

From a practicality standpoint, pervious pavement is difficult to install as a retrofit project. However all parking surfaces have a limited useful lifespan so installations can be planned in advance to gradually replace existing asphalt parking surfaces. There are also limitations of using pervious asphalt for high volume roadway loads due to the reduced material strength as compared to conventional asphalt. In addition, the porosity of impervious pavement decreases as fine particles such as sediment build up and clog the surface, essentially reducing the infiltration capabilities of the product. Therefore one of the biggest maintenance considerations needed is to ensure that impervious pavement areas are regularly vacuumed or cleaned via a street sweeper.

Estimated Water Quality Benefits: The main benefits of pervious pavement is stormwater volume reductions and Total Suspended Solids removal, ~70-99% (US EPA National Menu of BMPs)

Drainage Ditch Maintenance/Retrofit: Drainage ditches are one of the principal means of transporting stormwater runoff from roadways and parking lots to their ultimate discharge point into Murrells Inlet. Drainage ditches can be designed to slow runoff rates and provide some pollutant removal benefits. One maintenance measure is to maintain vegetation within and along the edge of the ditch. Ditches can be modified by incorporating a two-stage design.

Estimated Water Quality Benefits: The benefits of a two-stage retrofit include decreased bank erosion and reduced suspended solids loads.

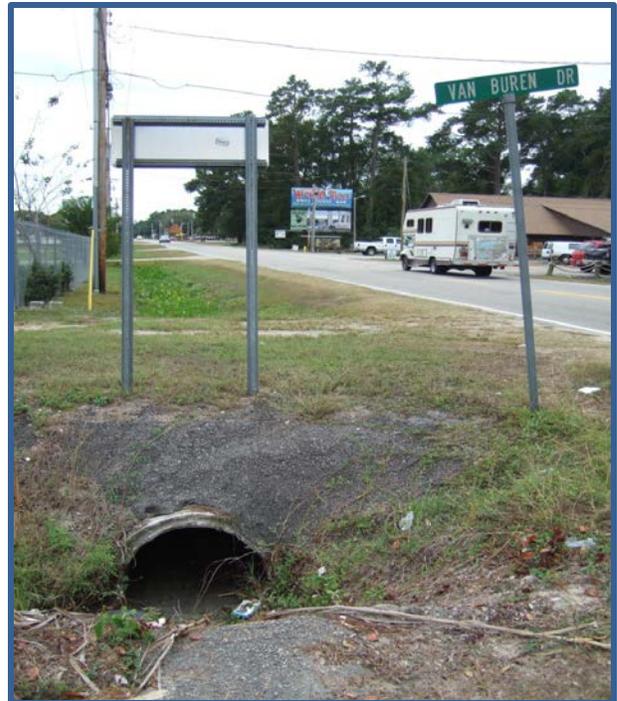


Figure H-16 and H-17: Examples of road side ditches in Murrells Inlet. The one on the left has good vegetation established which provides pollutant removal benefits. The ditch on the right provides no runoff retention and no pollutant removal benefits. (Photos courtesy of Dr. Dan Hitchcock, Clemson University)

Specific Subwatershed BMPs

The following section provides a list of specific best management practices recommended for implementation in the subwatersheds identified as being priorities for improvement as outlined in **Element F**. Detailed maps for all of the subwatershed comprising Murrells Inlet are located in **Appendix A**.

Melody	Nearby Monitoring Sites
	Tier One Site: 04-01 Volunteer Monitoring Site: Woodland Drive Pond
	BMP Recommendations
	<ul style="list-style-type: none"> ➤ <i>Install floating wetlands in ponds within Tupelo Bay, Melody Gardens, Bermuda Bay, and Oceanside Village neighborhoods.</i> ➤ <i>Retrofit catch basins within Tupelo Bay, Bermuda Bay, and Melody Gardens neighborhoods with filter media inserts.</i> ➤ <i>Install a floating wetland at the Woodland Drive Pond</i> ➤ <i>Install bacteria media filter strip devices along roadside ditches along Woodland, Calhoun, Vista, and Seabreeze</i>
Pine	Nearby Monitoring Sites
	Tier One Site: 04-01
	BMP Recommendations
	<ul style="list-style-type: none"> ➤ <i>Install bacteria media filter strip devices along roadside ditches along Cypress, Pine, Oak, and Atlantic.</i> ➤ <i>Install a floating wetland at the Pirate Cove Pond. Note that plant selection for this wetland will need to be suitable for brackish water.</i> ➤ <i>Install catch basin inserts or redesign parking lot at the Murphy's Law shopping center.</i>
Salters	Nearby Monitoring Sites
	Tier One Site: 04-01
	BMP Recommendations
	<ul style="list-style-type: none"> ➤ <i>Install a floating wetland at the Salters Cove Pond. Note that plant selection for this wetland will need to be suitable for brackish water.</i> ➤ <i>Install bacteria media filter strip devices along the roadside ditches in Salters Cove.</i>

Point Dr.	Nearby Monitoring Sites
	Tier One Site: 04-01
	BMP Recommendations
	<ul style="list-style-type: none"> ➤ <i>Install bacteria media filter strip devices along roadside ditches along Walmart, Jamestown, Jensens.</i> ➤ <i>Install floating wetland in Point Drive Canal</i> ➤ <i>Install catch basin inserts in Krogers shopping center. Consider parking lot retrofit to incorporate bioretention or underground storage facilities.</i> ➤ <i>Install catch basin inserts in the Wal-Mart parking lot.</i>
Rum Gully	Nearby Monitoring Sites
	Tier Two Sites: 04-02 and 04-27 Volunteer Monitoring Site: Rum Gully Creek
	BMP Recommendations
	<ul style="list-style-type: none"> ➤ <i>Install floating wetland in Rum Gully ponds.</i>
Sunnyside	Nearby Monitoring Sites
	Tier Two Sites: 04-02 and 04-27 Volunteer Monitoring Site: Rum Gully Creek
	BMP Recommendations
	<ul style="list-style-type: none"> ➤ <i>Establish grass buffers along marshfront properties</i> ➤ <i>Install catch basin inserts along Sea Marsh Road</i> ➤ <i>Introduce a series of small weir steps within existing ditches along Van Buren Rd and across from Vintners Road to promote retention and natural process treatment within existing drainage pathways. Bacteria media filter strips could also be installed to enhance treatment</i>
Garden City Pier N	Nearby Monitoring Sites
	Tier One Site: 04-01
	BMP Recommendations
	<ul style="list-style-type: none"> ➤ <i>Install catch basin inserts along Dogwood/ Atlantic</i>

Dogwood N	Nearby Monitoring Sites
	Tier Two Site: 04-26
	BMP Recommendations
	➤ <i>Install bacteria filter devices along roadside ditches on Dogwood. Install inlet protection catch basin insert along roadway as well.</i>
Mariner Wesley	Nearby Monitoring Sites
	Tier One Sites: 04-08, 04-16
	Tier Two Site: 04-06
	Tier Three Site: 04-31
	Volunteer Monitoring Site: BHR
BMP Recommendations	
➤ <i>Obtain conservation easement from private landowner. Expose existing stream and adjacent ditches to sunlight. Add “natural steps” to promote retention as the land allows.</i>	
Vaux Hall	Nearby Monitoring Sites
	Tier Three Site: 04-17A
	Volunteer Monitoring Site: HS
	BMP Recommendations
➤ <i>Obtain conservation easement from private landowner. Expose existing stream and adjacent ditches to sunlight. Add holding pond if the owner allows.</i>	
Bike Bridge	Nearby Monitoring Sites
	Tier Three Site: 04-07
	Volunteer Monitoring Site: Bike Bridge
	BMP Recommendations
➤ <i>Design and install a constructed wetland on Murrells Inlet 2020 property.</i>	

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