The Tybee Island

Stormwater and Water Quality Charrette

College of Environment & Design, Center for Community Design, Planning and Preservation and Department of Community Affairs

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CHARRETTE REPORT

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The Tybee Stormwater and Water Quality Charrette

Tybee Island

TABLE OF CONTENTS

INTRODUCTION—STORMWATER: A COASTAL MODEL

> "IT IS A TIME FOR RESPECTING NATURAL PROCESSES, THE SOCIAL STRUCTURE OF THE ISLAND, AND A PROTECTED AND ENHANCED QUALITY OF LIFE."

Tybee Island is arriving at a major point of transition – again. This is not an unfamiliar juncture for the Island. However, this time the future of Tybee is not about playing to outside audiences or trying to become something different than it has been. It is a time for respecting natural processes, the social structure of the island, and a protected and enhanced quality of life.

To this end, this charrette and the process of funding and implementing the recommendations will move Tybee closer to a long-term strategy of conservation based design improvements.

The charrette is a tool that will provide decision makers and citizens alike with a menu of concepts for sensitive change. For three days students, practitioners and faculty from the University of Georgia and the Georgia Department of Community Affairs converged on Tybee "en charrette". A previous planning and design study of the Business District and the process that identified historic resources in the city dovetails nicely with this charrette's findings. A strong history of protecting residential neighborhoods with land-use ordinances and being firm in restricting height variances for hotels along the beach has helped Tybee retain the visual integrity that is often lost in other oceanfront communities.

This water quality and conservation charrette brings the traditions that are here intentionally, naturally and accidentally toward conformance to the best management practices that we have seen in other places.

The Tybee Island Stormwater and Water Quality Charrette serves as a model for other coastal communities as they too seek to address water-related issues through innovative design and management practices. Utilizing the charrette process successfully in stormwater management opens the door for repeating this process to address other water quality and quantity issues.


MARIE

WHAT IS A CHARRETTE?

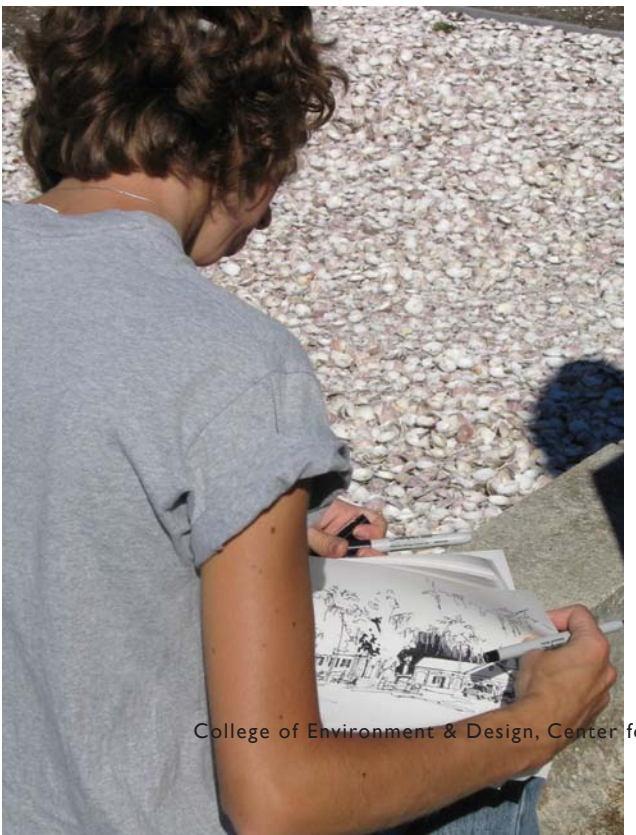
The French word Charrette means "cart" and is often used to describe the final, intense work effort expended by art and architecture students to meet a project deadline. This use of the term is said to originate from the École des Beaux Arts in Paris during the 19th Century, where proctors circulated a cart, or charrette, to collect final drawings while students frantically put finishing touches on their work.

Today the term has come to describe an intense creative period that is combined with public workshops and articulated community goals. The charrette is a collaborative planning process that harnesses the talents and energies of all interested parties to create and support a plan. It is an insiders view expressed visually by outside experts.

> "OUR CHARRETTES ARE HIGH ENERGY. NEW VISION. COMMUNITY IMPROVEMENT EVENTS!"

It has been called a creative "tornado in reverse." The process begins with a multitude of information scattered about and, with a flurry of activity, concludes in a coherent vision for a real place.

What really comes out of a charrette are the ideas and dreams of residents, filtered through urban planning professionals who understand how to turn a design idea into a real community improvement.



In short, Charrettes WORK!

They result in concepts that leverage implementation funds. Nearly all of the communities where charrettes were done have gone on to receive grants or local funds to implement our recommendations.

The University of Georgia's Center for Community Design, Planning & Preservation at the College of Environment & Design has been using the charrette process to help communities for many decades. The process has many proponents and has gained special favor in a new era of contemporary town planning, new urbanism, neo- traditionalism and just plain, hometown, good old fashioned concern for where you live.

THE TYBEE PRINCIPLES

1. Acknowledge the Water Cycle

Water is essential to life. It is all around us and it takes many forms—yet to the efficient modern mindset, this precious, symbolic, and sacred element is merely a simple consumptive resource. Through education about the water cycle, the mentality of stormwater as a nuisance or waste product could be changed to reflect a more positive approach. In essence, stormwater is simply water deemed a negative due to undesirable conditions.

Until the 18th century mountains were considered dangerous obstacles to commerce and civilization. As travel became more common and less treacherous the mountains became a source of sublime inspiration and awe. Could not our current-day perception and aesthetics of stormwater be turned into a positive?

2. Live within the Ecosystem/ Understand your Impact

Water is a critical part of the ecosystems of Tybee Island. Tourism and livelihood depend on a healthy water cycle.

It is important to consider the "ripple effect" of development on freshwater and seawater. In other words, understand your impact upon these natural water systems. Flooding is not an environmental problem but rather a human problem. Rain only becomes "stormwater" after the land is developed.

3. Develop an Economically Viable Stormwater Program Considerate of Local Interests

Disagreements and debate will arise, nonetheless, we propose that citizens make dedicated investments into Tybee Island stormwater infrastructure and adopt ideas that improve water quality.

The City of Griffin, for example, adopted the first stormwater utility in Georgia. While faced with some opposition initially, the utility has proven to be effective in funding its program of improving water quality. It is now a model being replicated throughout the state.

4. Manage Tybee's Water Resource Holistically

Consume water wisely by promoting conservation efforts.

- Install lowflow plumbing fixtures and minimize exterior water usage
- Promote usage of water saving devices (low-flow toilets, frontload washers, drip irrigation)
- Low water usage landscaping (principals of xeriscape)

Try harvesting rainwater.

- For non-potable needs, install rainwater catchments systems

Treat Stormwater as a Valuable Resource.

- Design for water quality to reduce non-point source pollution

5. Create a Comfortable Integration of Environmental Values

This principle might sound noncommittal or ambiguous, but the general idea is to promote environmental stewardship through positive experiences rather than negative enforcement. For this to work, public education and enjoyable participation are key components. A good example of this could be a public fundraiser for a raingarden area. Monies could be generated by placard is on benches or signage acknowledging participation, or t-shirt sales with witty logos such as "Tybee Go Porous"

6. Keep Water Alive!

It's important for the effort to remain in the public mind after this initial burst of energy. Ongoing discussions on conservation, water harvesting, and restorative stormwater strategies in council meetings and public venues would further adjustment and improvement of the program, ensuring continued success. Hand in hand with this thought, Tybee Island would benefit from regular monitoring of implemented stormwater management strategies.

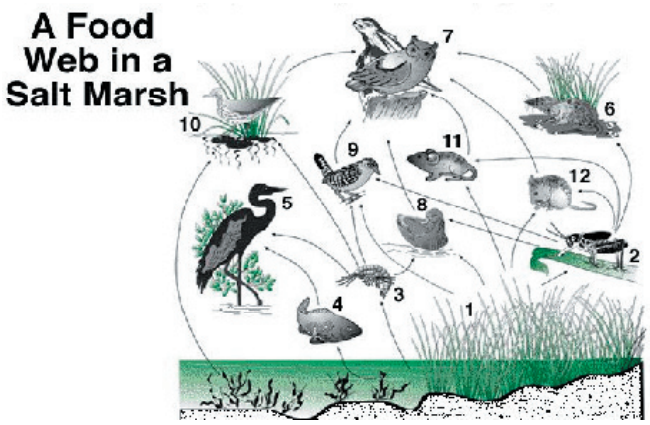
Erosion, deposition, and drift of barrier islands

Barrier islands, such as Tybee, serve three main functions besides being tourist destinations and wonderful places to live: first, they protect the mainland from storm damage; second, they provide various types of habitat that are considered refuges for wildlife; and third, the marsh ecosystem helps to purify runoff from the rivers and streams leaving the mainland. The shape of barrier islands depends heavily upon the interplay of topography, wind, tide, waves, current, sediment supply, and often the works of mankind. Barrier islands are transient things; built of sand. They move where the wind and currents send them and are therefore in constant motion.

Man-made developments on barrier islands create a negative intensification of these natural processes and can damage habitat if not done in a way that is sensitive to the delicate structure of the island. Because of this, addressing stormwater runoff created by rooftops, pavement, and other impervious surfaces, is especially significant on barrier islands. Reducing the erosive forces of stormwater through naturally designed systems can help minimize its impact.

THE COASTAL ECOSYSTEM – WHY IT'S IMPORTANT

The Coastal Ecosystem and the Salt Marsh



What is it about coastal ecosystems that are so important? They are a big sponge, a filter, for many pollutants and all the "crap" that we send downstream. Coastal wetlands, or salt marshes, play an important part in global ecosystem functions. It is a place where fish spawn. It provides nursery habitat for species such as blue crab, and marshes provide all the processes: physical, biological, and chemical, that take up and process pollutants. Salt marshes are extremely important, and you are right in the middle of it.

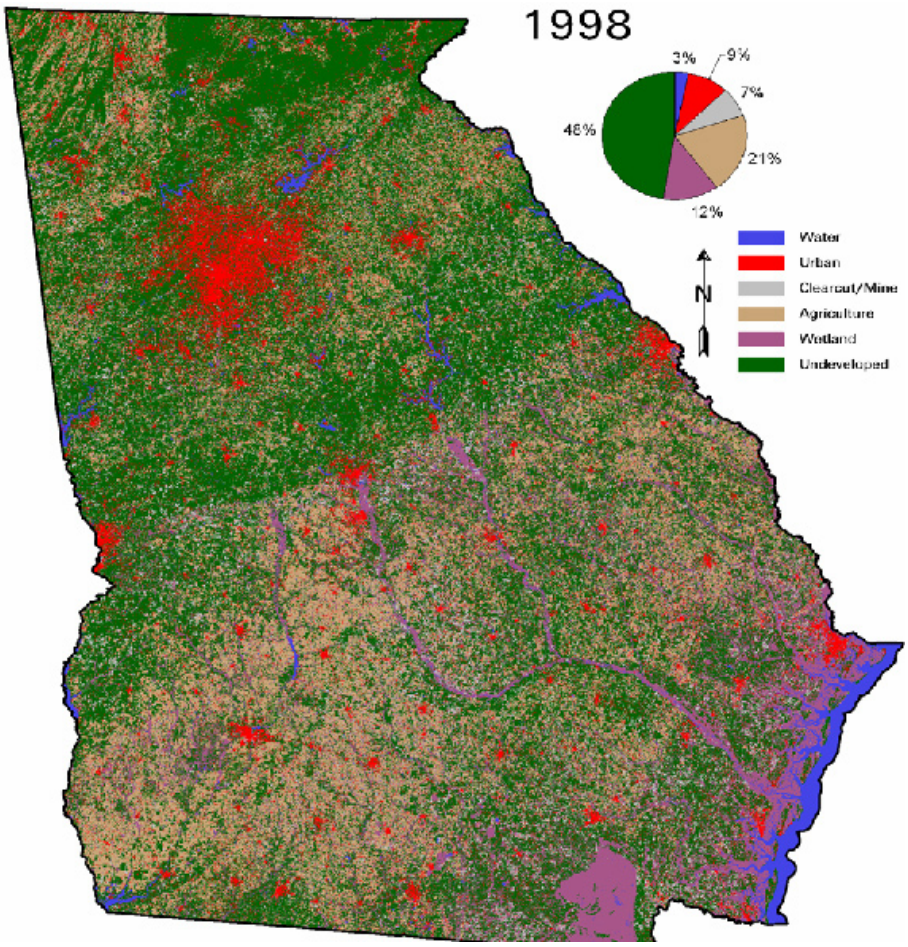
The Island

Why are we talking about stormwater on Tybee Island? This is a beautiful place and a unique environment. But, development in this part of the state is occurring at an alarming rate. And why do we care about development? It is the prime creator of stormwater runoff. Normally, the natural landscape absorbs stormwater into the ground. However, when large areas of pavement and other impervious surfaces are created, runoff increases as less uncovered land is available to absorb the water. Pollutants from these impervious surfaces are carried off by the stormwater into streams, rivers and the ocean. This nonpoint source pollution is the primary culprit of water quality problems today, and we need to determine the best ways to deal with it.

Tybee has two especially interesting issue: there is essentially no change in topography, and the island is often subjected to heavy downpours of rain, common in coastal areas. Therefore, if stormwater doesn't have the pervious surface necessary for absorption, flooding readily occurs. To deal with these issues created by excess stormwater, innovative planning, design and management must be considered and integrated into the daily operations of the island.

WHAT IS THE PROBLEM?

POPULATION GROWTH

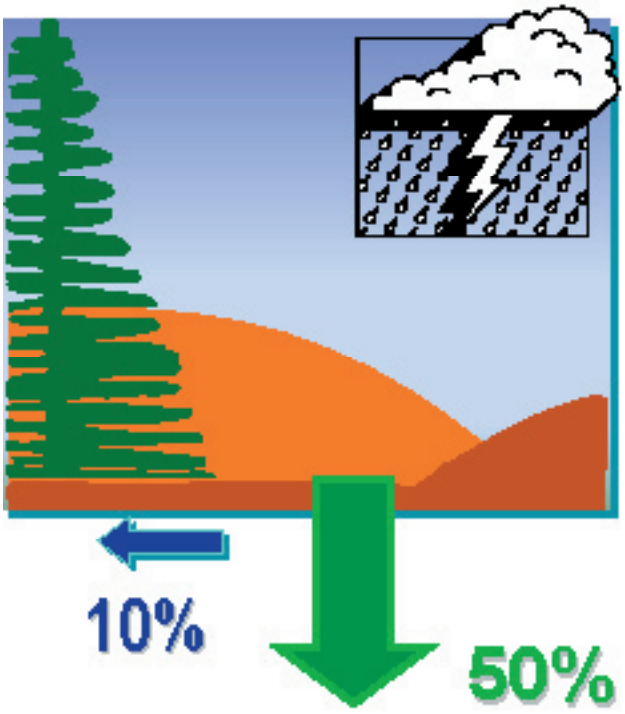


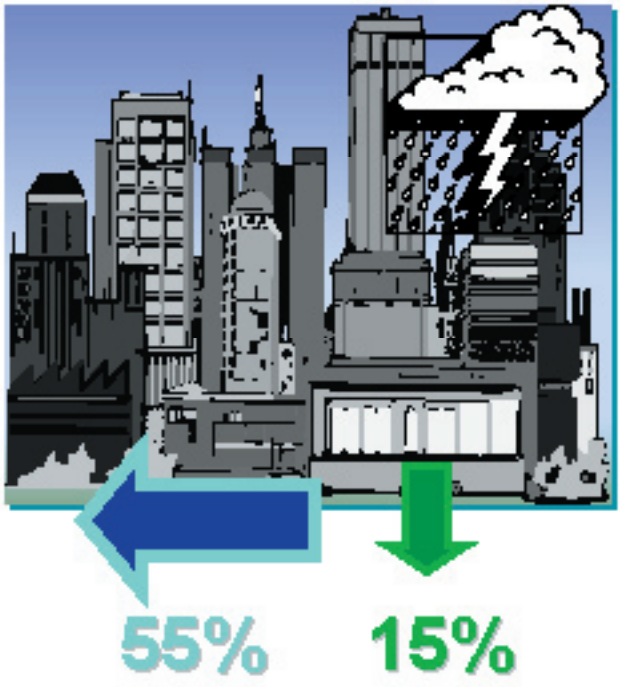
"POPULATION GROWTH, DEVELOPMENTAL PRESSURES, RUNOFF AND POLLUTION. THE TYBEE ECOSYSTEM IS OUT-OF-WHACK [BECAUSE BARRIER ISLANDS ARE NOT MADE FOR HUMAN HABITATION]"

WHAT IS THE PROBLEM?

RUNOFF AND NUISANCE

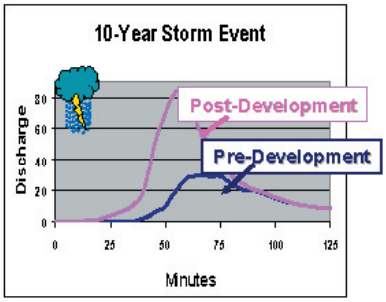
Development Impacts On the Water Cycle





As Development Increases:

- Runoff volume ↑
- Runoff velocity ↑
- Pollutants in runoff ↑



REMEMBER!

Stormwater runoff is a human problem that causes natural problems!

"Never, ever, think outside the box."

SOLUTIONS ARE DRAWN
FROM NATURAL PROCESSES.

Stormwater infiltration,

erosion,

groundwater recharge,

ecosystem happiness

THE SOLUTION:

PLANNING

In order to determine the "environmentally friendly" nature of Tybee's codes and ordinances and to make recommendations for changes to those ordinances, a worksheet prepared by the Center for Watershed Protection was used. The worksheet provides a format to evaluate existing ordinances and determine whether they protect the environment or favor development that is environmentally detrimental. The good news is that Tybee has a lot of room for improvement. The bad news is that out of a total of 100 points, Tybee scored 51, which indicates that development is not environmentally friendly. Following is an evaluation of the areas of success for Tybee and the areas to improve, followed by several specific recommendations for changes to existing ordinances.

> "...THE GOOD NEWS IS THAT TYBEE HAS A LOT OF ROOM FOR IMPROVEMENT..."

AREAS OF SUCCESS

Right of Ways:	Good width; Allow underground utilities
Setbacks and Frontage:	Conducive for dense development which would allow for the preservation of greenspace
Parking:	Space dimensions; Pervious materials allowed; Allowance of bioretention islands and landscaping
Stream buffers:	Disallowing disturbance activities within buffers
Tree Ordinance:	Encourage preservation of specimen trees
Stormwater:	Includes floodplain restrictions

AREAS TO IMPROVE

Streets:	Encourage efficient street layout that reduces overall street length; Encourage shared driveways
Vegetated Open Channels:	Revisit curb and gutter requirement; Establish design criteria for swales that can provide water quality treatment
Parking:	Consider instituting shared parking ordinance; Encourage pervious materials in spillover parking lot; Consider requiring a percentage of spaces to be for compact cars; Landscape parking lots to reduce runoff
Open Space:	Encourage cluster development to preserve greenspace in new developments; Adopt maximum impervious surface limits and/or maximum lot coverage limits; Encourage the placement of conservation easements on greenspace and environmentally sensitive lands; Encourage incorporating greenspace in all new developments; Create incentives for developers and landowners to conserve non-regulated land by providing density bonuses, stormwater credits, property tax incentives, and/or transferable development rights programs
Stormwater:	Require the treatment of stormwater for quality control before discharge; Utilize effective design criteria for stormwater BMPs (ex: Georgia Storm Water Management Manual)

TREE ORDINANCE (ARTICLE 7 OF TYBEE LAND DEVELOPMENT CODE)

The Tree Ordinance is comprehensive and will serve as a valuable means for protecting tree canopy on Tybee Island. Trees provide protection for water quality, water percolation, stormwater management, sedimentation control, temperature control, and wildlife habitat.

RECOMMENDATIONS FOR AMENDMENTS ARE:
Definition of Significant Tree: Ensure that current definition includes all tree species Tybee Island considers significant. Consider expanding definition of significant trees to include more native species.
Section 7-050A: Specify type, size, or status of the three trees required within the 4,500 square feet.
Section 7-080C: Amend section to read "…If the replanted tree becomes unhealthy or dies, it must be removed from the site and replaced by permittee/landowner as soon as conditions permit."
Section 7-080D: Consider increasing the ratio of replacement trees to removed trees in the Off Site Tree Planting Option (greater than the on-site tree planting option of one two (2) inch tree, caliper measure, for each two (2) inches DBH of the tree being replaced).

CITY OF TYBEE STORMWATER MANAGEMENT PROGRAM

A critical component of any Stormwater Management Program is Post Construction Runoff Requirements for Storm Water Quality Control. The City's draft Plan does not contain any specific requirements for post construction storm water quality control, but does state that these regulations and design guidelines will be adopted by December 2006.
The City's current ordinance primarily addresses storm water quantity control, although it does include elimination of illicit connections and discharges, storm sewer system maintenance and inspection, and other water quality control-related elements.

Given the pace of development on Tybee Island, it is recommended that the City implement effective post development storm water quality control requirements as soon as possible before the December 2006 deadline, to ensure protection of the natural environment and Tybee's valuable water resources.

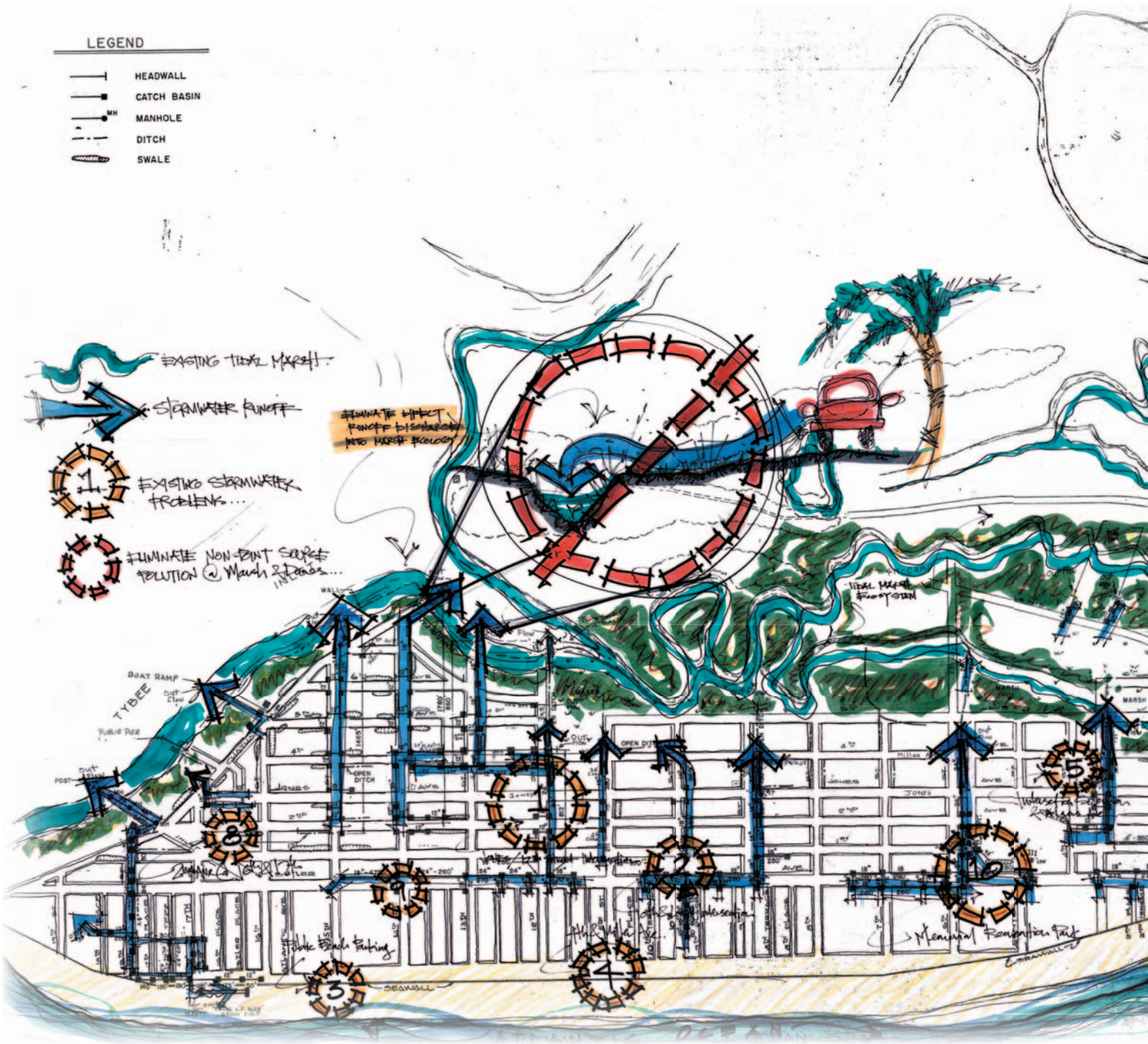
CITY OF TYBEE EROSION AND SEDIMENT CONTROL PROGRAM

The Georgia EPD currently issues Land Disturbance Activity (LDA) permits (required by the Georgia Erosion and Sedimentation Act) for new development in the City. The City has the option of becoming the Local Issuing Authority (LIA) for these permits and is in the process of gaining this authority from EPD. As part of this process, the City is updating its erosion control ordinance. Once the City becomes the LIA, it will have access to $40 of the $80 per disturbed acre fee paid by developers for a NPDES Construction Site Storm Water Permit, which is also required by the state for new development. By law, this money must be used for education, inspection and enforcement of erosion and sediment control activities by the City.

FUNDING ALTERNATIVES FOR WATER PROGRAMS

Consider the following options for raising funds for stormwater management and/or for creating incentives to participate in water conservation:

- INSTITUTE A TAX FREEZE PROGRAM – voluntary involvement in water conservation activities (installing green roofs, installing cisterns, reducing existing impervious surfaces, etc.) may allow for a landowner's city property taxes to be frozen at the current rate for ten years.
- CREATE LOCAL SPLOST-LIKE TAX - Increase seasonal water rates (May – September) for all commercial businesses. This cost would be incurred primarily by tourists who are responsible for much of the water use during that season. However, SPLOST is a county wide tax, and while the tax could be championed by Tybee, without county cooperation, it is not possible to implement.
- STORMWATER UTILITIES - operate like a city's water and sewer utility, but instead of charging you for the cost of bringing water to your home and carrying the wastewater away, the utility charges for handling the storm water that runs off roofs, driveways, parking lots, etc.

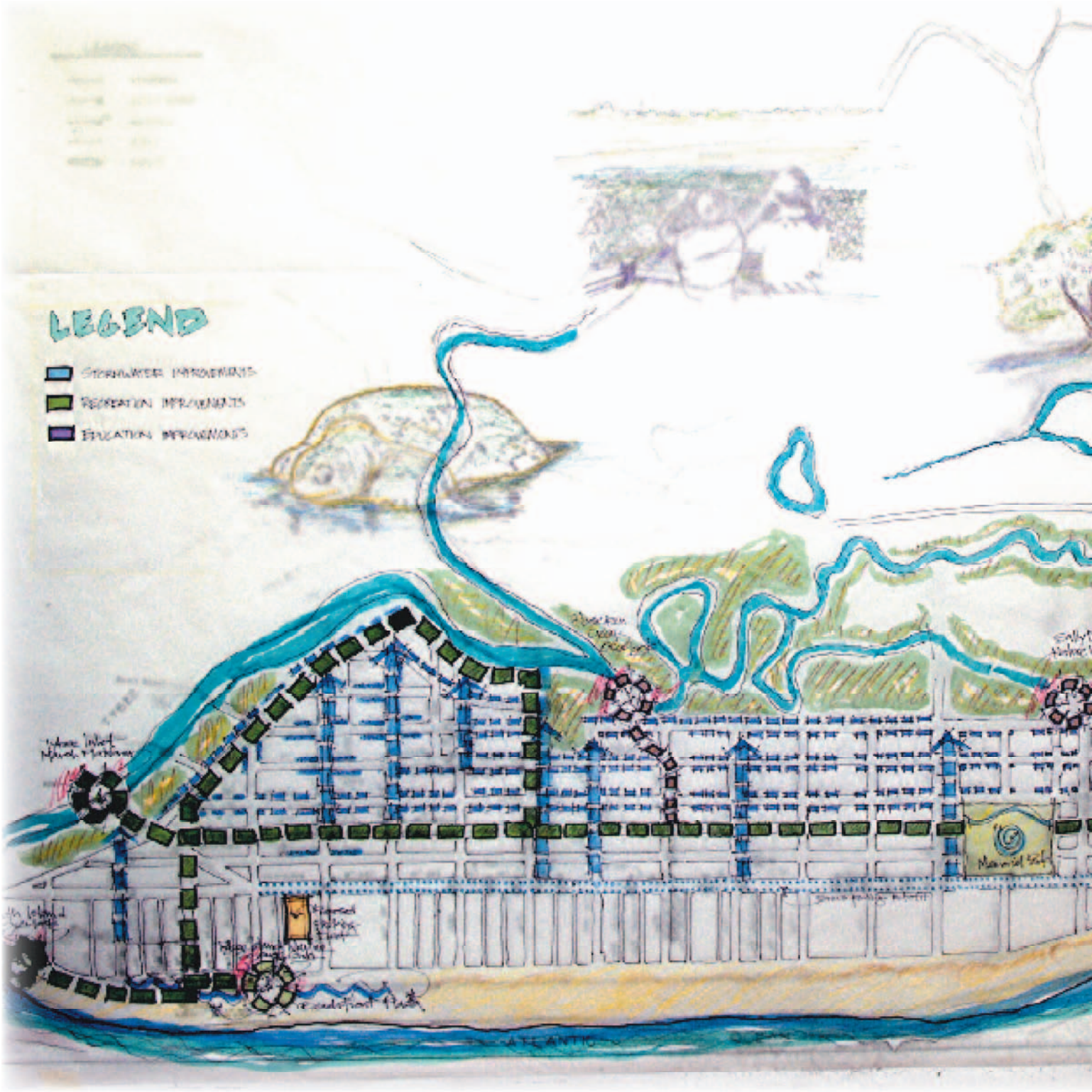

LEGEND
HEADWALL
CATCH BASIN
MANHOLE
DITCH
SWALE
EXISTING TIDAL MARSH
STORMWATER RUNOFF
ELIMINATE DIRECT RUNOFF DISCHARGES INTO MARSH ECOLOGY
EXISTING STORMWATER PROBLEMS...
ELIMINATE NON-POINT SOURCE POLLUTION @ MARSH 2 DAMS...
BOAT RAMP
TYBEE
PUBLIC PIER
OPEN DITCH
JONES
SEAWALL
Public Beach Parking
Memorial Recognition Park
1
2
3
4
5
6
7
8

DESIGN SOLUTIONS - AN OVERVIEW

The graphic to the left serves to illustrate the current stormwater system and the eleven sites that the charrette team developed "green" solutions for. The blue arrows on the map illustrate Tybee's current stormwater system. Local rain events pick up the pollutants on roadways, parking lots and rooftops, run through the current infrastructure and convey that stormwater, and every thing that it has collected along the way, directly into your marsh. So your marsh is getting polluted every time it rains, and because rains in this area tend to happen in quick, heavy bursts, the marsh can have a difficult time processing those pollutants before damage to the habitat occurs.

Again in the graphic to the left, you will see eleven numbered sites that we were asked to address specifically. On the following pages, you will find that we have developed a number of solutions to address not only reducing the direct input of heavy pollutant loads into the marsh, but also ways that each of these sites can be retrofitted with a design solution that will be beneficial to the island's environment. As the illustration in the upper left suggests, directing stormwater from impervious surfaces, through pipes and into the marsh is not the best solution, and we hope that you will find our recommendations both realistic and relatively easy to implement.

DESIGN



DESIGN SOLUTIONS - 11 SITES

Mother Nature made it so the rain falls, it hits the ground, and it slowly percolates through. We all learned this in the fourth grade, but over time we forget. We really don't value what we don't see. We don't see this water anymore because we have done such a good job of getting it off the parking lots, getting it off the streets, and conveying it away from us. These solutions reintroduce storm-water, and the processes that clean it, into the landscape and back into view. To better value our water resources, we should see them, interact with them, and be good stewards in the protection and management of them.

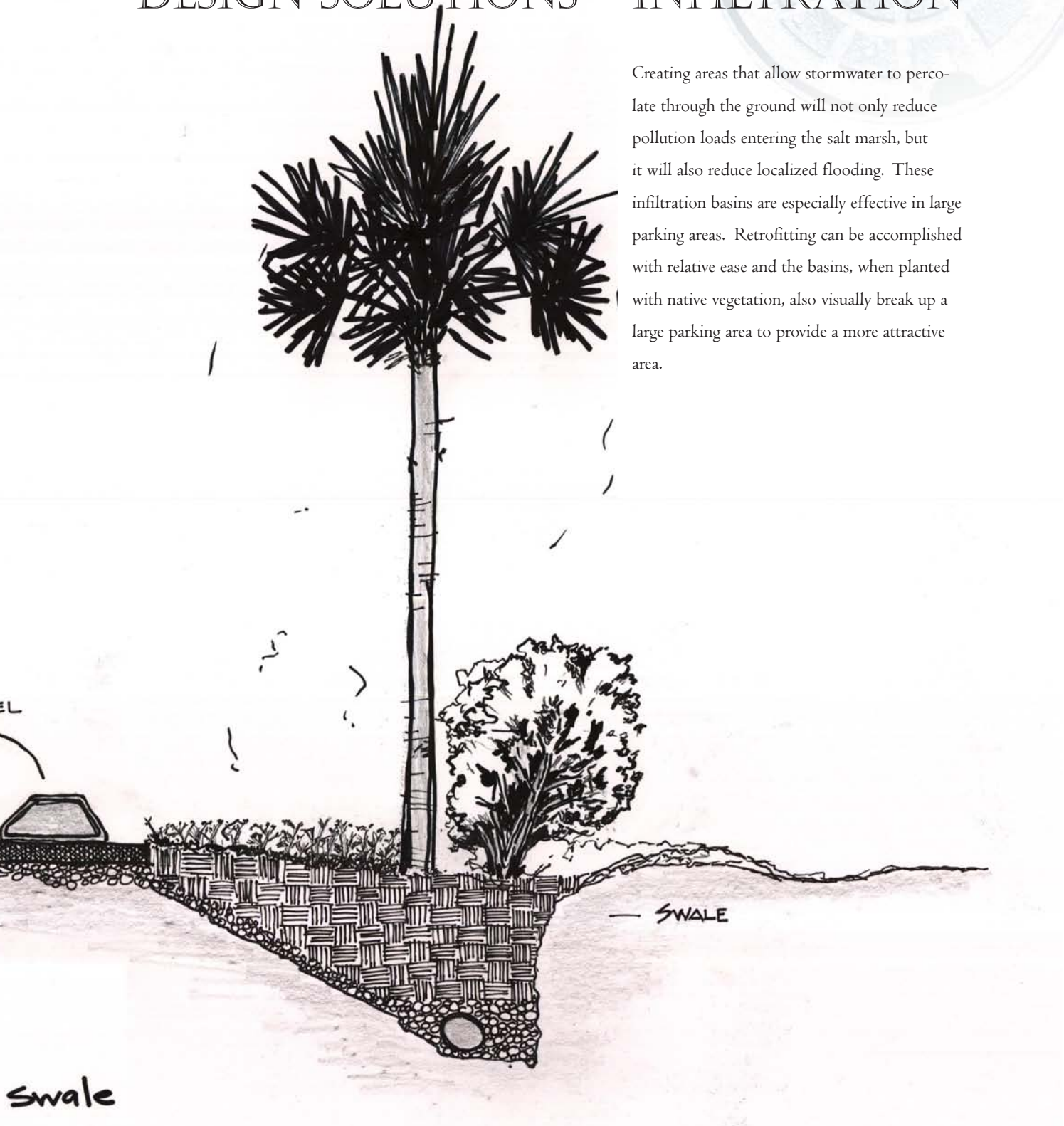
DESIGN SOLUTIONS - VEGETATED SWALES

We have all seen swales that are filled with concrete where the rainfall hits and is then directed quickly into a culvert. With a vegetative swale, while it can direct water to a culvert, it first provides the opportunity to have infiltration of the stormwater because there is a soil bottom and water loving plants that can absorb and filter some of that rainwater to slow that velocity down, reduce pollution, and reduce localized flooding. Vegetated swales are particularly effective along roadways.

CROSS SECTION VIEW
of PARKING LOT EDGE
— biofiltration strip +

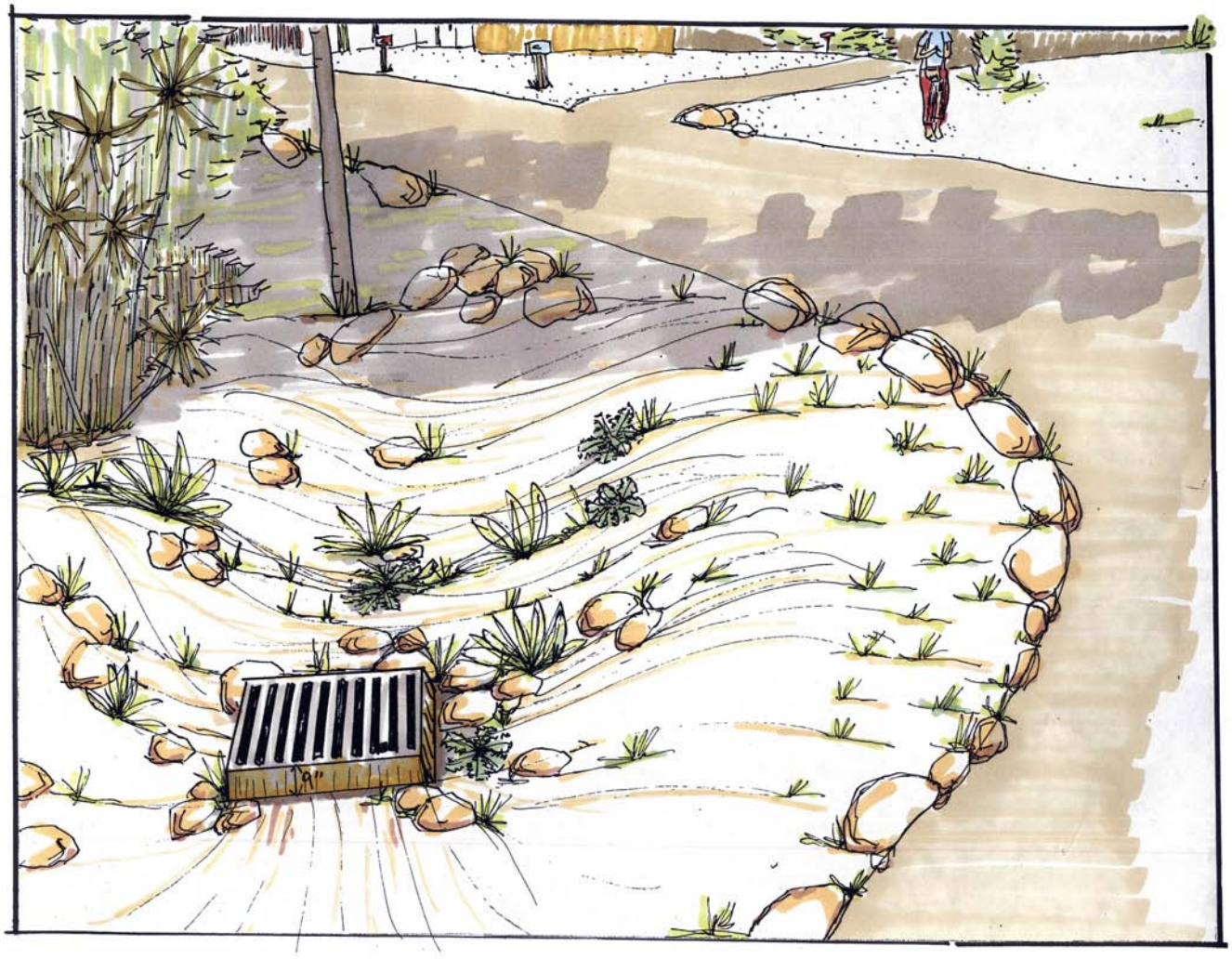
DESIGN SOLUTIONS - INFILTRATION

Creating areas that allow stormwater to percolate through the ground will not only reduce pollution loads entering the salt marsh, but it will also reduce localized flooding. These infiltration basins are especially effective in large parking areas. Retrofitting can be accomplished with relative ease and the basins, when planted with native vegetation, also visually break up a large parking area to provide a more attractive area.



DESIGN SOLUTIONS - RAIN GARDENS

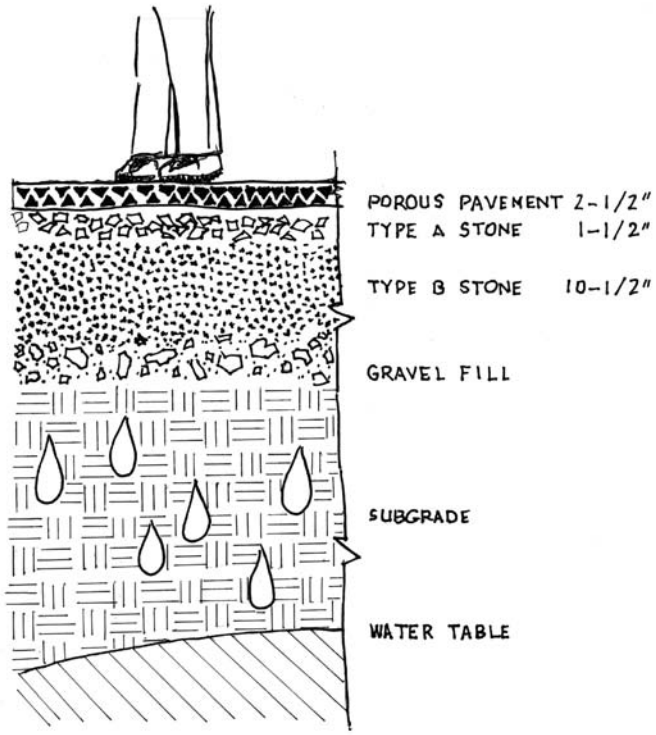
Rain gardens are similar to vegetated swales but can be designed as closed systems, not directing water in a particular direction. Stormwater, directed from roadways, parking areas, rooftops, and other impervious surfaces, enters the rain garden and is allowed to percolate slowly into the ground. Rain gardens are typically planted with native species that are well suited to periods of inundation and to the uptake of pollutants that are carried into the gardens by stormwater.



DESIGN SOLUTIONS – RAIN GARDENS

Rain gardens can also be designed to be part of a closed system, allowing large volumes of water to enter the storm sewer system. A storm drain can be included in the garden, but it must sit above the grade of the bottom of the garden. Water from small storm events will not enter the drain, but instead will percolate through the ground. In the case of large storm events and the higher water levels that they will produce in the garden, water can enter the drain and flow through the storm sewer system. As both illustrations show, the drains are above grade and are only needed to reduce water levels in large storm events.

TYPICAL POROUS PAVEMENT

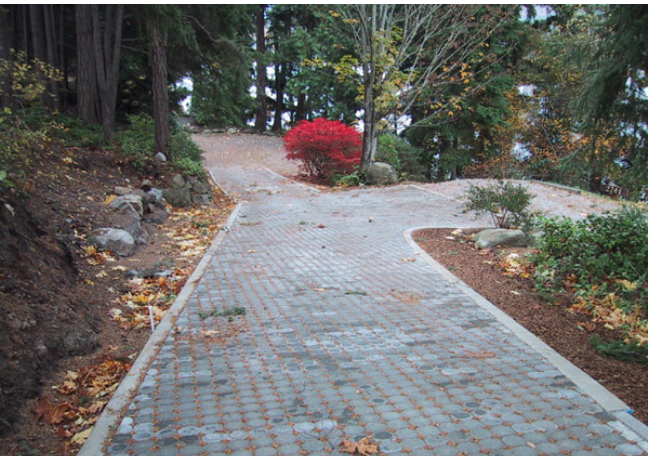


Typical Porous Pavement

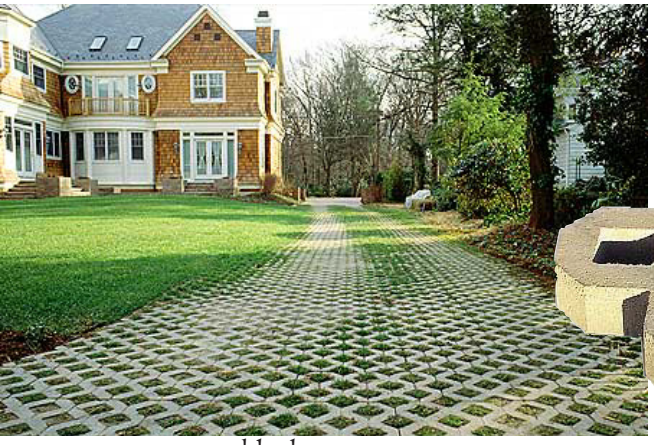
A typical porous paving installation requires several layers of gravel and stone to ensure proper infiltration. To the left is a cross section that illustrates these layers. From the bottom up, the installation begins with a layer of gravel fill I ½ to 2 inches thick. Above that, a 10 ½ inch layer of Type B stone is placed, followed by a I ½ inch layer of Type A stone. The top layer can be porous concrete, a paver system, or crushed shells. Tybee Island is not an appropriate location for the use of porous asphalt, as the high temperatures would cause the tar in the asphalt to melt and seal itself, leaving another impervious surface.

The proper installation of porous paving systems is paramount to its proper function. The layers of stone and gravel create voids where water can percolate through. If pavers or porous concrete are put directly on top of soils, there would not be enough void space to allow the stormwater to percolate down, and it would instead create additional runoff.

DESIGN SOLUTIONS – PARKING AND PERVIOUS SURFACES

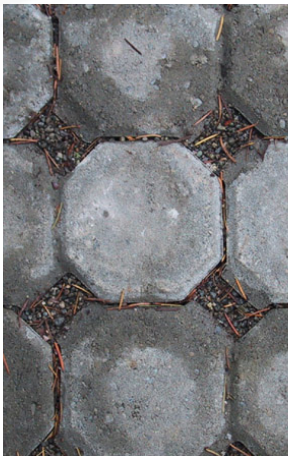


pavestone

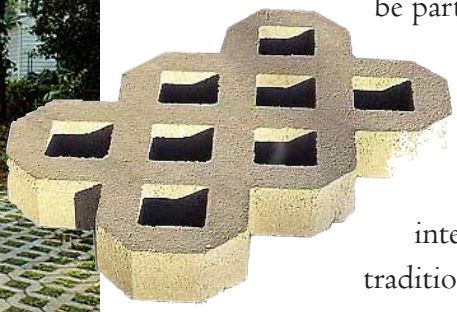


geo-block pavers

grid pavers



Increases in stormwater runoff, nonpoint source pollution, higher water temperatures, more instances of flooding, and higher water velocities can all be contributed to our addiction to pavement. Concrete and asphalt. As a nation, we love it. Need more parking? Pave that greenspace. Need to move traffic along? Widen that road. It seems that every time you turn around, there is more pavement, more impervious surface area, in our cities and towns. But it isn't just our addiction to paving over things. We tend to forget that rooftops, severely compacted soils, and sometimes even our very green front lawns can also be part of our impervious problem.



How then do we reduce our addiction to surfaces that do not allow stormwater to percolate through as Mother Nature intended? There are increasing alternatives to traditional concrete and asphalt. Porous concrete, pavers, and crushed shells are a few alternatives to their impervious cousins. To the left, you will see specific examples of various types of paver systems. Tybee currently allows residents to use porous materials for their driveways and walkways. It is important that you encourage its use in retrofitting existing drives, and require porous materials in new installations. It will reduce stress on your stormwater infrastructure, reduce localized flooding, and reduce the amount of nonpoint source pollution entering your salt marsh.

DESIGN SOLUTIONS – CONSERVATION AND IRRIGATION

- cisterns
- rain barrels
- green roofs

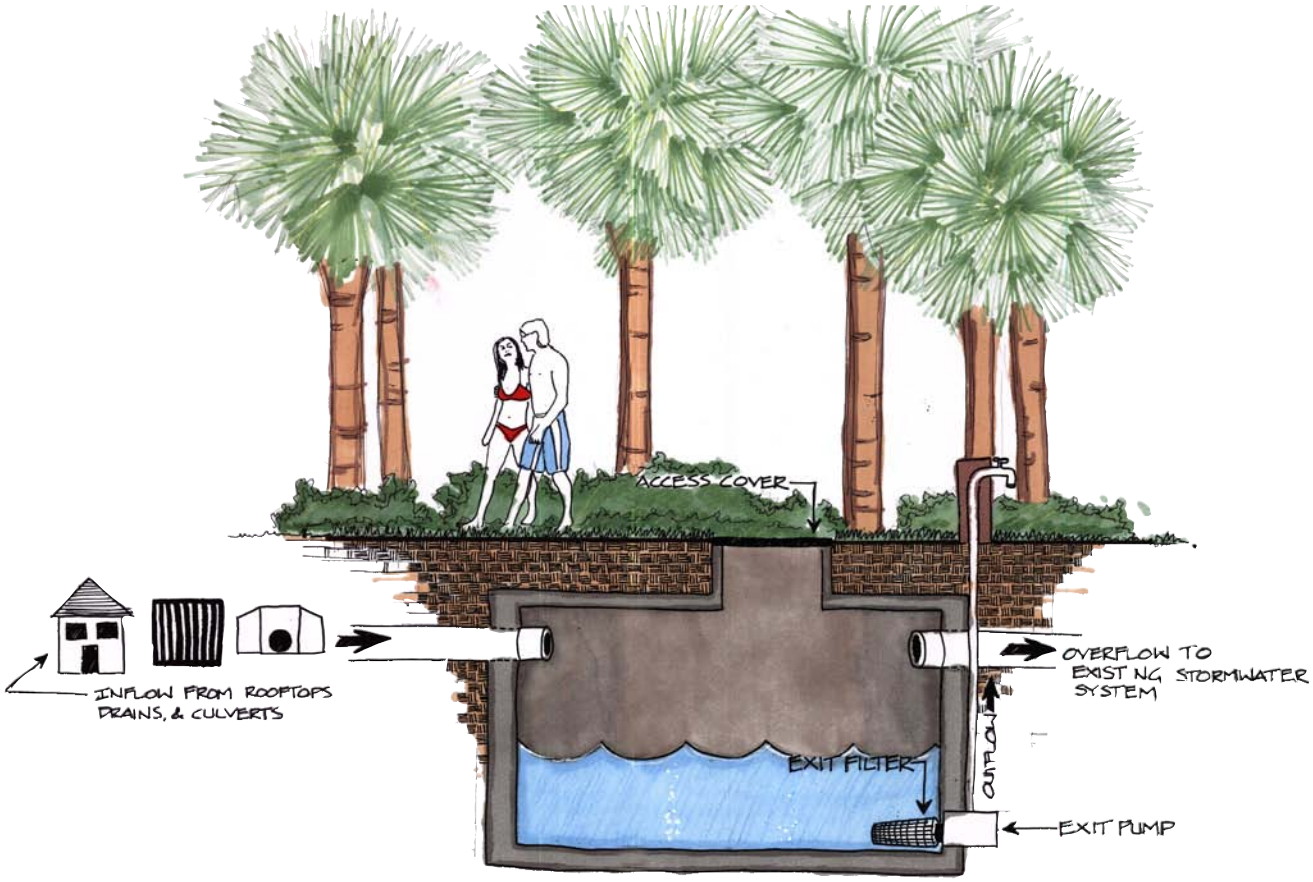
Water conservation is of utmost importance for Tybee Island, and the efforts that the community is currently making are commendable. The threats of salt water intrusion, permitting limits on the amount of potable water that can be provided, and the recognition that all the water we have today is all the water that there will ever be have all played a role in building Tybee's conservation ethic.

Using potable water for irrigation should not be allowed on Tybee. The limited amount of water provided to residents should be used for drinking, cooking, bathing, and other indoor purposes. In an effort to reduce the use of potable water for things like irrigation, there are several tools that can be integrated into homes, businesses, and public spaces to capture and store stormwater for later use. Cisterns and rain barrels are not new inventions. They have been around for much longer than any of us as a means to capture rainfall.

Another tool to not only reduce stormwater runoff, but that will also improve energy efficiency in a home or business and contribute to the reduction of the heat island effect, is the use of green roofs. Literally, rooftops are planted like gardens. This alternative, as well as the use of cisterns and rain barrels, is discussed further on the following pages.

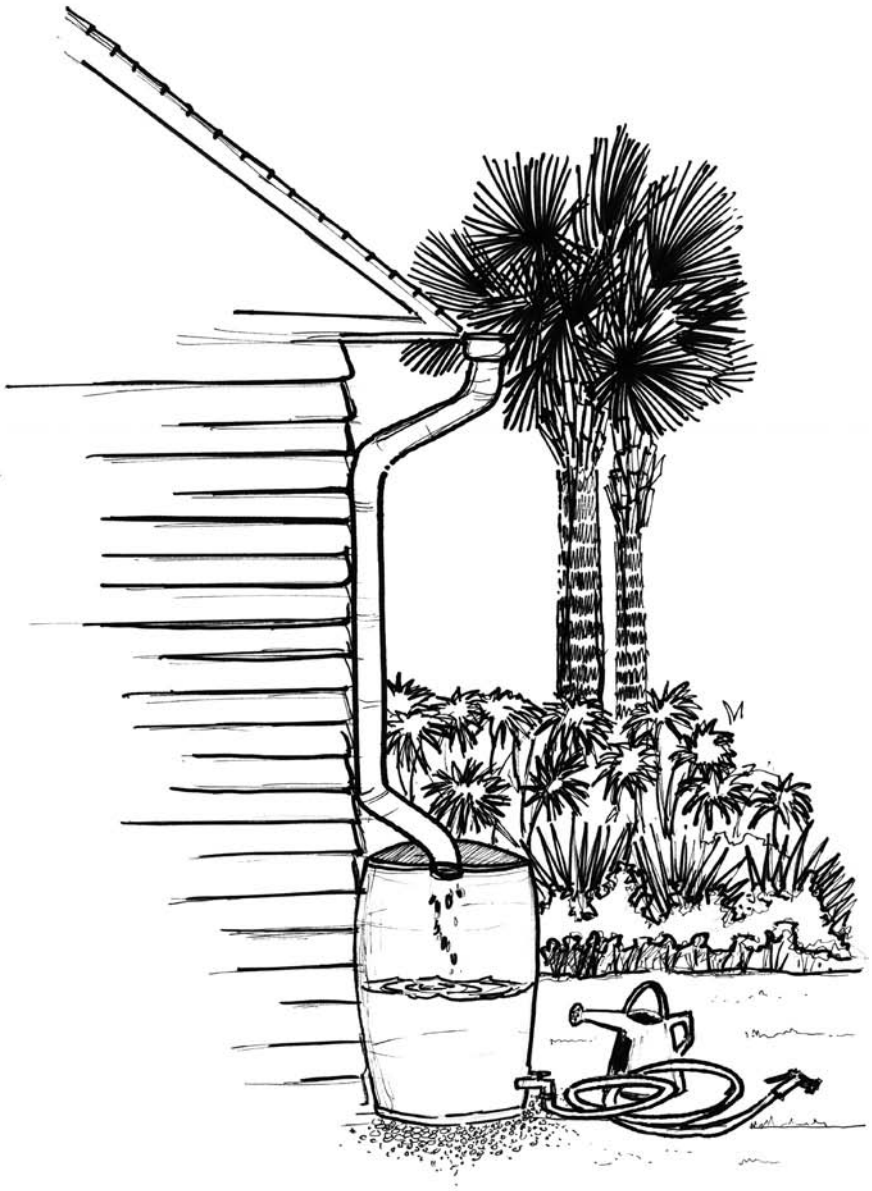
DESIGN SOLUTIONS - CONSERVATION AND IRRIGATION

Cistern Systems



Cisterns are essentially large underground storage tanks for rainfall. This illustration demonstrates the use of a cistern to provide water for the beach foot wash stations. The stormwater is captured from the flows generated, whether on parking lots, rooftops or roadways, and those flows are directed into the cistern for storage. A filter system is used to provide for basic cleansing of the water and a pump powers the water to the tap above ground. When water levels reach a determined height in the cistern, overflows are directed into the existing storm sewer infrastructure.

RAIN BARREL IRRIGATION



DESIGN SOLUTIONS - CONSERVATION AND IRRIGATION

Rain Barrel irrigation*

Collecting rainwater in rain barrels or other depositories is an ancient and traditional practice. Historical records show that rainwater was collected in simple clay containers as far back as 2,000 years ago in Thailand, and throughout other areas of the world after that. With the rising price of municipal water and drought restrictions now facing much of the United States during the summer months, more and more homeowners in our own modern society are turning to the harvesting of rainwater to save money and protect this precious natural resource.

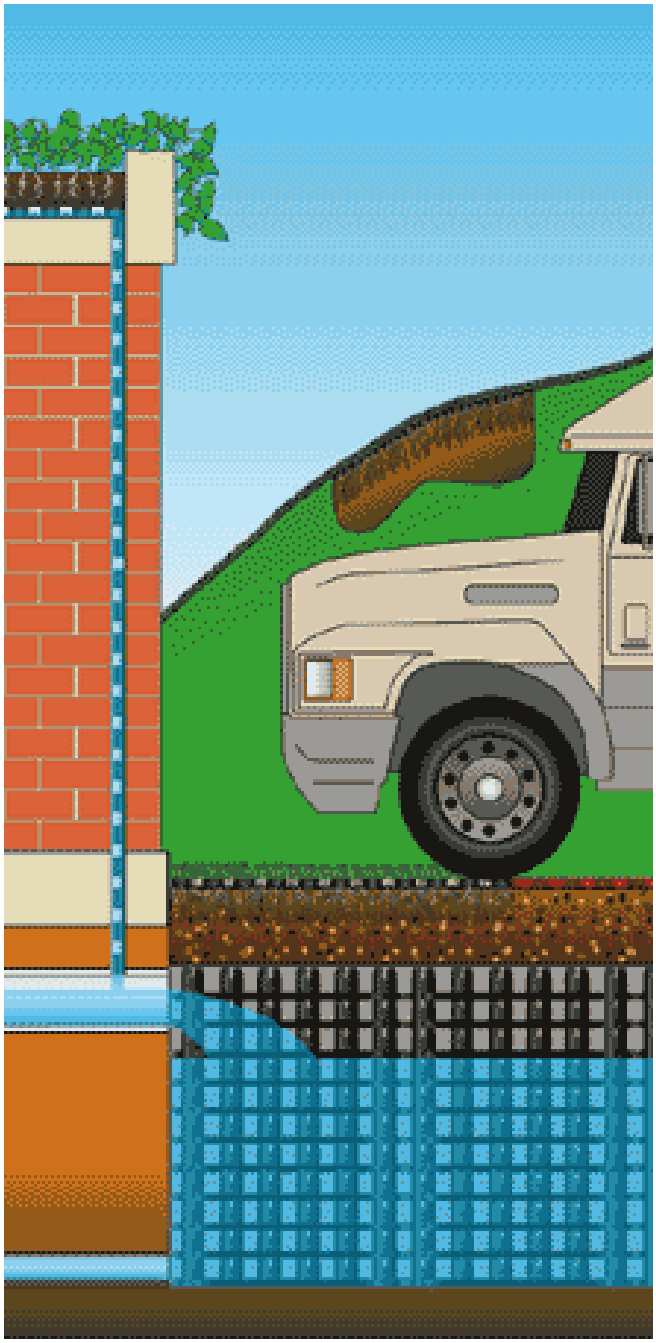
Believe it or not, for every inch of rain that falls on a rooftop of 1,000 square feet, you can expect to collect approximately 600 gallons of rainwater. Storing and utilizing this water for irrigation of lawns, trees, shrubs and other plants not only reduces the amount of potable water used by a household, but will also reduce monthly water bills.

Rain barrels are readily available. A number of communities around the state have purchased them in bulk and resold them to their residents at cost. The most basic rain barrel system, as seen in the illustration to the left, captures the flows from rooftops by connection to downspouts. All you need is gravity to make this system operable. A tap at the bottom allows for a garden hose to be attached. Rain barrels also have an overflow spout, so when they are full, the additional flow is directed to the ground. Rain barrels should be covered to prevent mosquito larvae from growing in the standing water.

*partially adapted from rainbarrelguide.com

DESIGN SOLUTIONS - CONSERVATION AND IRRIGATION

Green Roofs*



Green roofs are not a new concept. Consider the centuries-old tradition of using sod on rooftops in Scandinavia. Green roofs, or ecoroofs, are becoming common in parts of Europe, with Germany, the Netherlands and Switzerland leading the way. As early as 1989, over 10 million square feet of low-maintenance roof gardens were under construction in Germany, and in some Germany cities, roof gardens are required on flat-roofed industrial buildings.

While the requirements of some types of roof gardens, at least in their most simple form, are relatively modest, the environmental benefits are quite considerable.

GREEN ROOFS CAN:

- Improve a building's thermal insulation;
- Reduce the heat island effect by absorbing less heat than a conventional roof;
- Produce oxygen, absorb carbon dioxide, and filter air pollution;
- Store carbon;
- Provide habitat for birds; and
- Absorb up to 75 percent of the rain that falls upon it, reducing stormwater runoff.

*adapted from Sustainable Landscape Construction, William Thompson and Kim Sorvig

Photo: Bill Hunt

A number of layers are required for the installation of a green roof to provide not only for waterproofing but to establish a good growing medium for plants. Each year, more and more green roof systems are being developed that are lighter, more adaptable, and have little to no maintenance requirements. Here we will provide a brief description of a typical green roof installation and the layers needed for a successful, functioning green roof. This information is adapted from greenroofs.com.

WATERPROOFING: The greenroofing system may consist of a liquid-applied membrane, a specially designed singly-ply sheet membrane, or a built-up roof system consisting of 3+ layers. Depending upon the nature of the waterproofing membrane chosen (organic vs. synthetic), a root barrier layer may be needed to prevent the plant roots from penetrating and ultimately undermining the integrity of the waterproofing layer.

INSULATION: An insulation layer is optional, and prevents water stored in the greenroof system from extracting heat in the winter or cool air in the summer.

DRAINAGE: Every greenroof must have a drainage layer to carry away excess water; on very shallow extensive greenroofs the drainage layer may be combined with the filter layer.

FILTER FABRIC: The main function of the filter fabric/membrane is to hold the soil in place and still prevent small soil particles, such as plant debris and much, from entering and clogging the drainage layer below.

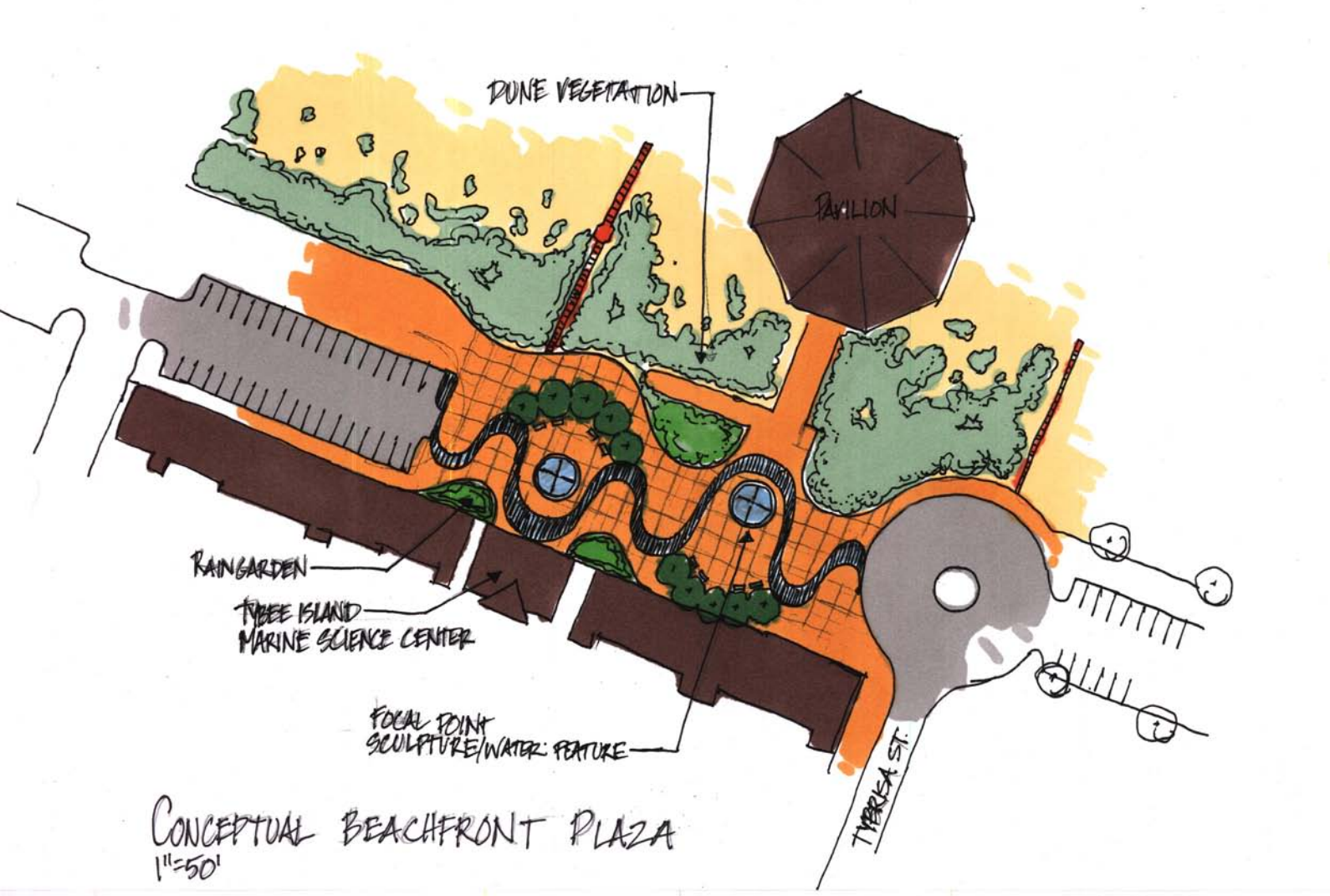
GROWTH MEDIA: The growing medium or soil substrate can be selected from several engineered factory mixes designed by the various single-source greenroof suppliers or they can be custom designed by a soil expert.

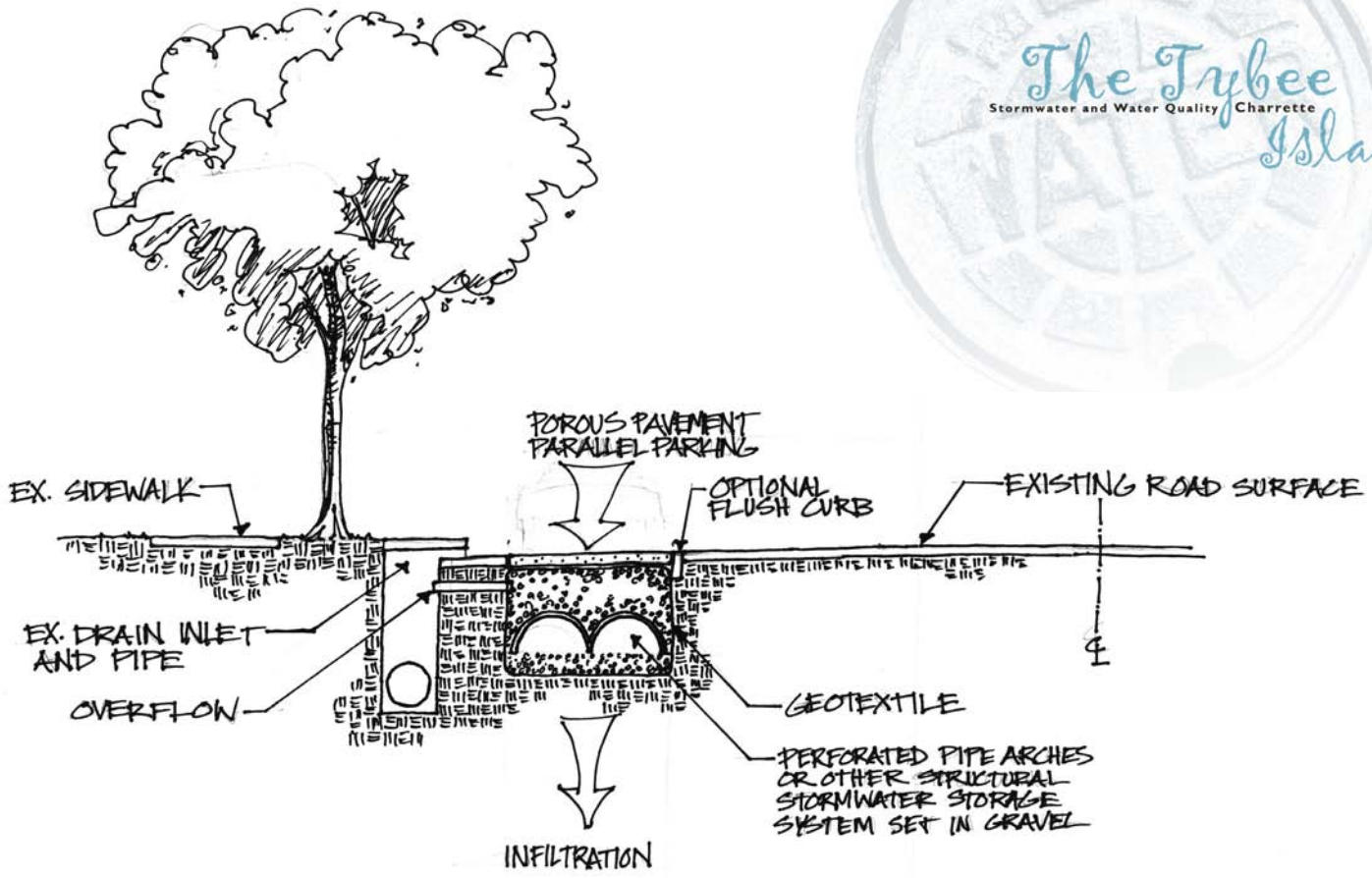
PLANT MATERIAL: The vegetation layer is the most vital and exciting part of the greenroof, and as such, suitable and dependable plant material selection needs to be assessed on a per region basis. Characteristics of landscaping typically used in extensive greenroof systems include shallow root systems, regenerative qualities, and resistance to direct radiation, drought, frost and wind.

DESIGN SOLUTIONS

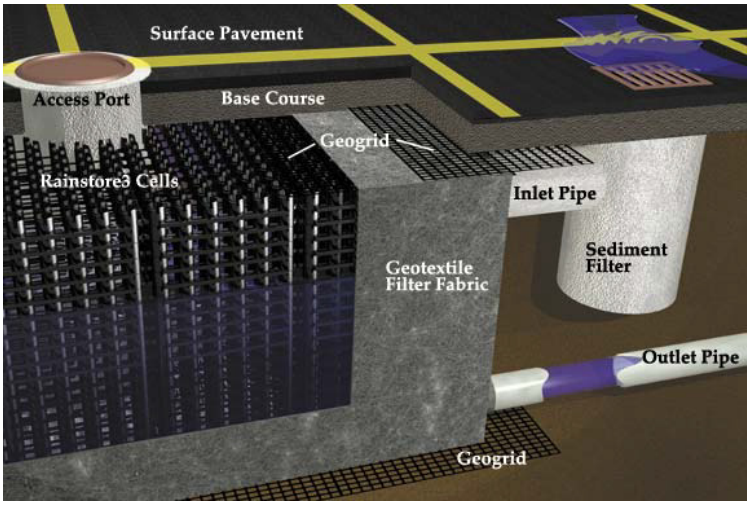
South Beach Parking and Stormwater Interpretation

What would be some of Tybee Island's most prized real estate is a parking lot: a large, visually-unbroken, except for a few suffering palms, expanse of concrete. While this parking is highly desirable on those warm spring and hot summer day trips to the beach, the island is missing an opportunity to develop a portion of this area as a pedestrian plaza, reduce the number of parking spaces that are ocean front and relocate much of the parking into a parking deck to be sited away from the ocean front yet easily "beach accessible."





RETROFIT STORMWATER DETENTION & INFILTRATION IN EXISTING RIGHT-OF-WAY



Underground Structural Stormwater Storage System

The conceptual beachfront plaza brings stormwater into the open through sculpture, interactive fountains and rain gardens. The fountains use only rainwater, stored and pumped from underground cisterns to operate. This type of system will also provide an opportunity for the education of residents and visitors alike on the importance of recognizing that our actions and attitudes towards water need to reflect an ethic of stewardship, protection, and wise use of this limited resource.

DESIGN SOLUTIONS

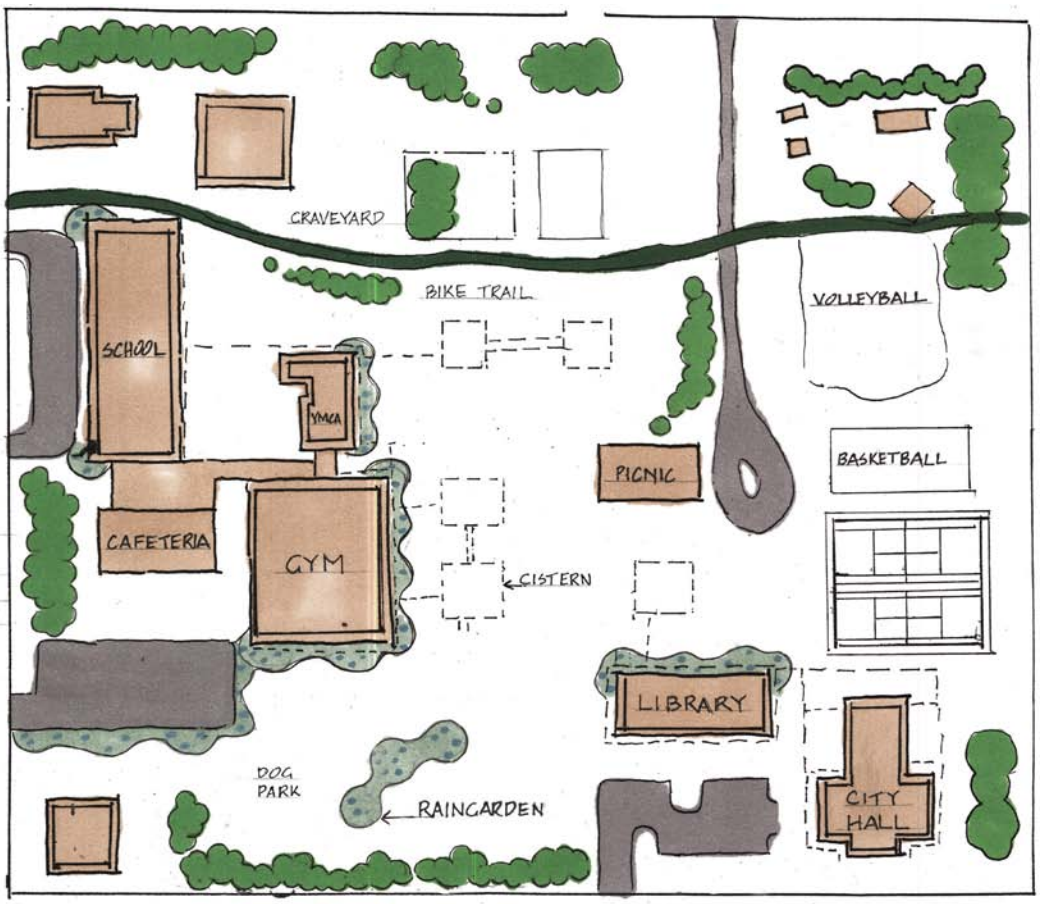
Memorial Park

Memorial Park is one of Tybee's great community assets, providing open space and recreational areas for residents and visitors alike. However, several areas within Memorial Park tend to flood, even with small rain events and become useless to the public, as no one wants to trudge through the muddy areas. To address those concerns, we have developed two solutions. One, a series of rain gardens that would be relatively easy and fairly inexpensive to install, and the other, a series of cisterns that while more expensive and time consuming to install, would provide storage of water for irrigation in times of drought. The illustrations to the right show the placement of both options. We have previously discussed each of them, their advantages, uses and requirements. Either option would reduce the standing water that is often found in the Memorial Park area, and in the case of the rain gardens, would beautify the area. The systems could also be used in combination to capture, treat, and store stormwater for later use.

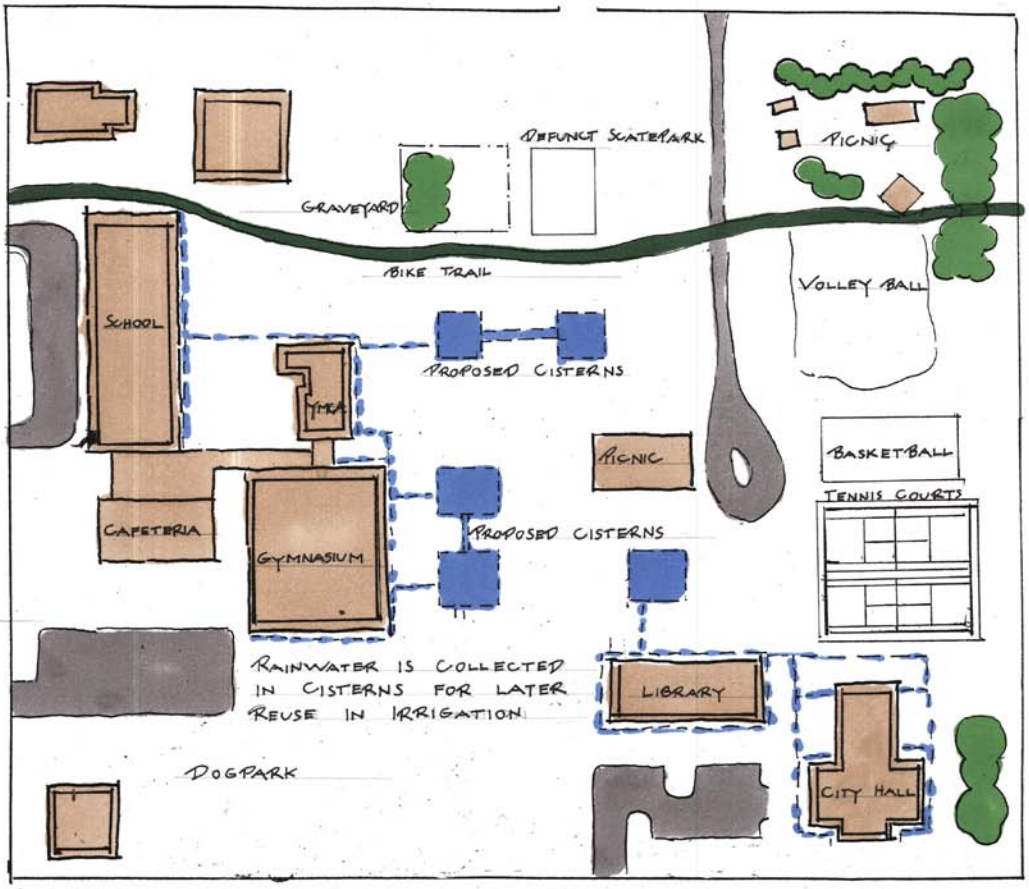
Because of the proximity of Memorial Park to Tybee's elementary school, the rain gardens could also be used as an outdoor classroom. Students would not only benefit from learning about stormwater, the importance of reducing nonpoint source pollution, and the benefits of providing habitat for birds and other species, but could also participate in the planting and maintenance of the gardens.

MEMORIAL PARK

RAINGARDENS REDUCE THE AMOUNT OF STORMWATER RUNOFF



MEMORIAL PARK



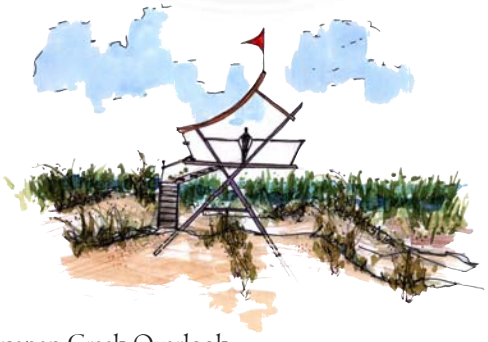
South Island Overlook

DESIGN SOLUTIONS

bike trail | bike traffic | overlooks | kiosks and interpretations

A favorite past time of many beach visitors, and an alternative means of transportation for residents and visitors alike, is biking. Providing a continuous bike circulation route around the island also provides an opportunity to integrate educational kiosks and overlooks along the path.

We recommend that the design of these overlooks fit with the eclectic nature of Tybee: something that is unique. The illustration to the left shows a structure designed to resemble the mast of a sailboat. The eye-catching design would draw people to the structure to take in the views and learn a little more about the island. Not only would these structures provide unique views, but they would also provide opportunities to educate visitors and residents on, among other things, the salt marsh habitat, the importance of sand dunes, and wildlife that is found in the area. The educational kiosks can also provide information on the form and function of barrier islands and discuss the natural processes that are occurring on Tybee, such as the migration and deposition of the beach from north to south.



Horsepen Creek Overlook

Tybee Inlet Marsh Overlook

Educational Kiosk

DESIGN MAINTENANCE

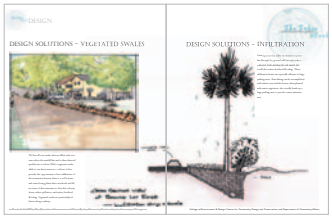
Numerous recommendations have been made on how to manage and use stormwater on Tybee Island. However, without the proper maintenance of rain gardens, vegetated swales and others, the systems will not work in the long term. Proper maintenance is critical to the continued success and effectiveness of implemented stormwater Best Management Practices. Adoption of the following maintenance guidelines will increase long-term functionality and public perception of applied stormwater BMPs.

BIORETENTION (RAINGARDENS)

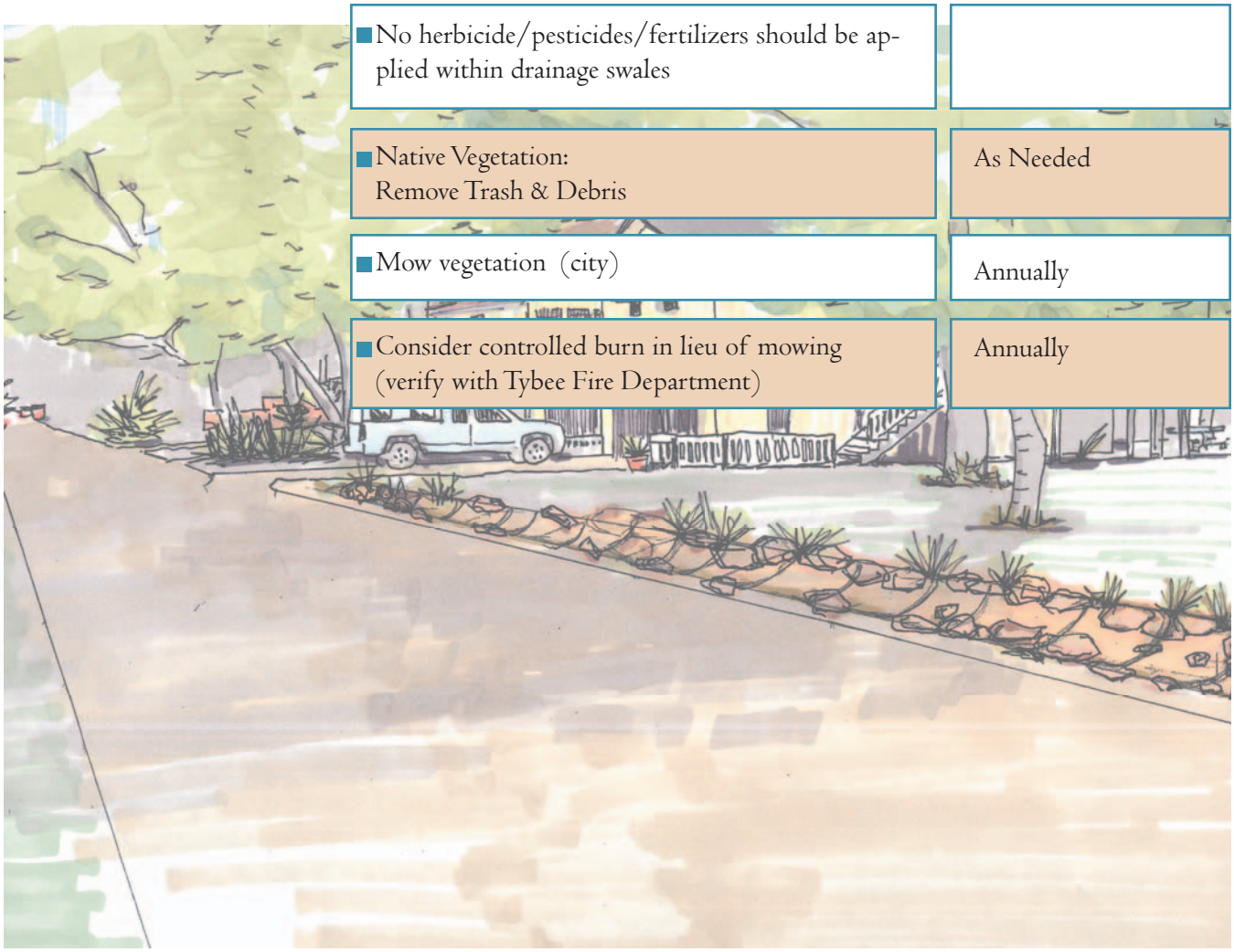
Maintenance Activity	Schedule
■ Pruning and Weeding to maintain appearance ■ Mulch Replacement when erosion is evident ■ Remove Trash & Debris	As Needed
■ Inspect Inflow points for clogging & Remove Sediment ■ Remove Fine Sediments within unvegetated areas	Monthly
■ Inspect Filter Strip / grass channel for erosion & ■ Re-seed or sod as necessary ■ Evaluate tree and shrub health & Remove dead or severely diseased vegetation	Semi-Annually
■ Test soil pH. If below 5.2, apply lime. If above 7.0, apply iron sulphate and sulphur.	Annually
■ Replace Mulch over entire planting area ■ Replace pea gravel at diaphragm if necessary	2-3 Years

VEGETATED SWALES

Roadside swales can be planted with either turf or native vegetation, however, native vegetation is encouraged in all swales.



Maintenance Activity	Schedule
■ Turf: Remove Trash & Debris Mow with 6" maximum height (homeowners)	As Needed
■ Mow swales with 6" maximum height (city)	Bi-Annually
■ No herbicide/pesticides/fertilizers should be applied within drainage swales	
■ Native Vegetation: Remove Trash & Debris	As Needed
■ Mow vegetation (city)	Annually
■ Consider controlled burn in lieu of mowing (verify with Tybee Fire Department)	Annually

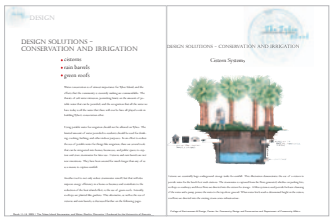


DESIGN MAINTENANCE

POROUS PAVEMENT

Maintenance Activity	Schedule
■ Porous Concrete: (utilize certified porous concrete installer) Remove Trash & Debris Monitor for adequate drainage/percolation Maintain vegetative cover on adjacent areas to minimize potential clogging from sand and debris	As Needed
■ Vacuum porous concrete to remove sand and debris	Annually, at minimum
■ Pavers: Remove Trash & Debris Replace broken/cracked pavers Monitor for adequate drainage and ensure non-compaction of intended voids at installation	As Needed
■ Shells with Geogrid: Remove Trash & Debris Follow manufacturers maintenance specifications Maintain a minimum 3" depth (replenish when low) Maintain edge definition between shells and adjacent land cover Re-grade to prevent rutting and pot-holing	As needed

RAINWATER HARVESTING



Dark, opaque colors recommended for rain barrels to discourage algae growth and should be located in shaded areas if possible; if attached to an irrigation system, should be low-flow rotors, bubblers, drip, or subsurface emitters; consider use of alternative energy sources such as solar or wind to power cistern pump system

Maintenance Activity	Schedule
■Ensure filtration of rainwater before it enters storage system (i.e. "roofwashers" at down-spouts, inline filtration device or screen at rain barrel cap) ■Clean/maintain rooftop and gutter convey-ance system ■Identify alternative water source for use	As Needed
■Flush out system for tank/barrel cleaning	Bi-Annually

GREEN ROOFS

utilize a certified green roof installer

Maintenance Activity	Schedule
■Use appropriate vegetation and re-plant Monitor for adequate drainage; eliminate standing water ■Monitor for leaks (see manufacturers war-ranty and specs)	As Needed
■Replace system as necessary	40-50 years

STREETS

Maintenance Activity	Schedule
■Street sweep on regular maintenance schedule ■Monitor drainage structures and clean out inlet/outlet debris ■Maintain vegetated swales and/or rain gardens	As Needed

STORMWATER MANAGEMENT

Another important component of a successful stormwater program is good management. Stormwater is part of the water cycle yet we have somehow turned it into something negative, damaging and polluting. Changing that perception is critical to the success of the recommendations made previously. While Tybee Island is considered a Phase I community under EPA's stormwater program, using the six minimum measures created through the Phase II Stormwater Program will not only assist with education, but in addressing other issues associated with nonpoint source pollution as well. Recommendations for a stormwater management program are listed here.

- PUBLIC EDUCATION AND OUTREACH
- PUBLIC PARTICIPATION AND INVOLVEMENT
- ILLICIT DISCHARGE DETECTION AND ELIMINATION
- POLLUTION PREVENTION/GOOD HOUSEKEEPING FOR MUNICIPAL OPERATIONS
- CONSTRUCTION SITE STORMWATER RUNOFF CONTROL
- POST CONSTRUCTION RUNOFF CONTROL

PUBLIC EDUCATION AND OUTREACH

Management Practice	Description
Development and stormwater runoff	Impact of development on land and impact of runoff on water quality and aquatic habitat
Lawn and garden activities	Conservation of water, reduction in runoff of nutrients, herbicides, pesticides, trash and lawn debris
Proper disposal of household hazardous waste	Reduce runoff of hazardous and toxic substances such as oil, antifreeze, etc. to protect public health and safety
Pet waste management	Pet waste can drain directly into water bodies contributing to increased fecal coliform levels
Trash management and recycling	Aesthetics, health and safety, pollution reduction, and reduction in stormwater system clogs
Tailor outreach to specific audiences including tourists	Direct educational materials to residential, commercial, industrial, seasonal residents, tourists through refrigerator magnets, property brochures and lease agreements
Education and outreach for commercial activities	Commercial/industrial activities contributing to stormwater pollution shall lead and outreach campaign within the watershed
Classroom education on stormwater programs	Introducing students and parents to stormwater pollution programs
Stormwater education materials	Brochures, flyers, bill inserts, bumper stickers, news media, website, cable channel, etc.
Educational displays	Enviroscape demonstrations, nonpoint source pollution information, etc.
Low impact development	New development or redevelopment
Promotional outreach	Rain barrels, low flow nozzles, stickers, etc.
Mobile commercial operators (concrete trucks, etc.)	Impact of equipment cleaning and waste disposal on water quality
Update of progress	Keep citizens informed about positive impacts, progress in program through website, media
Marsh and dune ecosystems	Promote management of sensitive areas and value of maintaining natural systems
Education and re-education	Consistent and frequent messages on ongoing basis, particularly targeting seasonal tourists

PUBLIC PARTICIPATION AND INVOLVEMENT

Management Practice	Description
Continue storm drain stenciling program	Labeling storm drain inlets with messages warning citizens not to dump materials into drains which connect to local water bodies
Beach, marsh and dune cleanup and monitoring	Expand existing programs and help citizens become directly involved in water pollution prevention and education
Volunteer water quality monitoring	Train and assist volunteer groups for inventory of problems, outfall screening, erosion, trash and debris build up, etc.
Habitat restoration and caretaking	Tybee has unique maritime ecosystems, beach, dune, forest, and marsh focused programs
Adopt-a-Beach, Storm Drain, Dune, Marsh Program	Excellent public outreach tool for studying, cleaning, monitoring, protecting and restoring habitats
Watershed organization	Coordinate on mutual efforts with local groups to increase public awareness
Attitude surveys	Obtain public feedback on stormwater programs and implementation
Community hotline	Dedicated phone line to report illegal dumping, dry weather flows, etc.
Awards program for businesses, builders, and engineers	Encourage the focus on erosion and sediment control and stormwater management

ILLICIT DISCHARGE DETECTION AND ELIMINATION

Management Practice	Description
Failing septic systems	Monitor existing systems; require tie-in to sewer as available
Industrial/Business connections	Manages identification and elimination of illegal or inappropriate connections to stormwater system
Recreational sewage	Regulates wastewater generated from outdoor activities such as boating, camping, and recreational vehicles by providing alternative methods of waste disposal
Sanitary sewer overflows	Detecting and correcting sanitary sewer overflows
Illicit sanitary sewer or other connections to stormwater drainage system	Dye-testing at suspected sites, including private properties
Eliminate illegal dumping	Runoff from dump sites can contaminate water
Comprehensive inventory of stormwater management facilities, including storm drains, detention basins, etc.	Develop a comprehensive storm sewer mapping/GIS program (Resources are available to assist in GIS program implementation)
Dry-weather monitoring of stormwater outfalls	Initiate program in industrial/commercial areas

POLLUTION PREVENTION/GOOD HOUSE KEEPING FOR MUNICIPAL OPERATIONS

Management Practice	Description
Inspection and enforcement	Labeling storm drain inlets with messages warning citizens not to dump materials into drains which connect to local water bodies
Pickup service for trash and debris from beach, dune, and marsh clean-up efforts	Expand existing programs and help citizens become directly involved in water pollution prevention and education
Inter-departmental coordination	Train and assist volunteer groups for inventory of problems, outfall screening, erosion, trash and debris build up, etc.
Drop-off points or pick up service for disposal of household hazardous and toxic waste	Tybee has unique maritime ecosystems, beach, dune, forest, and marsh focused programs
Animal waste collection	Excellent public outreach tool for studying, cleaning, monitoring, protecting and restoring habitats
Municipal operations: Automobile maintenance, car washing, illegal dumping control, landscaping and lawn care, parking lot and street cleaning, roadway and bridge maintenance, asphalt alternatives, septic system controls, storm drain system cleaning, stormwater detention basins maintenance, hazardous materials storage, spill response and prevention, used oil recycling, leaking fluids from autos and boats.	Internal assessment of Tybee activities for compliance

CONSTRUCTION SITE STORMWATER RUNOFF

Management Practice	Description
■ Revise Erosion and Sediment Control Ordinance to include more specific "Best Management Practices." BMPs include, but are not limited to: land grading, permanent diversions, preserving natural vegetation, construction entrances, check dams, filter berms, grass-lined channel, riprap/ oyster shells, mulching, permanent seeding, sod-	Increase enforcement of design and construction of soil erosion and sediment control measures per the State of Georgia's NPDES stormwater construction permit requirements and the Georgia Stormwater Management Manual for all new or redevelopment projects.
■ Contractor certification and inspector training	Training and certification programs for erosion, sediment control, and stormwater management
■ Construction reviewer/community hotline	Checks that erosion, sediment control, and stormwater management have been used and provides an opportunity for reporting violations
■ BMP inspection and maintenance	Aggressive enforcement
■ Model ordinances	Use available model ordinances
■ Design Professional Certification	Training for the engineering community

POST CONSTRUCTION RUNOFF CONTROL

Management Practice	Description
Adopt and enforce the use of water quality control and channel protection measures per the Georgia Stormwater Management Manual	Ensure that the "first flush" is treated to enhance water quality
Stormwater management site plan	Site design should be done in unison with the design and layout of stormwater infrastructure to attain stormwater management goals
Stormwater system/BMP inspection and maintenance	Maintain effectiveness of post-construction BMPs
Adopt and encourage the use of Better Site Design Practices per the Georgia Stormwater Management Manual: Conservation of Natural Features and Resources – preserve undisturbed natural areas, preserve riparian buffers and marsh and dune systems; Lower Impact Site Design Techniques – locate development in less sensitive areas, reduce limits of clearing and grading, create open space that provide social and ecological benefits, implement innovative design; Reduction of Impervious Cover – reduce setback and frontage, reduce roadway lengths and widths, reduce parking footprint and include vegetated stalls, reduce building footprints, use fewer or alternate cul-de-sacs, parking lot stormwater islands for bioretention; Utilization of Natural Features for Stormwater Management – use vegetated swale instead of curb and gutter where applicable, drain roof-top runoff to pervious areas or capture for reuse	Manage both the quantity and quality of stormwater close to its origin, prevent stormwater impacts rather than mitigate , utilize simple, nonstructural methods – low cost and low maintenance – create multifunctional landscapes, use hydrology as framework for site design
Retrofit existing stormwater management facilities for water quality control	Ensure that systems are appropriate for quantity of stormwater and to improve quality
Educational displays	Enviroscape demonstrations, nonpoint source pollution information, etc.
Conservation easements	Voluntary agreements that allow an individual to set aside private property to limit the type or amount of development on their property
Maufactured products for stormwater inlets	Consider selected locations where other BMPs are not feasible
Onsite treatment	Manage impervious area runoff onsite
Utilize open drainage	Install curb and gutter only as required to maintain public health and safety
Green parking	Minimize the dimensions of parking lot spaces, utilize alternative paving in parking areas, encourage shared parking, provide economic incentives for structured parking, create shuttle service for remote parking
Alternative pavers/porous paving	Permeable surfaces should replace asphalt and concrete and can be used for driveways, parking lots, and walkways, i.e. paving blocks, porous concrete, crushed oyster shells, limestone, terrapave, tumbled glass
Proprietary structural controls	Selected locations where other BMPs are not feasible
Stormwater plan presentation to Planning Commission	Review site plan concept to encourage and assist developer with use of better site design practices

CONCLUSIONS

Tybee Island is a wonderful and unique place. Embracing the opportunity to address the critical issues of stormwater and water quality through innovative "green" design will only add to the uniqueness of this place. Keep your high quality of life here. Continue to build the environmental ethic that already exists in this place. And continue to seek innovative ways to address environmental challenges.

March 11-14, 2005
The Tybee Island Stormwater and Water Quality Charrette
Produced by the University of Georgia
College of Environment & Design, Center for Community Design, Planning and Preservation
and Department of Community Affairs
Electronic copy available at: www.sed.uga.edu/pso/pdf/charrettes/tybee2005.pdf