Project Summary

Phase 2 Non-Regional, Hilton Head Portion of Beaufort County Stormwater Quality Retrofit Project

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Introduction

The Phase 2 portion of the Beaufort County Stormwater BMP Retrofit Project called for the development and evaluation of possible BMPs in the Broad Creek basin on Hilton Head Island. The basin is mostly developed, with little property available for the large regional retrofits being considered in the remainder of the County, so the scope of the work was to focus on smaller non-regional BMP options. The scope was further narrowed down to include work on William Hilton Parkway between Matthews Drive and Shelter Cove Lane, as well as on Town owned property located in the same area and behind the Shelter Cove Mall.

Ward Edwards worked with the Town of Hilton Head to collect some basic survey information on stormwater structures in that area, for use in the BMP analysis and for use by the Town in the GIS stormwater inventory. In addition to the survey, both groups worked to gather record drawings of the existing stormwater infrastructure in the area, including plans from SCDOT and from the Shelter Cove development. A list of potential BMPs were developed and organized into a matrix that identifies their relative feasibility, effectiveness, and costs. The following report presents the BMP matrix and summarizes a select few BMPs as the project scope and budget allowed.

Survey Scope for William Hilton Parkway

Survey Scope for Shelter Cove Lane area

Survey Scope for Marshland Road area

Non-Regional BMP Matrix

BMP	Location	Type	Feasibility	Effectiveness	Cost
Retrofit Permeable Paving	Shelter Cove Mall Parking Lot	Runoff Volume Reducing	High	High	Medium
Retrofit *Filterra* Boxes	Shelter Cove Lane	Filtering Linear Road	High	High	High
Retrofit Bioswales	Shelter Cove Lane	Filtering & Runoff Reducing Linear Road	Medium	High	Medium
Irrigation Reuse	Shelter Cove Mall Parking Lot	Runoff Volume Reducing	Low	Medium	Medium
Blue Roof	Shelter Cove Mall Building	Runoff Volume Reducing	Low	High	High
Irrigation Reuse	Town Property Shelter Cove Area	Runoff Volume Reducing	Medium	High	Low
Control Structure Retrofit	Town Property Shelter Cove Area	Filtering & Runoff Reducing Regional	High	High	Low
Pond Bank Retrofits	Town Property Hwy 278	Filtering & Runoff Reducing Regional	Medium	Medium	Medium
Rainwater Drip Field Disposal	Wooded Area of Town Property Shelter Cove Area	Runoff Volume Reducing	High	Medium	Medium
Bioretention	Town Property Hwy 278	Filtering & Runoff Reducing Regional	Medium	High	Low
Underground Infiltration	Town Property Hwy 278	Filtering & Runoff Reducing Regional	Low	High	Medium
Filter Box Retrofit on Outfall	Hwy 278 Outfall Pipes	End of Pipe Sediment Removal	Medium	Low	Low
Median Bioretention	Hwy 278 Medians	Filtering & Runoff Reducing Linear Road	Medium	Medium	Low
Retrofit *Filterra* Boxes	Hwy 278 Curb Inlets	Filtering & Runoff Reducing Linear Road	Low	Medium	High

Note: BMPs order does not reflect priority or recommendation

BMP Summaries

Below is a summary of each BMP included in the Non-Regional BMP Matrix, and an explanation of their relative feasibility, effectiveness, and cost. Explanations are provided in greater detail for a select few BMPs, based primarily on a combination of the highest feasibility and lowest cost. It was beyond the budget of this study to detail out fourteen different BMP options, but it was desired to present as many options as possible.

1.0 Retrofit Permeable Paving (Shelter Cove Mall Parking Lot)

The existing Mall as Shelter Cove has approximately 1,000,000 ft^2 (23 acres) of impervious area over the 35 acre site. If agreements can be made to reduce the impervious area with the currently property owner or any future developer planning to re-develop the property, it would provide an overall reduction in the freshwater volume reaching Broad Creek. Lesser used parking could be converted to permeable paving to help reduce runoff without affecting the overall function of the property.

Feasibility - High

Converting current asphalt parking spaces to permeable paving is a simple construction process that can be phased to avoid interruption of use to large sections of parking. The repaving will not affect any existing utilities, will not require re-grading or adjustments to the drainage infrastructure, and should benefit the existing vegetation. The biggest obstacle is getting the property owner to agree to the work, but incentives may help with accomplishing this.

Effectiveness - High

The effectiveness is actually dependent on the amount of parking that can be converted to permeable paving. The higher amount of permeable paving converted, the greater the benefit will be. A conversion of fifty percent of the spaces to permeable material could provide an overall reduction of impervious surfaces on the site my more than ten percent. A secondary benefit would be a possible increase in the time of concentration for the basin, meaning the stormwater will reach the Broad Creek in a slower, more spread out period, thus reducing the impact of the freshwater on the saltwater river.

Cost – Medium

The cost could vary depending on the permeable material selected. Use of a gravel material would be fairly low cost, but aesthetic paving stones could be more costly.

2.0 Retrofit *Filterra* Boxes (Shelter Cove Lane)

Filterra is a type of proprietary manufactured stormwater treatment device that functions similar to bioretention systems in that they filter stormwater and use vegetation to promote evapotranspiration. The boxes contain an engineered soil media that, similar to the media installed in bioretention systems, filters stormwater runoff to remove contaminants. Small trees or shrubs are planted in the media and are used to uptake and transpire captured runoff. The boxes can be retrofit along existing streets near the existing curb inlets. The *Filterra* boxes can be located to capture the first flush runoff in the soil media containing shrubs or trees and treat it before discharging back to the existing storm sewer. Larger storms will bypass the boxes and drain through the conventional curb inlets, so the flood control of retrofit roads are unaffected. There may be other similar “bioretention boxes” by other manufacturers that could be considered as well.

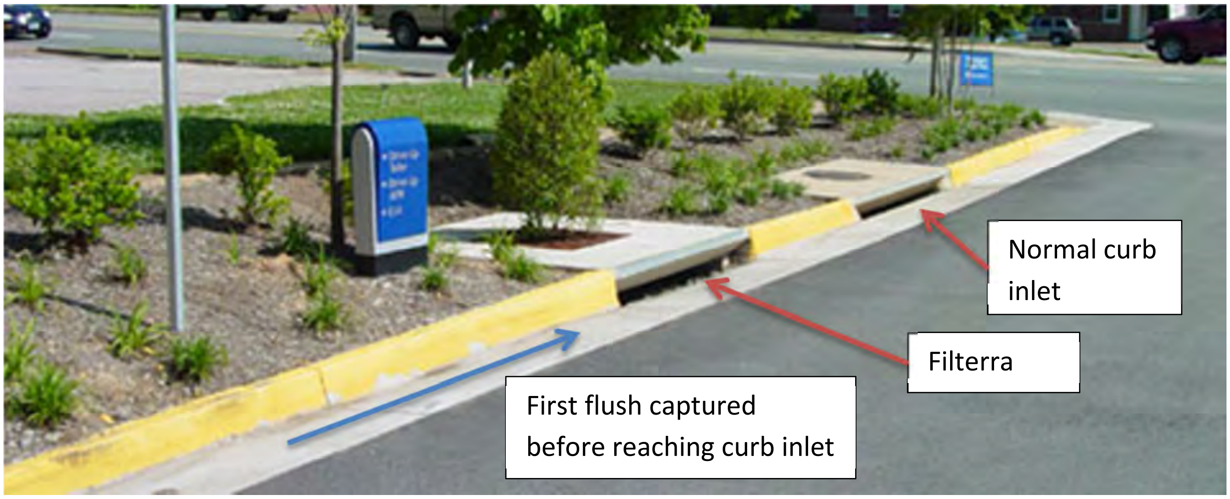

Figure 1 Typical *Filterra* installation (Picture from *Filterra* website)

Feasibility – High
The wide open shoulders of Shelter Cove Lane should make retrofit installation of the *Filterra* boxes fairly easy. The storm sewer pipes connecting the existing curb inlets should be deep enough to prevent conflicts with the retrofit boxes, and since the boxes will be in line with the existing curb inlets, there shouldn't be conflicts with any dry utilities or water/sewer lines. The biggest challenge would be getting the road owners to agree to the work.

Effectiveness- High
Since the treatment mechanics work similar to a bioretention system, *Filterra* boxes should provide good supplemental treatment of the runoff from Shelter Cove Lane. The road currently drains to a several ponds located along the marshes of Broad Creek, but it is unclear if those ponds were designed to handle water quality treatment. The ponds may only function as flood control structures and not provide adequate treatment of the first flush runoff. Beaufort County BMP worksheets in Appendix A indicate that, assuming the boxes function as bioretention, they will provide sufficient treatment of the road as a primary BMP.

Cost – High
The major drawback to this BMP would be the construction cost. In order to capture water from all portions of the road, two *Filterra* boxes will be required for each existing curb inlet (one on each side). With an estimated installation cost of $6000 each, the total project cost for the surveyed area would be approximately $144,000, assuming two boxes are placed around each of the twelve surveyed curb inlets. There are also maintenance costs associated with the boxes that would have to be considered, as the media would likely have to be replaced every few years and the plants must be maintained.

3.0 Retrofit Bioretention/Bio-swales (Shelter Cove Lane)
Similar in function and intent to the retrofit of the *Filterra* boxes, this option involves pre-treating the runoff from the road before discharging it to the existing curb inlets. The wide open shoulders of the road should allow room to construct shallow bio retention areas capable of capturing and treating the first flush. The BMP would be configured as an offline system, meaning the larger storms would bypass the bioretention system and drain directly to the existing inlets. Redirecting the first flush will require removal of some or all of the existing curb, depending on the BMP design and what the property owner

will allow. If a linear bio-swale type BMP is used, then the entire length of the curb will have to be removed to allow sheet flow off the edge of pavement to the swale. If a bioretention BMP is used, a break in the curb to allow concentrated discharge through flumes to the bioretention will be needed. In both cases, the existing inlets will have to be modified to be able to collect the bypass flow for the larger storms.

Figure 2 – Shelter Cove Lane Bioretention BMP Option

Figure 3 – Shelter Cove Lane Bio-Swale BMP Option

Feasibility – Medium

Limitations on the feasibility of this BMP mostly deal with getting the Mall owners to agree to a major change in the function and appearance of the road, particularly with the bio-swale option. They may not agree to removing curb and adding additional vegetation in the right-of-way. There are also some engineering challenges that could limit the feasibility. The presence of dry utilities may limit the depths of re-grading or installation of vegetation in certain areas. High groundwater may affect the soil media and planting depths of the BMPs. Additional soil testing and surveying would need to be done to fully assess the engineering feasibility.

Effectiveness – High

Bioretention and bio-swales both combine stormwater filtering and evapotranspiration treatment techniques, making them highly effective for bacteria treatment. It is likely the ponds to which the road currently drains were not constructed with water quality treatment in mind. The ponds do not have outlet structures to control the first flush runoff volume, so the bio-swale or bioretention would be good pre-treatment BMPs. The Beaufort County BMP worksheets for bioretention along Shelter Cove Lane (Appendix A) indicate the bioretention would even be effective as a primary BMP.

Cost – Medium

The cost to install bio-swales or bioretention should be less expensive than using structures such as the *Filterra*. Either option mainly requires minor grading and excavation, installation of the soil media, and planting of the vegetation. There will have to be some demolition work on the curb and some work on the existing curb inlets to assure collection of the bypass flow. If this option is pursued further, the scope and areas of installation will have to be better defined in order to prepare a construction cost estimate.

4.0 Irrigation Reuse (Shelter Cove Parking Lot)

The goal of this BMP option is to reduce the volume of freshwater reaching the Broad Creek by using captured stormwater to irrigate the existing vegetation within the open space in the Shelter Cove Mall parking lot. This will require capture of the stormwater, most likely in the existing ponds located on Town property, and then installation of a regional pumping and distribution system for the irrigation.

Feasibility - Low

There are a couple of challenges to overcome to make this option feasible. First is to determine if the existing ponds are tidally influenced. If the ponds receiving inflow of salt water during high tide, the stored water may not be suitable for use as irrigation. The second challenge is installation of the distribution system. Installing the pipes from the pond and to all the landscape islands in the parking lot could be difficult and costly. The Mall owners may not agree to cutting up existing pavement and installation by boring could be costly. If there are plans to redevelop the Mall property, it may be possible to incorporate the irrigation retrofit into those plans to improve the feasibility.

Effectiveness – Medium

Irrigation reuse is a runoff volume reducing BMP that, depending on the water needs of the existing vegetation, could have a large effect on reducing the volume reaching Broad Creek. It is also a seasonal benefit because with the plants likely going dormant during the winter months, there is little need for irrigation.

Cost – Medium

The cost of BMP installation would vary greatly depending on the circumstances of the retrofit. If it can be incorporated with the redevelopment of the Mall site, then the cost could be fairly low. However, if it is retrofitted to the existing parking lot, the cost could be more significant due to the need to bore pipes and/or cut and patch existing asphalt. There would also be annual maintenance and operation cost that need to be considered.

5.0 Blue Roof (Shelter Cove Mall Building)

This is another volume reducing BMP that involves capturing runoff and reusing it onsite. In this case, the reuse is a pan evaporation or spray evaporation system on the roof of the existing building. The evaporation would have some benefit to the building tenants and owner during the summer months, due to the cooling process involved in evaporation. It is believed that the use of one of these systems on the roof of a building would reduce the cooling costs in the interior of the building, by lowering the average temperature on the roof. Beaufort County introduced this BMP concept with the 2009 adoption of the Volume Control Ordinance.

Feasibility- Low

Building owners have been reluctant to use this BMP given the unknowns involved. These systems have been used elsewhere but not in the Lowcountry. Owners are also concerned about potential leaking or moisture problems that may arise. For this reason, this BMP is considered a low feasibility until a couple of pilot systems are installed and monitored in this area.

Effectiveness – High

It is estimated that during the summer months, a blue roof can evaporate as much as 0.1 gallons per square foot per day (assuming 8 hours of operation per day). At 320,000 ft^2, the current mall building could evaporate as much as 32,000 gallons per day. The effectiveness of the evaporation is seasonal, limiting its effectiveness in the winter months.

Cost – High

The construction cost could vary greatly depending on the type of system employed. A misting system would involve more equipment and have a higher operation cost, but shouldn't require modifications to the existing roof. The pan evaporation system would be less costly to install, but may require costly modification to the roof to handle the additional weight. There are also ongoing operation and maintenance costs, but these may be offset by potential cooling cost savings.

6.0 Irrigation Reuse (Town Property along Shelter Cove Lane)

The Town of Hilton Head owns the Shelter Cove Community Park which includes a large grassed area and numerous landscaping. It is unclear if this area is currently irrigated and if so, what the irrigation water source is, but there may be an opportunity to use captured rainwater for irrigation of the park. This is a volume reducing BMP that would have the added benefit of reducing potable water use, if that is the current source of irrigation. Rainwater capture and irrigation reuse on Town property was one of the strategies identified in the *Green Initiatives in Town Operations* report in November 2009.

Feasibility – Medium

The feasibility of this BMP option is dependent on whether or not the park currently has irrigation and what that source is. If it does have an irrigation system, it will have to be evaluated to determine if the source location can easily be altered. The easiest source of captured rainwater would be from one of the two ponds on park property; however, the water in the ponds will have to be evaluated to make sure it is suitable for irrigation. They may be receiving inflow from the adjacent salt water marsh during extreme high tides, making the water salty or brackish. Outlet structures and backflow preventers may need to be installed on the pond outfalls to prevent salt water intrusion. An alternate rainwater source could come from retrofit of an underground detention system, but this would add to the overall cost of the BMP.

Effectiveness – High

Irrigation reuse is a runoff volume reducing BMP that, depending on the water needs of the existing vegetation, could have a large effect on reducing the volume reaching Broad Creek. It is also a seasonal benefit because with the vegetation plants likely going dormant during the winter months, there is little need for irrigation. The BMP would also have an education benefit to the Town by acting as a sample project for the Town's green initiatives.

Cost – Low

The cost will be dependent on whether or not there is an existing irrigation system and dependent on its condition. If there is an existing system and the source can easily be altered, the overall cost would be low. The project would simply involve the design and installation of a pump, filter, and intake pipe into one of the existing ponds. The cost would be a little higher if a new irrigation system needs to be retrofit to the park, but the cost and scope of that can be adjusted to whatever budget is available for the project.

7.0 Pond Outlet Control Structure Retrofit (Shelter Cove Park)

It appears that the ponds located in the Shelter Cove development were not designed with water quality treatment in mind. At least one of the ponds located in the Shelter Cove Park does not have an outlet control structure on the outfall pipe, meaning stormwater collected in the pond is being discharged directly to the Broad Creek with very little attenuation. Ponds that are designed to control the first flush runoff typically have a control structure with a small low-flow orifice that will detail the first flush volume and release it over a 24 hour period. Retrofit of such a structure on the existing outfall pipes could significantly improve the water quality treatment of the ponds without negatively affecting their flood control capabilities. Another retrofit to consider would be the installation of backflow prevention devices on the outflow pipes to prevent extreme high tides from flowing saltwater into the ponds and reducing the available water quality storage volume.

Figure 4 – Shelter Cove Park: Possible retrofits include pond outlet structures, pond littoral shelves, irrigation reuse in landscaped areas, and rainwater drip field disposal in wooded areas.

Figure 5 – The existing outlet pipe in the Shelter Cove Park pond does not have a control structure. Retrofitting an outlet structure would improve water quality treatment.

Figure 6 – The discharge end of the pipe needs a backflow preventer to keep saltwater out of the pond and prevent loss of detention volume.

Feasibility – High

Installation of an outlet structure and a backflow preventer to the existing pipe should be an easy retrofit. The property is owned by the Town so no easements or property acquisition is needed. The design of the BMP should also be fairly simple, as outlet structures can be sized to control the first flush volume without reducing the peak flow out of the pond during larger storms. Permitting should not be difficult as the only permit needed would be SCDHEC-OCRM, which should be receptive to any efforts intended to improve water quality.

Effectiveness – High

Accomplishing first flush detention within the ponds could improve both the contaminant treatment, as well as reduce the volume of freshwater discharged. The effectiveness will depend on the size of the low flow orifice proposed. The smaller the orifice, the longer the runoff will be detained and treated. Figure 7 shows the estimated time-stage relationship for the pond with the culvert in existing conditions and with the proposed outlet structure installed. The blue line, representing the retrofit condition of an outlet structure with a 3” low flow orifice, demonstrates that water quality volume will be stored and released much slower than the existing conditions. The slower release will allow more time for treatment of the runoff by means of ultraviolet radiation, settling of sediment, and through contact with vegetation along the pond banks. The detention will also help reduce the effects of higher post development volume by spreading the discharge over multiple tide cycles. Additional modeling will be needed to properly design the outlet structure to prevent increases in the peak pond stages for the larger design storms, thus preventing upstream flooding.

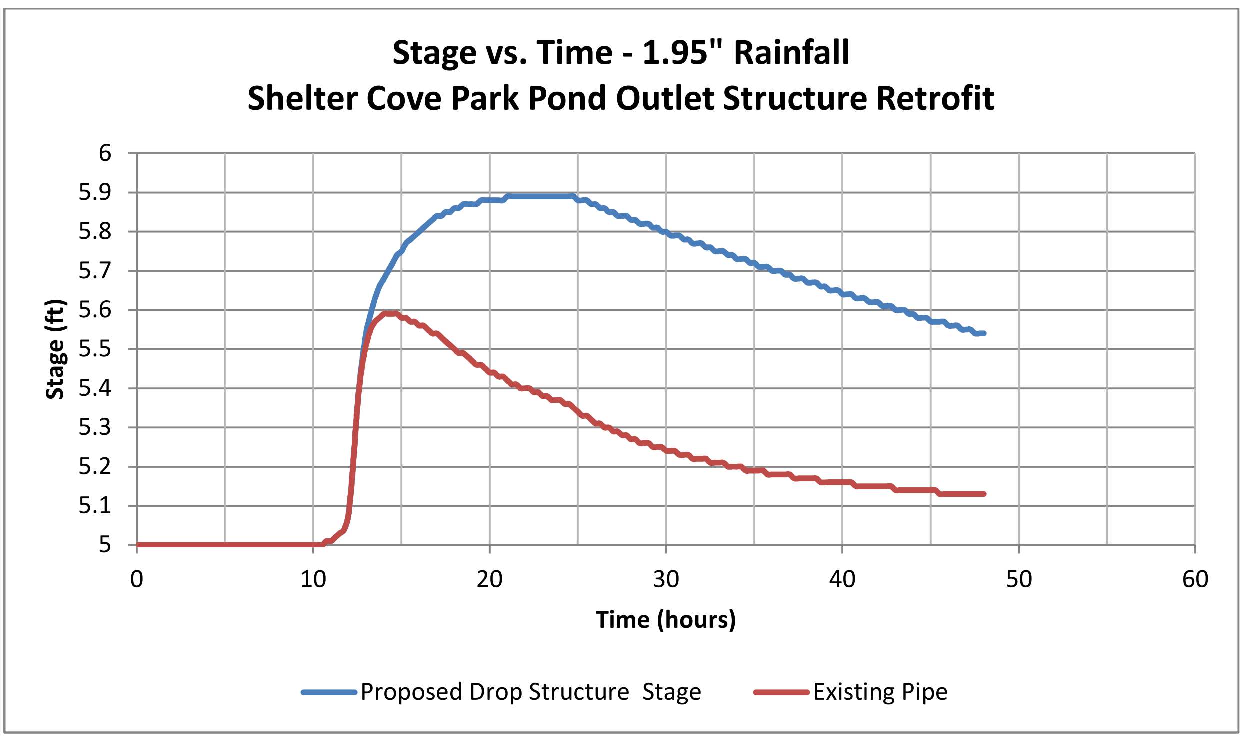

Figure 7 – Stage vs. Time chart of conceptual model of outlet structure retrofit to existing ponds.

Cost – Low

Adding a control structure and a backflow preventer to the existing pipe should be a relatively low cost BMP option. The material cost will consist of only the precast control box and the backflow valve. Installed cost for precast drainage structures typically range between $3000 to $6000. A backflow preventer like the *Tideflex* check valve would probably run in the same range of prices. Installing the BMP may require some dewatering of the pond, some minor grading work, and typical erosion control efforts, but those cost should be fairly low compared to some of the other BMP concepts.

8.0 Pond Bank Retrofits (Shelter Cove Park)

In addition to the retrofit of outlet structures to the existing pond outfall pipes, there may be some benefit to modifying the existing pond banks to incorporate littoral shelves. The ponds were not originally constructed with water quality treatment in mind, so the pond banks have fairly steep slopes. Vegetation on the slopes has naturalized and provides some treatment benefits, but the benefits could be much larger if the slopes were flatter and vegetation was targeted towards treatment. A 10 ft wide littoral shelf just below the water surface would provide additional area for vegetation growth, improve the treatment mechanisms, and could also increase the evapotranspiration from the pond.

Feasibility – Medium

Re-grading the pond banks will require widening the overall width of the pond in the disturbed areas, because flattening the slopes cannot be accomplished by filling. Fill added to the toe of the slope would be difficult to compact and stabilize, thus making it more likely to erode back to current conditions. Instead, the banks would have to be cut to the desired slope, effectively widening the pond. This may not be possible in certain areas around the ponds, due to existing trees, landscaping and hardscaping.

Effectiveness – Medium

Littoral shelves are believed to improve the water quality treatment ability of ponds for nutrients and bacteria contaminants. They also improve the evapotranspiration potential of the pond. The existing vegetation along the pond banks likely already provides some of these benefits, but the magnitude of those benefits could be increased by increasing the amount and the type of vegetation that would be installed on the littoral shelf.

Cost – Medium

The scope of the work is primarily grading and landscaping, but working with the existing ponds could be difficult and could drive up the cost. Significant dewatering and erosion control efforts will be required to accomplish the desired grading. The cost would also be dependent on the vegetation selected for the littoral shelf. The overall cost can be controlled by adjusting the scope and by careful selection of the proposed shelf locations.

9.0 Rainwater Drip Field Disposal (Wooded Area - Shelter Cove Park)

This BMP concept is a volume reducing strategy that will reuse captured stormwater from the existing ponds in the Shelter Cove Park, but instead of using it to irrigate the landscaped park property; it would be used to irrigate the existing wooded area. The system would function similar to drip field wastewater effluent disposal systems, by slowly releasing the water in a wide area within the woods, at a rate equal or less than the infiltration and evapotranspiration potential of the woods. The existing trees and undergrowth would transpire the rainwater and reduce the amount being discharged to the Broad Creek.

Feasibility – High

Although a system such as this is not typically used for rainwater disposal, it is commonly used for small wastewater treatment systems. It would require a pump system similar to an irrigation well, to pull water from one of the existing ponds and convey it to the wooded areas. A distribution system and drip pipes would be run through the woods on the ground surface or just below the forest litter. The pump rate of the system can be adjusted to maximize the flow output without creating runoff or negatively impacting the vegetation. Installation of the system should be fairly simple and is unlikely to cause impact to the existing park infrastructure.

Effectiveness – Medium

The drip field disposal concept is a runoff volume reducing BMP that, depending on the water needs of the existing vegetation, could have a large effect on reducing the volume reaching Broad Creek. It is a seasonal benefit because with the vegetation plants likely going dormant during the winter months, there may be less capacity for evapotranspiration; however there may still be some infiltration capacity in the soil that can be used.

Cost – Medium

The installation costs for this option should not be too high, as it is very similar to a standard irrigation system. The project scope could be adjusted as the budget allows and could be phased as needed. However, there would be ongoing maintenance and operation costs including supplying power to the pump system.

10.0 Bioretention (Town Property along William Hilton Pkwy)

Runoff from William Hilton Parkway within the project scope is currently untreated and discharges directly to the Broad Creek. The runoff collects in curb inlets and is conveyed by a system of pipes to eventually discharge to the river at three separate locations. The Town owns a number of parcels with right-of-way frontage along the parkway that may be of some benefit in treating the highway runoff. Although the parcels do not contain the main discharge points, it may be possible to re-route small portions of the drainage system and treat some of the runoff from the highway.

Figure 8 – Bioretention BMP to treat small areas of the existing highway

Feasibility – Medium

The primary limitation to the feasibility for this option is the inverts on the existing storm sewer pipes. Portions of the storm sewer may be too deep to capture at treat the runoff in a conventional bioretention BMP. The inverts may be at or below the seasonal high water table, meaning the bottom of the bioretention would be below the water table as well. Capturing runoff from the most upstream, shallowest boxes may be feasible. Another option is to consider a hybrid bioretention/created wetland BMP that would have a small intermittent wet pool. A secondary limitation to the feasibility would be getting SCDOT to permit the rerouting of the highway drainage. The work will require an SCDOT encroachment permit, meaning the SCDOT will have to review and approve any changes to the drainage system. Soil permeability is also a factor that could limit feasibility, because the soils would need a high permeability to make the system effective. Soil tests would need to be done to confirm existing groundwater elevations and the soil's permeability.

Effectiveness – High

Bioretention is one of the most effective structural BMPs for the treatment and removal of bacteria contamination, and should work effectively in this application. The feasibility limitation from the storm sewer depth issue will limit the potential service area, keeping it fairly small compared to the overall basin size. However, if the overall cost-benefit of the BMP is favorable and it can be applied in multiple small areas, the total benefit could add up to be significant.

Cost – Low

The construction cost would be limited to the installation of the bioretention area, the outfall pipe, and the connection pipe to the existing storm sewer. The Town property along William Hilton Pkwy is fairly open meaning it would be easy and low cost to work in the area. Installing the bioretention would mainly involve grading and landscaping. The installation of the connecting and outfall pipes would have limited impact to existing trees and utilities, with the only possible conflicts being within the highway right-of-way. There would likely be some sidewalks that would have to be replaced, adding somewhat to the cost.

11.0 Underground Infiltration (Town Property along William Hilton Pkwy)

This BMP concept is very similar to the concept discussed in the preceding section, except that instead of using a bioretention BMP in the Town property to treat runoff from the highway drainage system, the runoff would be treated by an underground infiltration system. The benefit to this option is that the underground system would allow the property to continue to look as it currently appears since the site can be restored to current condition once the underground system is installed. The concept will function very similar to the bioretention and has some of the same benefits and limitations.

Feasibility – Low

This option has a lower feasibility than the bioretention option due to the existing groundwater condition. In order to work properly, an underground infiltration system must be around 2 feet above the seasonal high water table. The existing Town properties are all fairly low in elevation above sea level and likely have seasonal high groundwater levels very near the surface. Because they are underground, the bottom of an infiltration system will be lower than that of a bioretention system, putting it close to the groundwater in a similar application. Just as with the bioretention, soil permeability is also a factor that could limit feasibility. The soils would need a high permeability to make the system effective. Soil tests would need to be done to confirm existing groundwater elevations and the soils permeability.

Effectiveness – High

Underground infiltration is less effective than bioretention in the removal of bacteria, but can be very effective in controlling freshwater volume if the soil has high permeability and high storage capacity. The feasibility limitation from the storm sewer depth issue will limit the potential service area, keeping it fairly small compared to the overall basin size. However, if the overall cost-benefit of the BMP is favorable and it can be applied in multiple small areas, the total benefit could add up to be significant.

Cost - Medium

The construction cost of underground detention is typically higher than that of bioretention systems, as there are a lot more material costs including the manufactured chambers, the connecting pipes, and the stone bedding. As these systems have become more common, market competition and contractor familiarity has driven down the cost; however, the overall cost could be expected to be higher than the bioretention for a similar application.

12.0 Filter Box Retrofit on Outfall (William Hilton Pkwy Outfall Points)

The easiest way to treat runoff from William Hilton Pkwy would be by an end-of-pipe method such as a hydrodynamic separator or media filter system at the collection system outfall points. SCDOT has been experimenting with the use of different types and with different manufacturers of these boxes over past few years, in both retrofit and new construction applications. In conjunction with SCDOT, the USGS did a study in 2005-2006 of four different types of boxes in Beaufort and Colleton County to evaluate their effectiveness in removing a variety of contaminants. All four boxes were hydrodynamic separator style boxes and all by different manufacturers. The study, available at http://pubs.usgs.gov/sir/2008/5150/pdf/sir20085150.pdf, found that the boxes were effective at varied degrees of removing suspended sediment, oil, grease, and trace metals, but less effective for nutrients and bacteria.

Feasibility – Medium

Physically retrofitting boxes to the pipe ends or inline with the outfall pipes should be fairly simple to accomplish; however, gaining approval from SCDOT to do so may be very difficult. The existing outfall pipes run through privately owned property, and it is unclear if SCDOT has drainage easements over the pipes. SCDOT may not be willing to go to the expense and effort to research and possible acquire the easements needed to install the structures. Survey of the pipe outfalls found that they are not being maintained and in some cases are collapsing. Based on these findings, installing the structures may also require replacing the outfall pipe and re-working the energy dissipation at the pipe ends. Another limit to the feasibility might be the type of structure that SCDOT would allow. A media filter type of box would be more effective than a hydrodynamic separator at treating the runoff for bacteria, but SCDOT may only allow the latter over concerns the media filter boxes may negatively impact the peak flow capacity of the storm sewer system.

Effectiveness – Low

As stated above, the research performed by USGS indicates the hydrodynamic separators are not effective at treating for bacteria. Installing these units would help with the overall water quality of Broad Creek by removing the sediments, oils, greases, and heavy metals common to runoff from streets, but would have little effect of the primary pollutant of concern, bacteria. Media filters are generally considered to be more effective in removing bacteria and would be a better in this application; however as mentioned above, SCDOT may not allow a media filter device.

Figure 9 – William Hilton Pkwy drainage system outfall pipe. The pipe is crushed and needs to be replaced.

Figure 10 – Media filter/hydrodynamic separator BMP option on William Hilton Pkwy drainage outfall

Cost – Low

While the material costs for media filters and hydrodynamics separators can be quite high when compared to other drainage structures, the labor costs and scope of disturbance for this type of BMP would be relatively low when compared to larger BMPs. Installing the BMPs may require repair or replacement of the outfall pipes and the rip rap aprons at the pipe ends, which would drive up the cost somewhat. Another potential cost that may be needed would be a gravel maintenance access road. If the boxes can be installed close to the highway right-of-way, the access roads will not be needed, or can be much shorter.

13.0 Median Bioretention (William Hilton Pkwy Medians)

The existing landscaped medians located along portions of Hwy 278 could be modified to function as bioretention BMPs and serve as pretreatment of runoff from the pavement. The application of this BMP will be limited to areas were the road surface is sloped to drain to the existing median and where the median has sufficient depth and width to accommodate a properly sized and designed bioretention BMP. Constructing the BMP would simply require adjustments to the existing drainage structures to allow 3" to 6" of ponding in the center of the median, amendment of the existing soils (if needed), and re-planting of the median with select vegetation.

Figure 11 – Bioretention BMP option within William Hilton Pkwy median

Feasibility - Medium

There are two primary limitations to the feasibility of this option, the physical limitations of the existing landscape islands, and chances of getting the project permitted by SCDOT. In order to fit a properly sized and designed bioretention cell, the existing landscape island will need to be at least 20 ft wide. That minimum width should provide room for shoulders along both edges of pavement and should provide room to slope down to a depth allowing 6" of ponding. The total bioretention depth should keep the ponding from backing up to the existing edge of pavement, and should prevent prolonged moisture in the pavement base. Assuring these conditions will be critical to gaining approval from SCDOT to construct the BMPs, as SCDOT will not want the pavement integrity undermined and will not want drainage situations that could be hazardous to motorists. SCDOT will also have concerns over the plant materials selected and the placement of the landscaping as they relate to driver visibility and safety. Lower growing shrubs are more likely to be approved than trees or large shrubs.

Effectiveness –Medium

As stated previously, bioretention BMPs are one of the most effective BMPs given their ability to filter and treat runoff for bacteria removal, and their ability to reduce volume by means of evapotranspiration. However, the effectiveness of this application will be limited by the amount of area served by the BMPs. In many cases, only the inside lanes drain to the landscaped medians, meaning only half of the pavement area is being served. In other applications, it may only be possible to treat a short linear length of the road due to changes in width of the median, existing trees that prevent the needed re-grading, or objects that limit the size of the BMP. However, if the overall cost-benefit of the BMP is favorable and it can be applied in multiple small areas, the total benefit could add up to be significant.

Cost – Low

The construction cost would be limited to the installation of the bioretention area and modifications to the existing inlets. Cost could be a little higher than typical onsite bioretention BMPs due to the need for traffic control or possible night work. Installing the bioretention would mainly involve grading and landscaping. The modification of the existing inlets would mainly involve raising the rim elevations and replacing the grates with a different style, which would not be very costly. There may be some existing utilities that will have to be worked around, but for the most part, they can probably be avoided.

14.0 Retrofit *Filterra* Boxes (William Hilton Pkwy)

This BMP option is similar to the retrofit proposed along Shelter Cove Lane. The concept calls for installation of *Filterra* or similar modular bioretention systems along the highway curb line. The boxes will capture runoff from the gutter line and treat the stormwater by means of filtering and evapotranspiration. The boxes contain an engineered soil media that, similar to the media installed in bioretention systems, filters stormwater runoff to remove contaminants. Small trees or shrubs are planted in the media and are used to uptake and transpire captured runoff. The boxes can be retrofit along existing streets near the existing curb inlets. The *Filterra* boxes can be located to capture the first flush runoff in a soil medium containing shrubs or trees and treat it before discharging back to the existing storm sewer. Larger storms will bypass the boxes and drain through the conventional curb inlets, so the flood control of retrofit roads are unaffected.

Feasibility - Low

There shouldn't be many physical constraints to installing the bioretention boxes. Existing water, sewer, and dry utilities shouldn't be along the existing back of curb, so there shouldn't be many conflicts. If the storm sewer pipes connecting the existing curb inlets are deep enough, the new boxes can be installed over top of them. The biggest challenge to the feasibility would be getting SCDOT to agree to the work. There are no instances of these types of structures being installed on SCDOT streets, so it would take a significant permitting effort to get SCDOT comfortable with the operation of the BMPs. It may take a trial installation of one or two boxes, plus help from the manufacturer to gain SCDOT approval.

Effectiveness- Medium

Since the treatment mechanics work similar to a bioretention system, *Filterra* boxes should provide good primary or supplemental treatment of the runoff from William Hilton Pkwy. The road currently drains directly to the Broad Creek, so the runoff currently receives no water quality treatment. The boxes could be used in conjunction with other BMPs such as the end-of-pipe filter boxes suggested previously. Beaufort County BMP worksheets in Appendix A indicate that, assuming the boxes function as bioretention, they will provide sufficient treatment of the road as a primary BMP.

Cost – High

The major drawback to this BMP would be the construction cost. In order to capture water from all portions of the road, two *Filterra* boxes will be required for each existing curb inlet (one on each side). With an estimated installation cost of $6000 each, the total project cost for the surveyed area would be approximately $252,000 to install 42 units around the existing 21 curb inlets. Installation of the boxes could be phased based on budget allowances. There are also maintenance costs associated with the boxes that would have to be considered, as the media would likely have to be replaced every few years and the plants will have to be maintained.

Appendix

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WARD EDWARDS, INC.
No. C00152
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PLAN REVISIONS

WARD EDWARDS
ENGINEERING • PLANNING • SCIENCE

P.O. BOX 381
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PH (866) 837-5250 / FAX (843) 837-2558
WWW.WARDEDWARDS.COM

NON-REGIONAL WQ RETROFITS
BEAUFORT COUNTY, SC

TOWN OF HILTON HEAD ISLAND
Beaufort County, SC

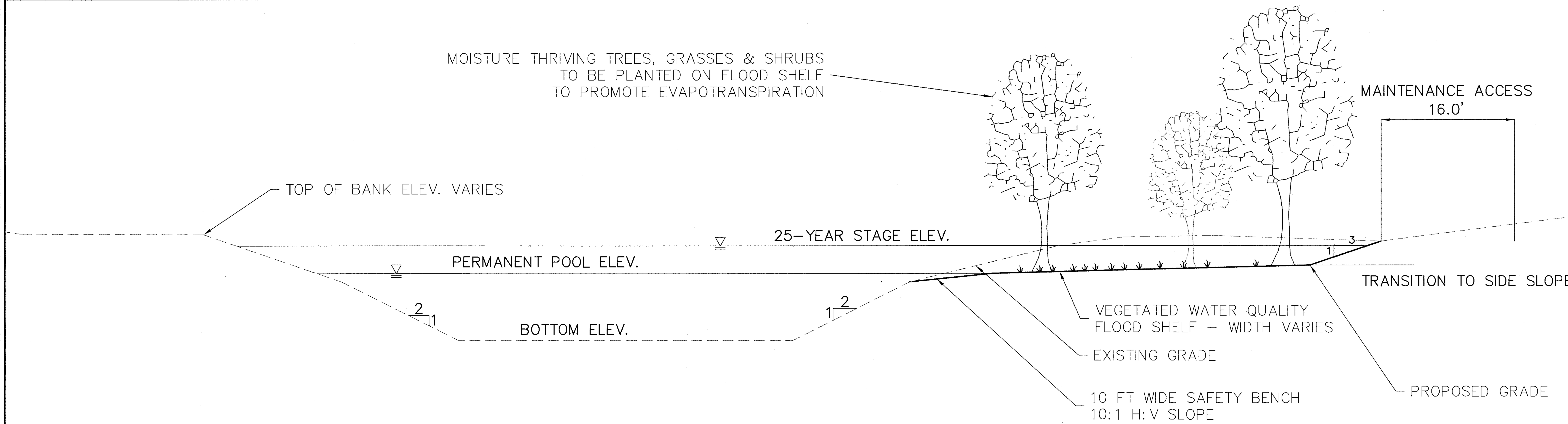
SURVEY SCOPE EXHIBIT

☑ NOT FOR CONSTRUCTION
☐ RELEASED FOR CONSTRUCTION

PROJECT #:	090100
DATE:	04/14/11
DESIGNED BY:	PRM
CHECKED BY:	HED
SCALE:	1"=400'

SHEET
EX.1

IF THIS SHEET IS LESS THAN 22" X 34" IT IS A REDUCED PRINT, SCALE ACCORDINGLY



POND BANK RETROFIT CROSS SECTION

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POND BANK RETROFIT EXHIBIT

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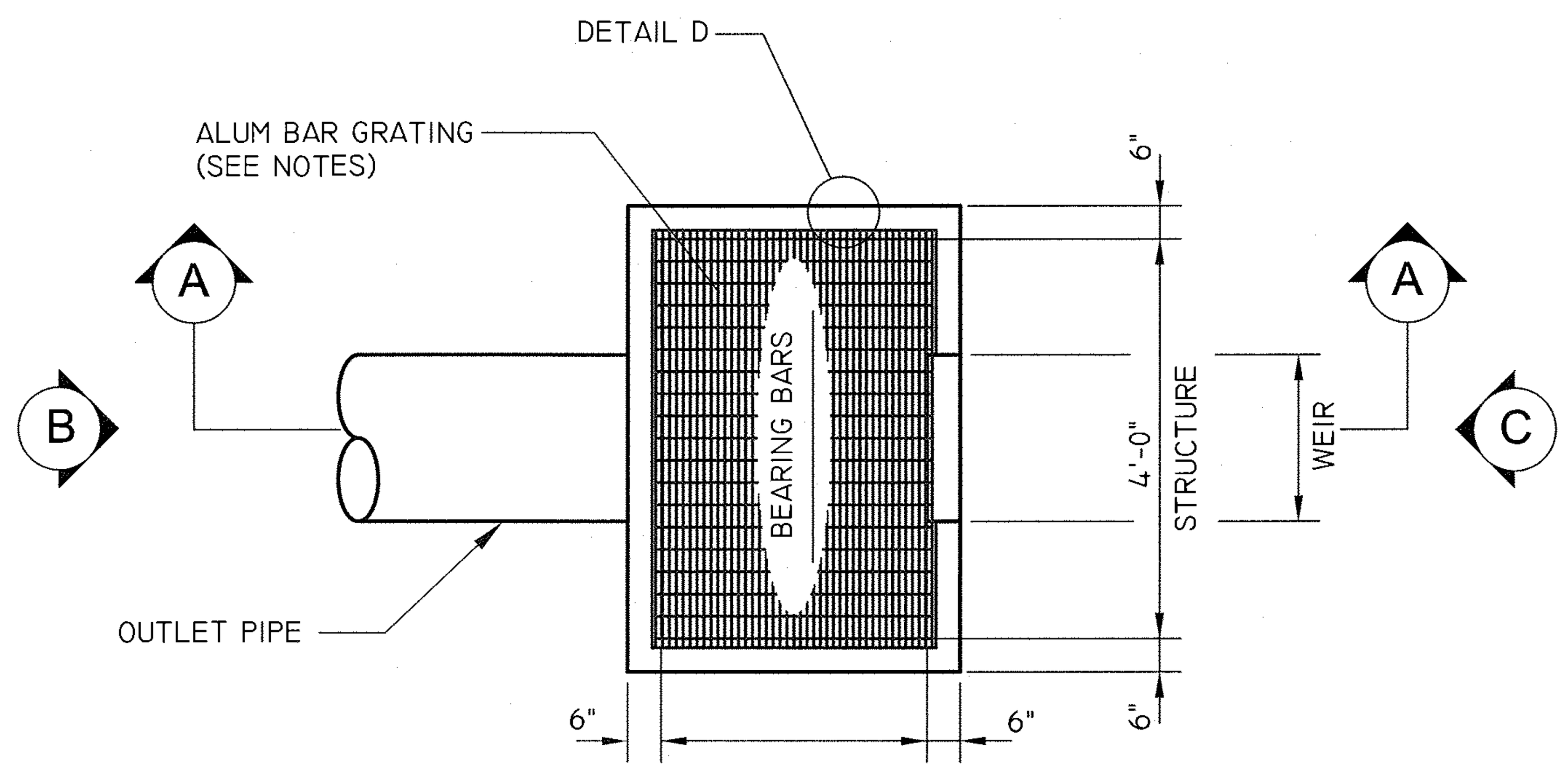
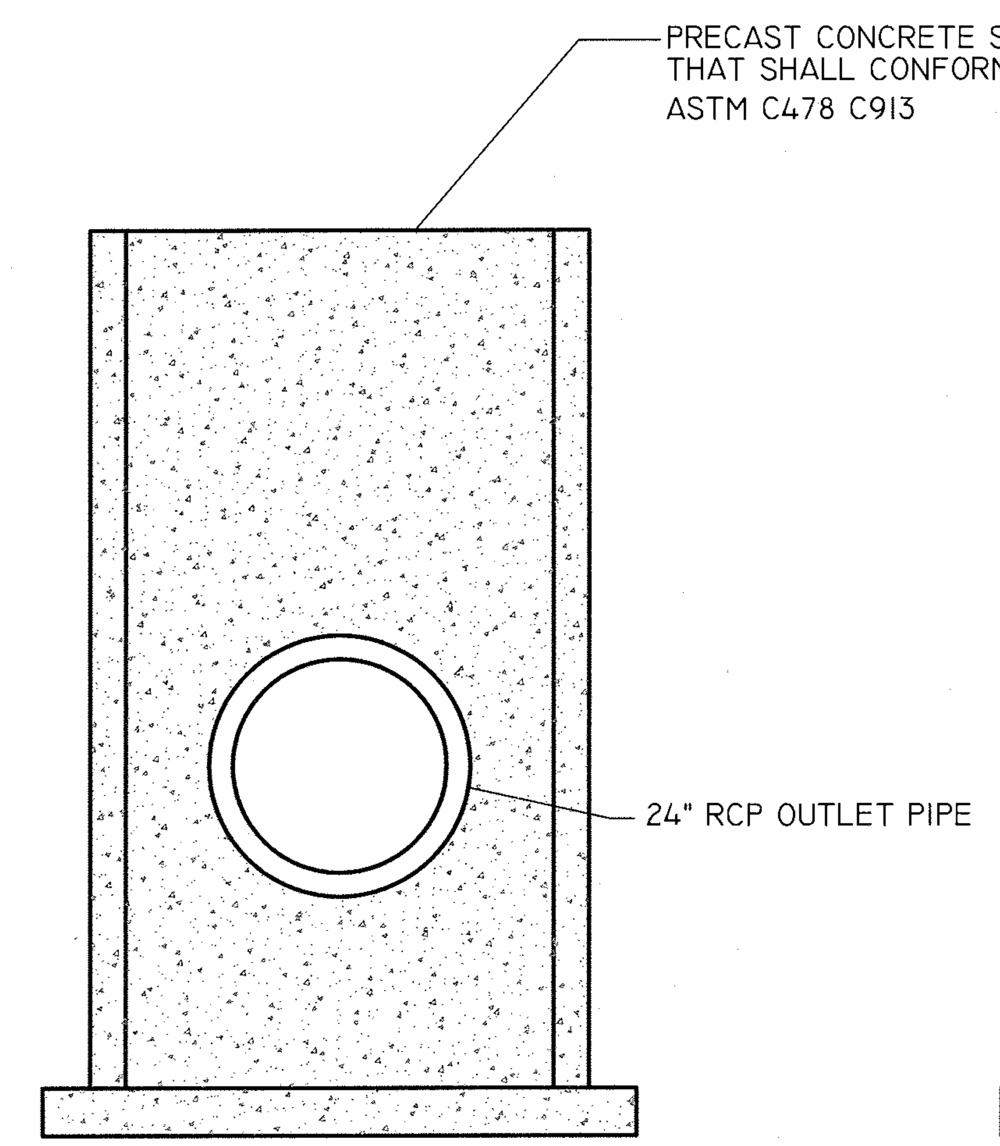
DATE:	04/14/11
DESIGNED BY:	PRM
CHECKED BY:	HED
SCALE:	N.T.S.

SHEET
EX.03

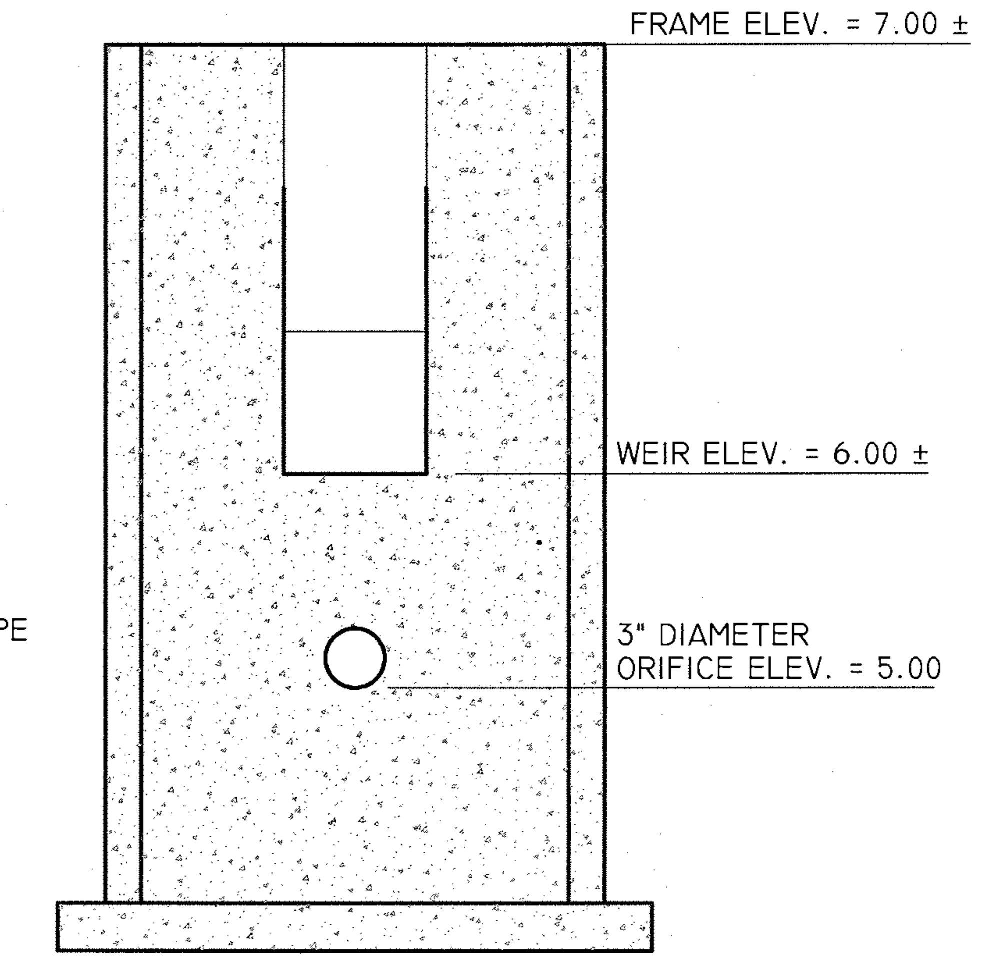
IF THIS SHEET IS LESS THAN 22" X 34" IT IS A REDUCED PRINT, SCALE ACCORDINGLY



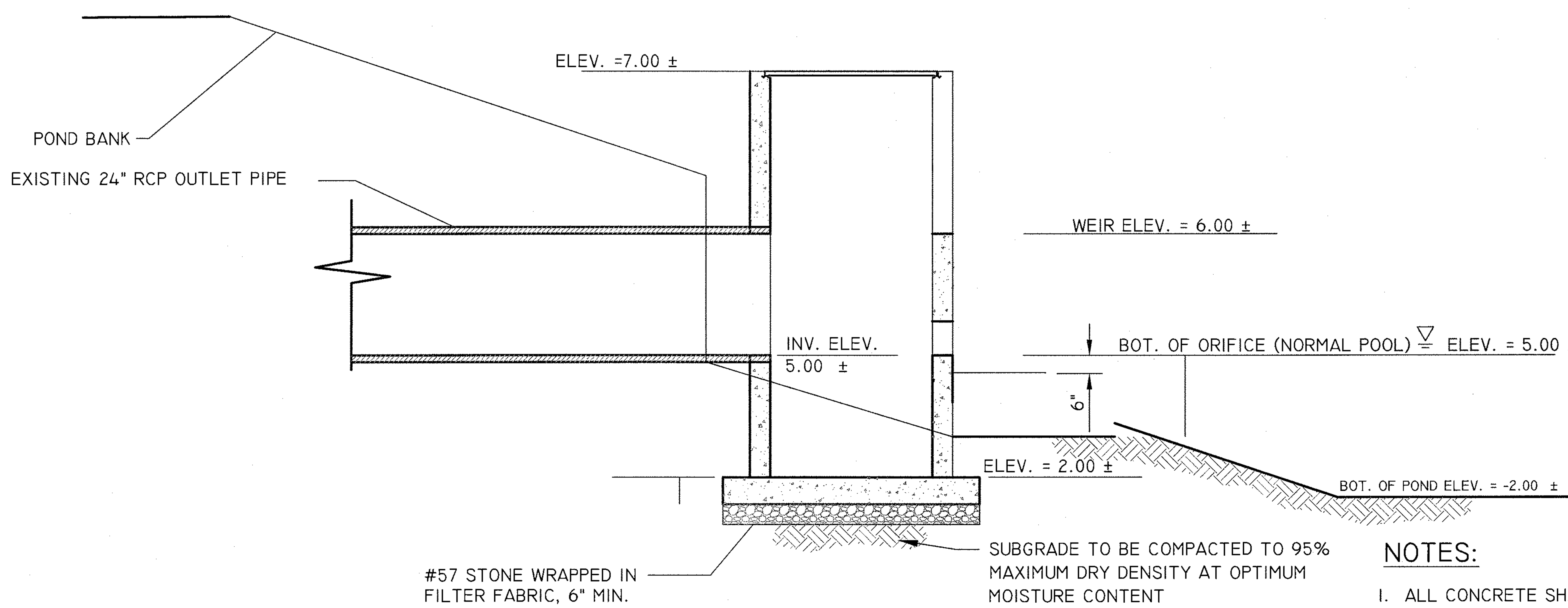
PLAN



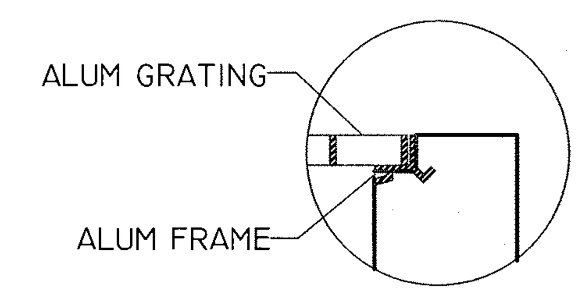
ELEVATION B



ELEVATION C



SECTION A-A



DETAIL D

CONCEPTUAL OUTLET STRUCTURE RETROFIT

NOTES:

1. ALL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI.
2. WHERE UNSTABLE FOUNDATION MATERIAL IS ENCOUNTERED, EXCAVATE TO DEPTH AS DIRECTED BY THE ENGINEER AND BACK FILL WITH ACCEPTABLE SOIL MATERIAL OR STONE.
3. ALUMINUM GRATING SHALL BE DESIGNED TO SUPPORT A UNIFORM LIVE LOAD OF 100 LBS. PER SQ. FT. WHEN SPANNING THE DIRECTION INDICATED. BEARING BARS SHALL BE PLACED NO MORE THAN 1 $\frac{3}{16}$" ON CENTER. CROSS BARS SHALL BE PLACED AT 4" ON CENTER.
4. EXPOSED PORTION OF STRUCTURE TO BE PAINTED "CHARLESTON GREEN" OR APPROVED ALTERNATIVE.

SOUTH CAROLINA WARD EDWARDS, INC. No. C00152 CERTIFICATE OF AUTHORIZATION

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Beaufort County, SC
OUTLET STRUCTURE RETROFIT EXHIBIT

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SHEET
EX.03

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