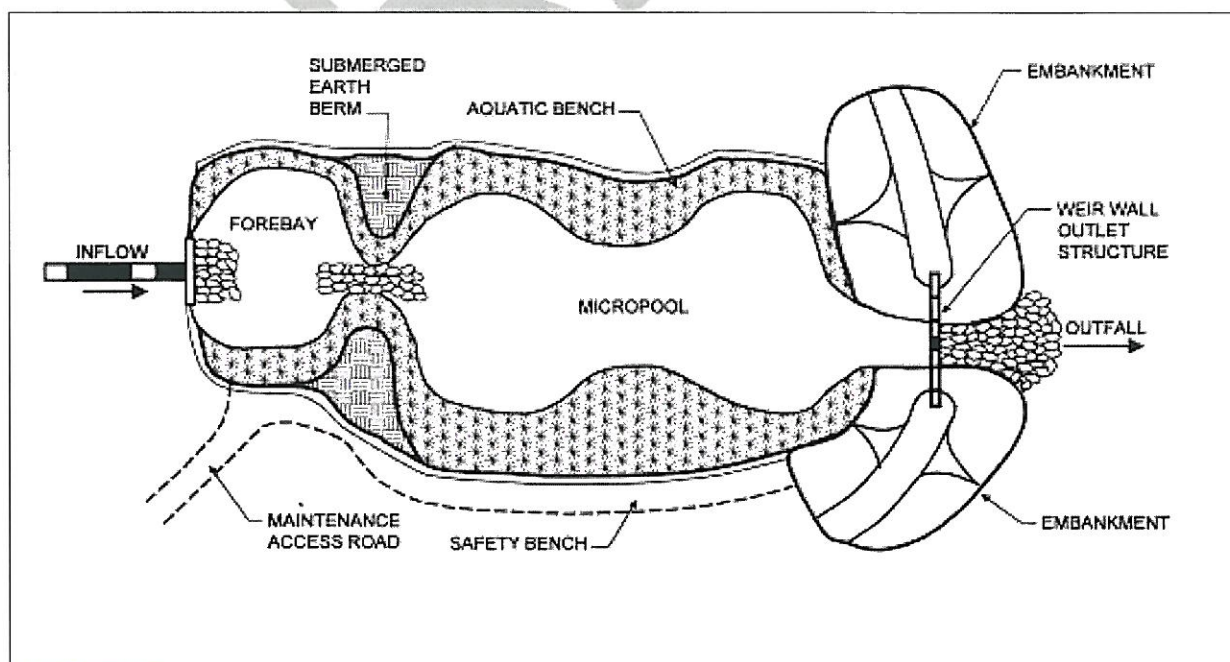


## Wet Detention Pond Guidance Sheet

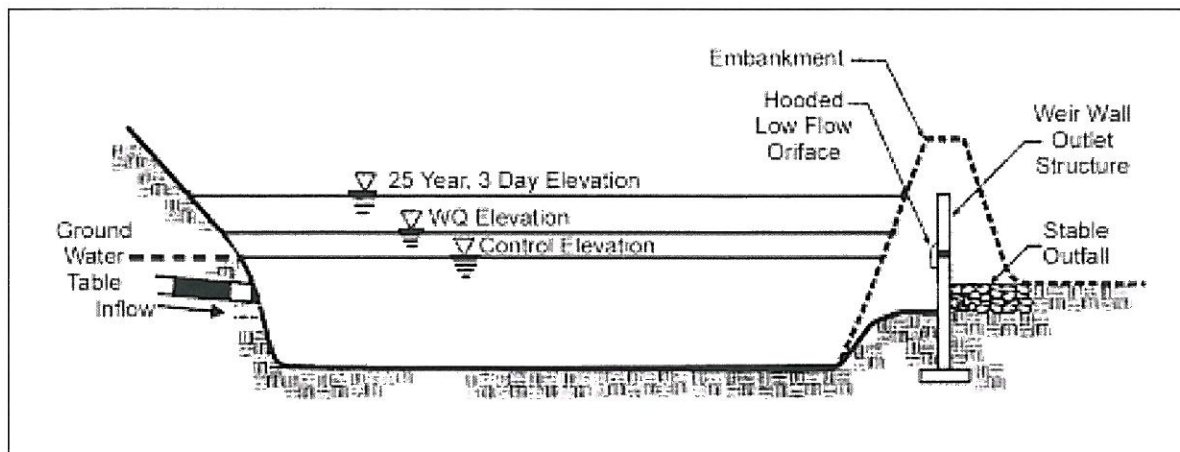
### Description

Wet detention ponds are designed to maintain a permanent pool of water at the seasonal high groundwater level and provide temporary storage of runoff until it is released, gradually, at a controlled rate. These systems are more efficient in removing soluble pollutants (nutrients) than dry detention due to the biological activity in the vegetation and water column. Enhanced designs include a forebay to trap incoming sediment where it can be easily removed. A littoral zone or aquatic bench should also be established around the perimeter of the pond. **Figure X-X** shows a schematic of a cross-section of a wet detention pond.

Ponds treat incoming stormwater runoff by settling and algal uptake. The primary removal mechanism is settling while stormwater runoff resides in the pool. Nutrient uptake also occurs through biological activity in the pond. Wet ponds are among the most cost-effective and widely used stormwater treatment practices. While there are several different versions of the wet pond design, the most common modification is the extended detention wet pond, where storage is provided above the permanent pool in order to detain stormwater runoff in order to provide greater settling.



**Figure X-X.** Schematic of a typical wet detention pond.



**Figure X-X.** Cross-section schematic of representative wet detention pond.

### **Design and Siting Criteria**

#### ***Hydrology***

A wet pond should maintain a permanent pool in the deeper areas at all times, with the exception of driest periods. It should receive flow from rain, runoff, and ground water rise. The permanent pool, generally at the high groundwater elevation, is necessary in order to maintain vegetation in the pond and adjacent areas. Florida precipitation is well-suited to maintenance of permanent pools in wet ponds. To aid in maintaining the permanent pool, the drainage area for a wet detention pond should be 10-25 acres.

The permanent pool storage capacity should provide at least a 21-day residence time during the wet season (June 1 – October 31). This allows for important pollutant removal processes to take place including the uptake of nutrients by algae and other vegetation, adsorption of metals and nutrients, oxidation of organic materials, and sedimentation. The most important and time-consuming of these processes for water quality is the uptake of nutrients.

- The drainage area should be 10-25 acres
- The permanent pool storage capacity should provide at least a 21-day residence time during the wet season (June 1 – October 31)
- The design treatment volume should be the larger of the following criteria:
  - (a) one inch of runoff over the drainage area
  - (b) 2.5 inches times the impervious area (excluding water bodies)

- One half of the required treatment volume should be discharged from the outlet within 24-30 hours after a storm event. However, no more than one half of the volume should be discharged within 24 hours.
- To avoid resuspension of settled out solids, nonerosive velocities should be maintained along the pond bottom during peak runoff events.

### ***Pond Sizing and Configuration***

A wet pond should have a length to width ratio of 2:1 and be wedge shaped with the narrow end at the inlet. If the site does not allow this configuration, then the effective flow path can be increased by adding islands, baffles, and other additions to increase the travel length of the water. The design should promote good mixing with no "dead spots" to maximize treatment. The configuration should also allow for the 14 day residence time to maximize treatment of the water.

The pond slopes should be at a 3:1 ratio for safety and to promote settling of sediments. Shallower areas in the pond, such as the littoral zone, should have slopes of around 6:1 to promote vegetation growth and should go to a depth of 2-3 feet below the normal water surface elevation. The shore slopes should be between 5:1 and 10:1 to allow for easy maintenance and safety of the public.

The maximum depth of a wet pond should be 12 feet with an average depth between 2 and 8 feet. (3) If a pond is too deep, stratification and anaerobic conditions may develop. Anaerobic conditions should be minimized to prevent release of nutrients and metals from the sediments on the bottom of the pond. However, if the pond is too shallow, sediment re-suspension is more likely and excessive growth can cause the pond to become eutrophic.

The forebay of the pond is necessary to capture coarse sediment, prevent sediment accumulation, and limit erosion. The forebay should be a small pond separated from the main pond by a berm. This forebay should be located at the inlet between 4-6 feet deep to allow for sedimentation and dissipation of energy. Allowing the majority of the sediments to fall out in this area will keep the wet pond from accumulating sediment and will also allow for easier removal of the sediment without disturbing the wet pond habitat. A permanent marker should indicate the depth of sediment accumulation. The forebay should contain about 10-15% of the permanent pool volume.



Concentrated runoff should flow through a sediment trap (see section X) or a dry detention/retention area (see section X) upstream of the wet pond. A vegetated filter strip may be utilized for sheetflow.

- A wet pond should have a length to width ratio of 2:1
- The maximum pond depth is 12 feet.
- The pond area should represent 3% of the drainage area, sized to treat the water volume and mitigate peak rates for larger events.
- The configuration should allow for the 14 day residence time
- The pond slopes should be at a 3:1 ratio

### **Soils**

The soils under the wet pond should have a permeability of  $10^{-5}$  to  $10^{-6}$  cm/sec to decrease infiltration and aid in maintaining the permanent pool. Site soil conditions should be confirmed during excavation to ensure that soils are consistent with design soil conditions. Hydrologic soil groups C and D are typically suitable without modification. However, soil groups A and B may require some modifications to aid in reducing permeability. This is necessary to ensure that the pond will not be affected by excessive infiltration.

Care should be taken to minimize ground water interaction for normal water table levels. Ground water interaction could cause mixing and pollution of the pond and/or ground water.

### ***Vegetation***

The vegetation component of the wet pond system functions to enhance removal of pollutants, reduce algal growth, reduce erosion, create habitat, and reduce temperature fluctuations. The littoral zone of the wet pond should cover at least 30% of the pond surface area. This percentage is what is found in natural systems; however more vegetation may promote nutrient removal from the water. The littoral zone should have 80% coverage of vegetation within two years of construction. It is recommended that this percentage be met at construction by planting the littoral zone. An alternative to a littoral zone is to increase the pond volume by adding 50% of the original volume, or by pretreatment of the water before it enters the pond.

Native and non-invasive plants should be used when planting the littoral zone and all other vegetated areas around the pond.

### ***Maintenance***

Accessibility of the pond for maintenance is crucial. There should be easy access for mowing and other equipment around the pond and on any embankments. Maintaining the pond is important to keep the pond functioning as it was designed to. Proper maintenance can add to the treatment efficiency and the longevity of the pond. Guidelines for a maintenance schedule are as follows. However, each system is unique and may need more attention than others.

## **Specifications**

These specifications are intended to serve as general guidelines, but the materials presented are intended for typical applications of wet ponds, and are not meant to limit or exclude other materials. Detailed specifications by the designer should take the specifics of the intended site into consideration.

### **Excavation:**

- Excavation of the wet pond area should be to a specified depth below the desired bottom elevation in order to accommodate any liner, accumulated organic matter, and planting materials.
- Excavation depth should not penetrate any impervious soil or rock layer that is functioning to prevent groundwater intrusion. The controlled water depth for wet pond excavations should not exceed 12 feet.

### **Subsoil Preparation:**

- Subsoil must be delivered as frozen or muddy material, and should be inspected to ensure that it does not contain ashes, hardpan, slag, stiff clay, hard clods, construction or demolition debris, or other undesirables.
- The subsoil material should be broken with a rototiller to a depth of 8-10 inches in thickness.
- The subsoil should be rolled to a dense seal with 4-6 passes of a roller. The compacted soil layer should be at least 8 inches thick.

### **Topsoil:**

- A minimum 12 inches of topsoil should be installed in the emergent vegetation zone of the pond.
- This vegetation zone should be less than 18 inches thick.
- For sandy soils, topsoil must have at least 8% organic content in the A horizon of the soil. Other soil types must have 12% organics.
- Vegetative zones should be evaluated after soil placement but prior to planting to ensure appropriate grading and compatibility with the planting plan.
- Side slopes should be stabilized with vegetation within 3 days of construction.

- A post-construction bathymetric survey should be conducted by a professional surveyor.

#### **Planting:**

- A planting plan should serve as a guideline for installing vegetation. This plan should be consistent with SFWMD requirements and local Land Development Code requirements.
- Only plants from the Florida Native Plant List (refer to this elsewhere in the manual) are to be used. Planting locations shall be consistent with those in the planting plan and should be directed by a field ecologist specializing in wetlands.
- All plants should be inspected for the presence of live buds or shoots as well as firmness and resilience. Soft or mushy stock should not be used for planting. The plants should also be free of disease, defects, and insect infestation, or any other characteristics that could adversely affect the survival and, ultimately, the performance of the vegetation.
- Plant stock should not contain any plants or seeds associated with nuisance or invasive plant species.
- Plants should be kept free from extreme temperature changes, wind, and sun during transit to the wet pond site.
- Vegetation should be watered regularly until accepted.
- The planting plan should designate areas requiring regular maintenance, such as areas to be mowed.
- Detailed planting specifications can be found in Appendix X.

#### **Maintenance:**

- Eroded areas or undercut banks should be repaired on an as-needed basis in order to maintain embankments and side slopes.
- Areas designated in the planting plan should be mowed on a monthly basis.
- Inlets and outlets should be cleaned on a monthly basis, with any debris removed.
- The control structure and facility should be inspected every six months or following a major storm event for any type of system damage, sediment



accumulation, and damage to the inlet and outlet. Any damage or hindrance to system operation should be repaired following this inspection.

- Fertilizer use should be used only as a last resort.
- The forebay should be cleared from accumulated sediments every five years.
- Upon a significant change in pond volume or change to eutrophic status, a major undertaking of sediment removal should be conducted. This type of maintenance may be necessary in the long-term life of the wet pond, such as 20-50 years following construction.

### **Regulations**

All applicable SFWMD and County regulations concerning stormwater treatment, surface water management, excavation, and spoil removal and disposal must be met. The appropriate development permits for the wet pond project, including excavation, must be secured by the appropriate SFWMD and County authority. The required setbacks are detailed in the individual County Land Development Codes. For Lee County, these setback requirements are contained in Section 3, Surface Water Management, of the Land Development Code. For Collier County, surface water management systems are addressed in Section 6 of the County Land Development Code.

### **Pollutant Removal Efficiency**

Nutrient removal efficiency in wet ponds is dependent on the residence time. Based on at least a 21-day residence time during wet season, nutrient removal in wet ponds ranges from

### **References**

- (1) SFWMD BMP Manual
- (2) Stormwater Management Fact Sheet
- (3) SJRWMD Handbook
- (4) Lee County (2007). "The Planted Littoral Zone." Brochure. Ft Myers, FL.



- (5) DB Environmental, Inc. (2005). "Quantifying the Effect of a Vegetated Littoral Zone on Wet Detention Pond Pollutant Load Reduction". Final Report prepared for the Florida Department of Environmental Protection, Tallahassee, FL.
- (6) Florida Department of Environmental Protection- [www.dep.state.fl.us](http://www.dep.state.fl.us)
- (7) SWFWMD [www.swfwmd.state.fl.us](http://www.swfwmd.state.fl.us)
- 8<sup>th</sup> Conference proceedings
    - Quantifying the Effect of a Vegetated Littoral Zone on Wet Detention Pond Phosphorus Load Reduction
    - Effects of Residence Time and Depth on Wet Detention System Performance
  - Basis of Review
    - Reviews design criteria for wet detention ponds
  - Stormwater Research Projects through 2005
    - Comparative Water Quality Data of a Deep and a Shallow Wet Detention Pond
- (8) Dr. Mark Clark, personal comm..
- (9) Pennsylvania BMP Manual
- (10) USEPA. Storm Water Technology Fact Sheet: Wet Detention Ponds (EPA 832-F-99-048) 1999.