Structural Controls

Structural controls include water quality basins, infiltration basins, and catch basins to regulate or impound runoff. These structures detain and filter water through plant material prior to discharge and can reduce runoff quantity as well as nutrient and pesticide discharge.

Subsurface Drainage. Subsurface drainage directs drainage water and can reduce runoff and leaching. Subsurface drainage is also installed to control a water table or to interrupt subsurface seepage or flow. Where possible, directing this drainage into vegetative areas for biological filtration or infiltration basins helps to control the potential loss of nutrients and pesticides from the golf course, rather than directly draining it into surface water.

Water Quality Basins. These basins are designed to capture the "first flush" runoff and provide water quality treatment primarily through physical settling of sediment-based pollutants. These basins can be constructed by excavation or embankment (or both) to create a ponding area sufficient to handle the required water quality volumes. Planting wetland species in the bottoms of these basins achieves additional quality control through biological filtering and uptake. The discharge system for basins can include a gravel underdrain layer with a small diameter perforated drainage pipe to slow dissipation of runoff over an extended period. Gravel underdrains without an outlet can also provide a measure of infiltration and groundwater recharge where appropriate. Finally, higher intensity storms can be routed through water quality basins for proper flood control and flow attenuation.

Wet Ponds. These ponds are earthen embankments or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water retention basin. Wet ponds are one of the most effective structural BMPs for protecting water quality. Wet ponds at the golf course use a permanent water surface to achieve a high removal rate for sediment, nutrients, and metals. Aquatic plants and biochemical processes within the ponds enhance the removal of nutrients, metals and other pollutants. Secondary benefits include recreation, aesthetics, and wildlife habitat.

Pollutant removal efficiencies of wet ponds vary based on the pollutant of concern and the size of the permanent pool. The highest removal efficiencies are achieved in larger ponds at the golf course, where the ratio of basin volume to the volume of runoff from the average storm is greatest. Wet ponds are also effective in reducing peak discharges, downstream flooding, and stream bank erosion at the golf course.

This feature traps and removes sediment and sediment-attached substances from runoff. Trap control efficiencies for sediment and total phosphorus transported by runoff may exceed 90% in silt loam soils. Dissolved substances, such as nitrates, may be removed from discharge to downstream areas because of the increased infiltration. Where geologic conditions permit, the practice leads to increased loadings of dissolved substances toward groundwater. Water temperatures of surface runoff, released through underground outlets, may increase slightly because of longer exposure to warming surfaces during its impoundment.

Infiltration Controls. Infiltration controls are a general category of structural BMPs that maintain or enhance the ability of water to percolate through the soil profile. Infiltration generally improves water quality by

allowing natural physical, chemical, and biological processes to remove pollutants. Pollutant removal in an artificial media or natural soil profile occurs through filtration, absorption, and oxidation by soil microorganisms.

Catch Basins. Catch basins are used primarily as a pretreatment device for the removal of coarse grit, sand, and debris. This pretreatment extends the life and performance of the other BMPs. From the catch basins, runoff is conveyed to the other water quality BMPs.

Wetland and Riparian Zone Protection. Wetlands and riparian areas are often continuums along rivers, streams, and coastal waters and are particularly sensitive to landscape changes and fragmentation. These areas play a critical role in attenuating nonpoint source pollution by intercepting runoff, subsurface flow, and certain groundwater flows and then removing, transforming, and storing pollutants (such as sediment, nitrogen, phosphorus, and certain heavy metals). In addition, they provide aquatic habitat, stream shading, flood attenuation, shoreline stabilization, and groundwater recharge. Wetlands and riparian areas are often highly regulated by the state and local regulatory authorities.

Constructed Wetlands. Constructed aquatic ecosystems features poorly drained soils and rooted emergent hydrophytes, which simulate the role of natural wetlands in water purification. These structures efficiently remove certain pollutants (nitrogen, phosphorus, metals, sediment, and other suspended solids) and can treat wastewater, such as discharges from equipment wash pads. Once these areas are constructed, however, they are considered wetlands and regulated as such.