CHAPTER 6

WET PONDS

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DEFINITION

Wet ponds are designed to have a permanent pool of water, which prevents the resuspension of sediments in the pond from previous storm events. Microorganisms and plants in the permanent pool assist in biological uptake and degradation of pollutants. Additional storage is provided above the permanent pool to detain stormwater. Properly designed wet ponds can achieve both pollutant removal and peak discharge reduction.

EFFECTIVENESS

A properly sized and maintained wet pond can achieve a high removal rate of sediment, BOD, nutrients and trace metals. The high removal rate of wet ponds is primarily attributed to the permanent pool of water which provides for gravity settling of sediment, chemical flocculation, and biological uptake of pollutants.

Wet ponds can be effective in controlling post-development peak discharge rates to pre-development levels for desired design storms. Wet ponds, are not, however, effective in controlling post-development increases in total runoff volume from a project site.

Wet ponds are not without negative impacts. These include possible thermal impacts on cold water fisheries, potential safety hazards, occasional nuisance problems (e.g., odor, algae, and debris), and the eventual need for sediment removal. However, with proper maintenance the nuisance problems should be minimal. The primary limitations for the use of wet ponds are soils, terrain features and drainage area size. Soils must be either Hydrologic Group C or D, and have an infiltration rate that is less than 0.5 inches/hour (New York Department of Environmental Conservation, 1993). If the foregoing soil conditions can not be met then the pond may have to be lined or constructed into the water table.

The United States Environmental Protection Agency (1993) list the following percent removals of wet ponds:

Pollutant	TSS	TP	TN	COD	Pb	Zn	Factors
Average	60	45	35	40	75	60	Pool volume
Reported Range	(-30)-91	10 - 85	5 - 85	5 - 90	10 - 95	10 - 95	Pond shape
Probable Range	50 - 90	20 - 90	10 - 90	10 - 90	10 - 95	20 - 95	
No. Values	18	18	9	7	13	13	

The pollutant removal capability of two wet pond facilities were evaluated during the Washington, D.C. area NURP study. The wet ponds were found to be effective in removing particulate pollutants, with long-term average removal for the two ponds of 54% for sediment, 30% for chemical oxygen demand, 51% for zinc, 65% for lead, and approximately 20% for both organic nitrogen and phosphorus. In general, the removal of particulate pollutants in the wet ponds was very similar to that observed in extended detention ponds. Removal of organic materials was slightly lower in wet ponds in comparison to extended detention ponds, perhaps as a result of export of biomass and/or detritus from the ponds. The wet ponds were more effective in removing soluble nutrients with long term removal of 60% of the nitrate and over 80% of the soluble phosphorus recorded during the course of the study. Uptake by algae and aquatic plants was apparently responsible for the removal (Schueler, 1987).

Wet ponds monitored at other NURP projects followed the same pattern of pollutant removal observed in the Washington, D.C. area, with high sediment and trace metal removal, moderate removal of organic nutrients and COD, and apparently high removal of soluble nutrients. The absolute level of pollutant removal was found to be primarily a function of the ratio of pond volume to watershed size. Relatively undersized wet ponds had low and occasionally negative removal efficiencies, while moderate to large-sized ponds had correspondingly higher removal rates (Schueler, 1987).

PLANNING CONSIDERATIONS

Wet ponds require a drainage area of at least ten acres to generate sufficient water to keep the permanent pool full. As an alternative, the pond may intercept the ground water table. Wet ponds should not be constructed in natural wetlands or stream channels. Wet ponds should not receive continuous base flow as this will tend to keep the particulates in suspension and limit detention time needed for nutrient removal.

Wet ponds are not feasible in areas with shallow bedrock and highly permeable soils. In most cases a wet pond will consume less than 5% of the total watershed area. They do, however, require a relatively flat area at the bottom of the watershed.

The United States Environmental Protection Agency (1993) lists the following advantages and disadvantages for wet ponds:

ADVANTAGES	DISADVANTAGES
-Can provide peak flow control -Can serve large developments; most-cost effective for larger, more intensively developed sites -Enhances aesthetics and provides recreational benefits	-Not economical for drainage areas less than 10 acres -Potential safety hazards if not properly maintained -If not adequately maintained, can be an eyesore, breed mosquitoes, and create

ADVANTAGES (Continued)

-Little ground-water discharge
-Permanent pool in wet ponds helps to prevent scour and resuspension of sediments
-Provides moderate to high removal of both particulate and soluble stormwater pollutants

DISADVANTAGES (Continued)

undesirable odors
-Requires considerable space, which limits use in densely urbanized areas with expensive land and property values
-Not suitable for hydrologic soil groups "A" and "B" (SCS classification)
-With possible thermal discharge and oxygen depletion, may severely impact downstream aquatic life

DESIGN CRITERIA

Wet ponds should have an average depth of 3 to 10 feet in the permanent pool to prevent turbulent resuspension of the sediments.

The maximum depth should be no greater than 15 feet to avoid thermal stratification and associated release of phosphorus from the sediments.

Twenty five to thirty percent of the permanent pool surface area should be a maximum of 18 inches deep to promote wetland plant colonization along the pond edge.

The permanent pool should be designed to hold the volume of runoff generated by the design storm over the entire contributing watershed area.

Sufficient detention time is critical to the wet ponds effectiveness. Phosphorus is removed by sedimentation of fine particles and by biological activity.

Sediment storage should be provided in the permanent pool.

At least one foot of ice cover should be provided for.

The pond should be wedged shaped with the narrow end at the inlet and the permanent pool at the outlet end.

Ponds should have a length to width ratio of 3:1 of greater, with the inlet and outlet as far apart as possible.

Two or more ponds in a series provide the most effective treatment. The first pond experiences some mixing as incoming runoff meets still water, but water is pushed into subsequent ponds at a steady rate that discourages mixing and promotes plug flow. Multiple ponds also restrict wind-generated mixing over the total volume of the pond. Overflow outlets should be installed between ponds to ensure that water is released from the top of the pool.

The first pond, (for a multiple pond system) or the pond (for a single pond system), should be equipped with a sediment forebay equal to ten percent of the pond area, approximately one foot deep.

Ponds should have side slopes no steeper than 3:1 (h:v) nor flatter than 20:1.

Steep drop offs should be avoided.

If steep drop offs can not be avoided then some type of restriction such as fencing or dense vegetation should be provided to restrict access.

The elevation of the pond's outlet should be a minimum of one foot above the seasonal high water table to prevent a continuous discharge of water from the pond and continuous flow of water into the pond.

Outflow from the pond should be to a stable channel.

Pond berms may be classified as a dam and require approval by the Water Resources Division of DES

Figure 6.1: Schematic of a wet pond