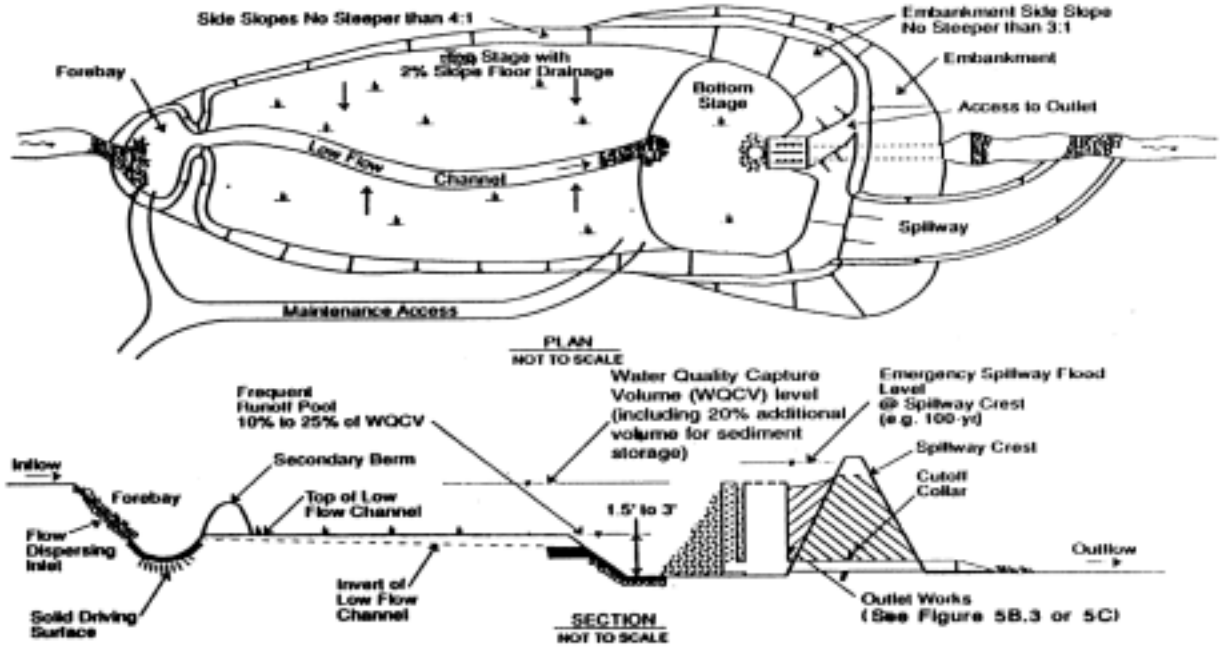
Extended Detention Basin

Plan and Section Views of an Extended Detention Pond



Reference: California Stormwater BMP Handbook, 1993.

Description

Extended detention basins temporarily detain stormwater for an extended period of time, typically 24 to 40 hours, but remain dry between storms. A bottom outlet releases the water slowly so that settling of sediments and particulate matter can occur. Detention basins can also serve as flood control basins if the outlet works are designed to provide control of large events as well as smaller, frequent ("water quality") events. However, a common problem with basins that experience high flows is resuspension of settled matter. The figure at the end of this fact sheet illustrates a typical extended detention basin design.

Effectiveness

If designed and maintained properly, these basins can be fairly effective at removing particulate matter; however, they do not have the ability to remove dissolved pollutants. Enhancements to improve their efficiency include: installation of a forebay to settle out (and clean out) coarse sediments; addition of an adjustable outlet device to ensure that target detention times are achieved; and the use of meandering channels and micropools within the basin to increase detention time and treatment of low flows.

Opportunities for Use

This BMP is suitable for a variety of land uses, from individual commercial development to large residential subdivisions, provided that sufficient land is available for the basin (the lack of available space limits their use in urban areas). Also, they are generally not practical if the drainage area is less than 10 acres. Extended detention basins are often designed to be used as multi-purpose facilities, such as parks and athletic fields, during dry weather.

Costs

Extended detention basins are usually the least expensive stormwater quality pond option available. Addition of extended detention to conventional stormwater detention facilities adds 0% to 25% additional cost. Construction costs range from $0.10 to $5.00 per cubic foot of storage. Construction costs may be lowered slightly if silt basins used for erosion control during construction are subsequently prepared for use as extended detention ponds. Annual maintenance costs are 3% to 5% of construction costs.

Design Considerations

The following is some design guidance for extended detention basins.

Residence time: The pool should provide an average residence time of 24 hours for the water quality storm. This will eliminate mosquito problems since mosquitoes generally require 48 hours to breed and hatch. Additional steps may be taken to avoid mosquito problems including: fountain aeration to limit periods of still water during detention, minimizing the area of the pond that has a depth less than 18 inches and planting emergent vegetation with minimal submerged growth.

Slopes: Slopes inside the basin should not be greater than 3:1 (horizontal:vertical) to minimize erosion and allow heavy equipment access for periodic sediment and debris cleanout.

Inlet: Energy dissipation should be used to minimize erosion and promote settling in the forebay. A trash rack should be used at the inlet to capture large debris before it enters the basin.

Outlet: Several methods have been used to discharge water from the pond, including negatively sloped pipes, perforated pipes in a gravel bed, and vertical risers. Vertical risers are less susceptible to clogging and are considered the favored method.

Vegetation: Emergent wetland vegetation and non-wetland plants tolerant of inundation may be incorporated into the lower pools of extended detention ponds to enhance pollutant removal and aesthetic appearance.

Guidance on sizing detention basins can be found in the California Stormwater Municipal BMP Handbook (March 1993), and the Bay Area Preamble to the BMP Handbook (WCC, 1994).

Extended detention ponds should not be used for both construction-stage and post-construction runoff. Sediment generated by construction will settle in the pond, reducing storage capacity. Extended detention ponds can be used for both flood control and stormwater pollutant removal. In order to control pollutants, the pond must detain high-frequency storms rather than passing them through the pond. This can be achieved with a multiple-orifice outlet structure.

Extended detention ponds can be used in sites with clay soils with low permeability since the dominant pollutant removal mechanism is settling. The fraction of pollutants removed by infiltration is minimal; therefore clay soils should not affect pollutant removal rates.

Operation and Maintenance Requirements

Extended detention basins have the highest routine maintenance burden of any stormwater pond system. Primary maintenance activities include mowing, unclogging of the outlet control device(s), and cleaning out accumulated sediment. Occasionally replanting or reseeding to control erosion is necessary. If they are not drained and maintained properly, they can be unsightly and create mosquito breeding conditions, and generally become a nuisance to local residents. They are more likely to be maintained well if they serve a dual purpose and are integrated into the project landscape.

Regulatory Issues

According to RWQCB staff (Lichten, June 1997) extended detention ponds will not be classified as a jurisdictional wetland that is subject to mitigation if their land use is later changed, as long as:

The ponds are clearly identified on plans and in accompanying documentation as a stormwater treatment Best Management Practice (BMP).

The pond is not used as wetlands mitigation.

The pond does not impact existing jurisdictional wetlands.

Extended detention ponds represent a limited liability hazard. Incidences of drowning in ponds are very rare. However, a number of design factors can improve pond safety:

Fencing around the pond. Fencing can often be easily obscured by vegetation planted adjacent to the pond or on its banks.

Planting of a vegetative barrier around the pond.

Shallow side slopes (8:1 to 12:1) to enhance safety and use by wildlife.

The use of many extended detention ponds over a large area can increase downstream flooding under some conditions for some drainages. Detention pond design, location, and use should be coordinated with the local municipal public works department and/or county flood control department.

Case Studies

The Alameda County-wide Clean Water Program conducted a study in Alameda on detention basins. A report was produced in September 1995 titled Quail Run Detention Basin Retrofit Technical Feasibility Study.

Flood control basins in the City of Sunnyvale were retrofitted for water quality. A report Sunnyvale Detention Basin Demonstration Project (November 1994) provides a description of the project. The detention basin study was conducted by the Santa Clara Valley Non-Point Source program.

References

ASCE Manual of Practice No. 77, Design and Construction of Urban Stormwater Management Systems (1992).

Camp, Dresser, and McKee, March 1993. California Storm Water Municipal Best Management Practice Handbook. Regional Water Quality Control Board.

EPA: Office of Water, January 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. US govt. doc. 840-B-92-002.

Horner, Richard R., December 1988. "Biofiltration Systems for Storm Runoff Water Quality Control." Seattle: Washington State Dept. of Ecology, Municipality of Metropolitan Seattle, King County, City of Bellevue, City of Mountlake Terrace, City of Redmond.

Horner, Richard R., Skupien, Joseph J., Livingston, Eric H., and Sharer, H. Earl, March 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. Washington, D.C.: Terrene Institute.

MWCOG, A Current Assessment of Urban Best Management Practices: Techniques for Reducing Non-point Source Pollution in the Coastal Zone, 1992.

Schueler, Thomas, 1987. Controlling Urban Runoff. Washington, D.C.: Metro. Washington Council of Govts.

Schueler, Thomas, 1992. A Current Assessment of Urban Best Management Practices. Washington, D.C.: Metro. Washington Council of Govts.

Urbonas and Stahre, Stormwater: Best Management Practices and Detention for Water Quality, Drainage, and CSO Management (1993).

Woodward-Clyde Consultants, 1994. Bay Area Preamble to the California Stormwater Best Management Practice Handbook and New Development Recommendations. Prepared for the Alameda County Urban Runoff Clean Water Program and the Contra Costa Clean Water Program.

Yousef A. Yousef, et. Al., 1986. Final Report on Best Management Practices: the effectiveness of retention/detention ponds for control of contaminants in highway runoff. 1986. Tallahassee, Florida; Florida Dept. of Transportation. (Available from the National Technical Information Service, Springfield VA.)

Yousef A. Yousef, et. al., 1991. Final Report on Maintenance Guidelines for Accumulated Sediments in Retention/Detention Ponds receiving highway runoff. Tallahassee, Florida; Florida Dept. of Transportation. (Available from the National Technical Information Service, Springfield VA.)