4.12. Detention Basins

Detention Basins can be a cost effective method to provide temporary storage, conveyance, and treatment of runoff when used within the context of Low Impact Development (LID) strategies. Long, linear, interconnected basins can provide the designer with an economically attractive method to provide source control of storm water as well as convey water without the slope and cover requirements of conventional storm sewer design. This allows for the drainage of the proposed development to more closely mimic existing conditions, minimizing earth work and the ecological impact to downstream receiving bodies. Further, the associated open vegetated aesthetics can provide for passive recreation, quality of life, and increase property values.

LONG, LINEAR, INTERCONNECTED BASIN

Detention basins provide storage on the surface or subsurface either by impoundment within a natural depression, or in an excavated area. Traditional detention basins function primarily to provide water quantity control. The designer should note that detention basins can also be configured to provide water quality treatment. These designs should incorporate methods that remove target pollutants. More information on incorporating methods and designs for water quality must be designed within parameters required by the Storm Water Design and Specification Manual.

Key elements:

- Most basins are designed to provide channel protection and flood control only.
- Pretreatment, such as rain gardens or wetland entrainment facilities can help decrease maintenance.
- Over-excavation in anticipation of sediment accrual can prolong the design life of the basin.
- Vegetation stabilizes the soil in the basin.
- Outlet structure design is critical and determines how the basin meets storm water control requirements.

Table 4.12.1: Detention Basins Potential Application and Storm Water Regulation

Potential applications			Storm water regulations		
				Infiltration	No Infiltration
Residential Subdivision:	Yes		Water Quality Benefit	Yes	Yes
Commercial:	Yes		Volume Reduction	Yes	No
Ultra Urban:	Limited		Attenuation Benefit	Yes	Yes
Industrial:	Yes				
Retrofit:	Yes				
Highway Road:	Yes				

Acceptable forms of pre-treatment

- Sediment forebays
- Filter strips
- Vegetated swales
- Bioretention gardens
- Wetlands
- General Disconnection of impervious areas from detention facilities

Detention Basins in the Urban Landscape

Detention basins are suitable for large developments and high-density commercial projects. They can often be designed for use between storm events, creating an open space available for recreational purposes.

Components of a Detention Basin

Detention basins are typically comprised of the following components:

- Pretreatment
- Vegetation
- Micropool
- Outflow structure

SEDIMENT FOREBAY

Sediment Forebay

Supplementing a dry pond design with a sediment forebay is required to increase the treatment efficiency. The sediment forebay improves pollutant reduction by trapping larger particles near the inlet of the pond. The forebay should include a permanent pool to minimize the potential for scour and re-suspension. Sediment forebays should be designed with ease of maintenance. Forebays must be accessible to heavy machinery. Those constructed with a bottom made of concrete or other solid material make sediment removal easier and more accessible by heavy machinery.

Keeping storm water out of a pipe and within a minimally sloped, vegetated landscapes in advance of a detention basin can be considered another source control to provide pre-treatment. If no pretreatment is proposed, then the entire Detention Basin can be viewed as the Forebay. The design volume of the Basin should reflect a summation of volume necessary for attenuation requirements as well as the accumulation of sediment over a prescribed design life such as 50 or 100 years. Sediment accrual rates based upon land use and / or soil type are available and should be referenced in the design.

Vegetation

Surface vegetation in the basin provides erosion control, sediment entrapment, aesthetic value, and acts as a water fowl (Canadian Geese) deterrent. The images below demonstrate a traditional detention pond planted with turf grass, which does not provide the above items, and a detention pond edge planted with native forbes and grasses. Side slopes, berms, and basin surface should be planted with species concurrent with expected hydrologic conditions. Appropriate species can be found in Chapter 5: Storm Water Landscape Guidance.

WET AND/OR DRY POND EDGE OPTIONS- CONVENTIONAL TURF EDGE

WET AND/OR DRY POND EDGE OPTIONS- NATIVE FORB AND GRASS EDGE

Micropool at the Outlet (Optional)

Applying a micropool design to a detention basin can increase water quality performance. The micropool is typically shallow and permanently inundated. Its function is to reduce re-suspension and to guard against vegetation encroachments toward the outlet. The micropool can be planted with wetland vegetation species but should be deep enough at the outlet pipe to discourage vegetative encroachments that could encourage clogging over the design life. Refer to Chapter 5: Storm Water Landscape Guidance.

Athletic field to be used as a detention basin

Outflow Structure

The outlet structure determines the performance of the basin. By installing a multi-stage outlet, the basin can be designed to meet both Water Quality and Flood Control requirements.

A gate valve or orifice plate may be used to regulate the drawdown time. In general, the outflow structure should have an acceptable means of preventing clogging at the entrance to the structure over the design life to minimize maintenance requirements. The design must be designed within parameters required by the *Storm Water Design and Specification Manual*.

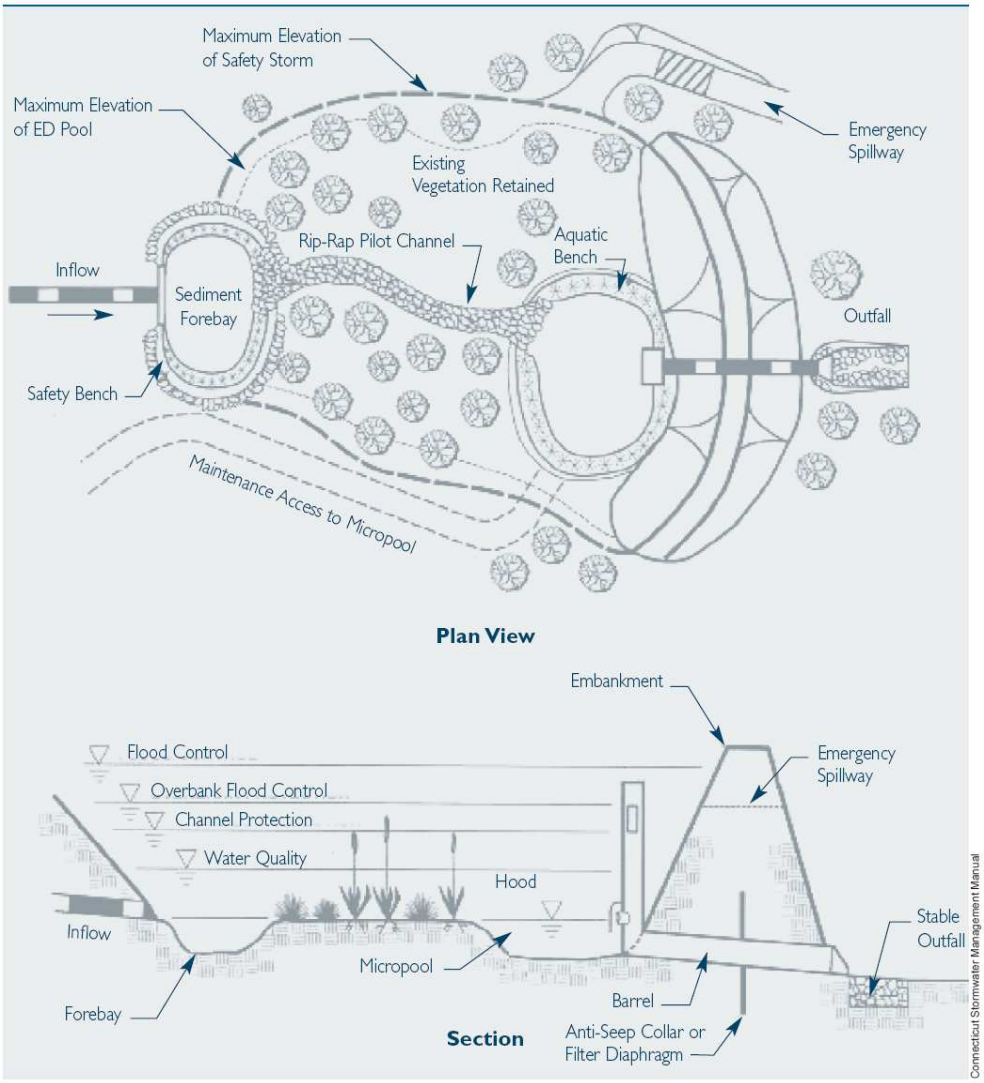

Figure 7.20: Extended detention basin schematic

Recommended Design Procedure

- Determine the storm water management requirements for the site within parameters required by the *Storm Water Design and Specification Manual*.

- Create a Conceptual Site Plan for the entire site and determine what portion of the control requirements the detention basin will meet.

- Consider a dry extended detention basin to provide water quality treatment if infiltration is infeasible on the site. Organic soil amendments may be utilized above proposed underdrain systems in order to simulate infiltration to remove dissolved metals and *E. Coli*.

- Detention basins should be considered in existing low areas so that the facility can be constructed with low impact and minimal earth work.

- Extended detention basins should not be considered within USACE or IDNR jurisdictional waters, unless the applicable permit is first obtained.

- Create a conceptual design for the basin. Estimate required basin size according to design parameters as well as approved calculation method required by the *Storm Water Design and Specification Manual*.

Table 4.12.2: Starting Design Parameters for Detention Basins	
Detention time for water quality volume	Designer should reference the Storm Water Design and Specification Manual.
Water depth	Designer should reference the Storm Water Design and Specification Manual.
Width	depends on design
Shape	Design basin to maximize length of storm water flow pathways, and to minimize short-circuiting from inlet to outlet

- Design an outlet structure (or multiple structures) that provides the level of control required. (A multistage outlet structure will generally reduce the necessary size of the facility)

- Energy dissipaters are to be placed at the end of the primary inlets to discourage erosion.

- If the basin discharges to a channel with dry weather flow care shall be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone between the outlet and natural channel.

- The hydraulic design of all outlet structures must consider any tailwater effects of downstream waterways within parameters required by the *Storm Water Design and Specification Manual.*

- The primary and low flow outlet shall be protected from clogging by an acceptable means.

- On sites that have the potential for accidental spills, the outflow structure should be fitted with a valve so that discharge from the basin can be halted. This same valve also can be used to regulate the rate of discharge from the basin.

- Emergency overflow design should agree with design criteria within parameters required by the *Storm Water Design and Specification Manual*.

- Determine the final contours of the basin.

Table 4.12.3: Contour Design Parameters for Detention Basins	
Lowest basin elevation	2 feet above seasonal high water table (Minimum) if infiltration is accounted for in hydraulic calculations.
Basin shape	Irregularly shaped to lengthen effective flow path and provide natural appearance
Low flow channels	may be used to discourage severe ponding due to native soils if necessary Always vegetate with a maximum slope of 3% to encourage sedimentation Consider other BMPs such as wet ponds, constructed wetlands or bioretention
Vegetated embankments	Less than or equal to 3 feet in height (Recommended) 20 feet in height (Maximum)* Maximum slope 3:1 (Horizontal to vertical)
Basin freeboard	Minimum 1 foot above the 100-yr design storm
* 20 feet or higher or that which will impound more that 100 acre-feet of runoff or drain more than 1 square mile will be regulated as dams by IDNR. Consult - IC 14-27-7.5 for further detail.	

- Design an inlet control so that inflow energies can be dissipated. If specified, the sediment forebay volume may be considered to meet a portion of the water quality volume if non-turbulent conditions are expected to dominate during inflows.

Table 4.12.4: Inlet Control and Sediment Forebay	
Forebay length	10 ~~f~~percent of projected flow path (Minimum)
Storage	Designed to trap sediment over a period of 2 to 10 years

- Verify that the basin meets all control requirements concurrently as designed.

- Choose appropriate vegetation using the guidelines in Chapter 5: Storm Water Landscape Guidance. Fertilizers containing phosphorus shall not be used. The use of pesticides is discouraged.

- Complete construction plans and specifications.

Materials

Basin Soil

- A minimum of 6 inches of planting soil is recommended. Soil shall be a high-quality topsoil with a loam or sandy loam texture. The use of 30% organic content by volume is recommended for dry basins that discharge to waterways listed on the IDEM 303(d) for dissolved metals or fecal coliforms.

- Clay cores may be necessary in basins designed to withstand excessive pressures and seepage forces.

Plants

- It is critical that plant materials are appropriate for soil, hydrologic, light, and other site conditions. Select plants from Chapter 5: Storm Water Landscape Guidance.

- Trees and shrubs shall be freshly dug and grown in accordance with good nursery practice.

- Perennials, grass-like plants, and groundcover plants shall be healthy, well-rooted specimens.

- Plantings shall be designed to minimize the need for mowing, pruning, and irrigation.

Construction Guidelines

- Install all temporary erosion and sedimentation controls. The area immediately adjacent to the basin must be stabilized in accordance with IDEM Rule 5 during construction activities and Rule 13 at the cessation of construction activities.

- Prepare site for excavation and/or embankment construction.

- All existing vegetation should be left in place if feasible, and shall only be removed if necessary for construction.

- Care should be taken to prevent compaction of the basin bottom.

- If excavation is required, clear the area to be excavated of all vegetation.
- Excavate bottom of basin to desired elevation (if necessary).

- Install surrounding embankments and inlet and outlet control structures.

- Grade subsoil in bottom of basin, taking care to prevent compaction. Compact surrounding embankment areas and around inlet and outlet structures.

- Apply and grade planting soil.

- Apply geotextile and other erosion-control measures.

- Seed, plant, and mulch according to Planting Plan.

Maintenance Guidelines

- Properly designed Detention Basins should require little to no maintenance throughout the design life. However, maintenance is expected for the proper operation of detention basins. Plans for detention basins should identify owners, parties responsible for maintenance, and an inspection and maintenance schedule for extended storage detention basins.

Table 4.12.5: Detention Basin Maintenance Guidelines	
Activity	Schedule
Remove trash and debris Remove invasive plants. Grassed areas may require periodic prudent fertilizing, dethatching and soil conditioning. Trees, shrubs, and other vegetative cover may require periodic maintenance such as fertilizing, pruning, and pest control. Mow/trim detention basin vegetation if desired.	As needed
Sediment should be removed from the basin at such time as the sediment accrues to an extent such that the Basin loses design attenuation capacity.	As needed
Inspect outlet control structure	Quarterly and after every storm greater than 1 inch
Inspect detention basin for potential problems including: subsidence, erosion, cracking or tree growth on the embankment; damage to the emergency spillway; sediment accumulation around the outlet; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel; and erosion within the basin and banks.	Annually
Maintain records of all inspections and maintenance activity.	Throughout the design life
*The frequency of sediment removal depends on the design, which should account for site conditions such as soil type, impervious percentage, and drainage area, all of which influence the sediment load on the basin.	

- In most cases, no specific limitations have been placed on disposal of sediments removed from detention basins. Studies to date indicate that pond sediments are likely to meet toxicity limits and can be safely landfilled. On-site sediment disposal is always preferable as long as the sediments are deposited away from the shoreline to prevent their re-entry into the pond and away from recreation areas where people could inhale resulting dust. Sediment disposal should be included in the Operations and Maintenance (O & M) Plan and will be evaluated on a site by site basis. Designers are encouraged to plan for long-term sediment-accumulation within detention basins, which is more economical, and environmentally preferable to dredging and disposing of sediments.

- Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the drainage area include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed.

4.12.1. Detention Basin Designer/Reviewer Checklist

Item	Yes	No	N/A	Notes
Pretreatment considered?				
Forebay provided?				
Minimum depths of 10 feet for wet ponds used?				
Appropriate inlet and outlet structures?				
Outlets protected from clogging?				
Trash rack provided to prevent clogging?				
Lowest base elevation above seasonal water table?				
Feasible construction process and sequence?				
Bank vegetation requirements met?				
Appropriate plant species indicated?				
Bank slope requirements met?				
Soil requirements met?				
Storage requirements met?				
Maintenance accounted for and plan provided?				