PC-18 STORMWATER BASINS

Refer to: ITD Standard Specifications, Sections 205 and 212.
ITD Standard Drawings P-1-C and P-4-A.

BMP Objectives

- ☐ **Perimeter Control**
- ☐ **Slope Protection**
- ☐ **Borrow and Stockpiles**
- ☒ **Drainage Areas**
- ☒ **Sediment Trapping**
- ☐ **Stream Protection**
- ☒ **Temporary Stabilizing**
- ☒ **Permanent Stabilizing**

Definition and Purpose

Configurations may include retention and detention basins.

A retention basin is an impoundment created by a dam or an excavation for the purpose of storing water and settling sediment and other pollutants from surface runoff. A retention basin is designed to hold a specific amount of water until the water can evaporate or infiltrate. Usually the basin is designed to have overflows drain to a receiving conveyance system when the water level exceeds the basin capacity.

A detention basin is designed to temporarily hold, or detain, a specified volume of runoff while slowly releasing flows at a controlled rate to a receiving conveyance system. By detaining water and controlling release rates, detention basins can be designed to reduce peak runoff rates. Typically, detention basins are designed with an orifice invert level with the bottom of the basin so that all of the water eventually drains out of the basin following a rainfall event.

Appropriate Applications

- Basins can be constructed in series to provide greater holding capacity for surface runoff.
- Small extended detention basins can be used in conjunction with other measures to trap sediment in runoff. In such applications, the outlet orifice size is reduced to maximize settling time and sediment capture.
- Large basins can provide substantial reduction of peak runoff rates when incorporated into the design of a storm drainage system.
- A retention basin typically consists of a dam or embankment, a storage basin, a riser discharge, and an emergency spillway.
- A detention basin typically consists of a dam or embankment, a storage basin, an outlet orifice, and an emergency spillway. If a detention basin is designed as an extended

detention basin for water quality purposes, then a riser discharge may be an appropriate outlet control.

Limitations

- Not suitable for drainage areas exceeding 150 acres.
- Not suitable if the water depth will exceed 10 feet when measured from the original bed of the drainage channel to the crest elevation of the riser discharge. For safety purposes, fencing is required around all detention/retention facilities when the ponded water would create a drowning risk.
- If basins do not drain properly, resulting nuisance problems such as vegetation overgrowth, insects/vectors, erosion or rubbish accumulations, and fire hazards can complicate basin maintenance activities. It is recommended that water detention times be less than 96 hours to prevent vector/mosquito breeding.
- Side slopes should be gentle (3H:1V or flatter). Steep slopes will increase runoff rates and create greater potential for erosion.
- "Waste Disposal and Injection Wells" (Title 42, Chapter 39, Idaho Code; IDAPA 37.03.03; or any local jurisdiction) regulations shall be checked before completion of final design of basins.
- Federal and local requirements shall be checked if the basin is designed to retain water more than 2 feet deep.

Design Parameters

Retention Basins

- Retention basin design should be based on the total contributing drainage area. Locate the dam to provide maximum volume capacity. The structure becomes part of the permanent drainage system for the area.
- Retention basins should be designed by a professional engineer.

Detention Basins

- Detention basin design should be based on the total contributing drainage area. The release of runoff water must be at a non-erosive rate. Proper energy dissipation must be provided at the detention basin outfall location if discharging to an unlined conveyance system.
- Detention basins should be designed by a professional engineer.

Storage and Discharge Capacity

- Select a site that can provide adequate storage for not less than 1.25 inches of runoff per 2.5 acres of drainage area. For trap efficiency calculations, use the volume below the emergency spillway crest (or the riser discharge crest if there is no emergency spillway). If necessary, excavate additional storage capacity to meet these storage requirements, and plan for periodic basin clean out to maintain capacity requirements. If no available sites

can meet these design criteria, seek approval (from the permit issuing authority) to design and install a basin with less storage.

- Perform runoff calculations based on soil cover conditions expected to prevail during the anticipated effective life of the structure. Discharge risers and emergency spillways together should be able to handle requirements as specified by local jurisdiction design standards.
- Design the storage area such that it does not produce a public nuisance (vegetation overgrowth, vector issues associated with standing water, etc.).

Embankment

- The embankment should have a minimum top width of 8 feet. Side slopes should be 3H:1V or flatter.
- Minimum freeboard should be 12 inches for retention or detention basins with an emergency spillway and 3 feet for retention or detention basins with no emergency spillway. (Freeboard is the difference in elevation between design high water and the top of the compacted embankment.) The emergency spillway should be designed 1 foot above the local design storm standard surface elevation in the basin (based on hydraulics from the principal outlet structure). The emergency spillway should also convey the local design flow standard in the event of principal outlet clogging or back-to-back storm events.
- Vegetation should be established on all disturbed embankment slopes, borrow areas, or any other areas suitable for vegetative growth. Non-vegetative stabilization should be utilized where vegetation cannot be established.
- Foundation soils should be reviewed by the ITD Geotechnical Engineer for potential settlement.

Discharge Riser

- All riser discharge retention basins should have an emergency spillway.
- Design the discharge to handle not less than 5 inches runoff from the drainage area for 24 hours. The discharge riser will consist of a perforated vertical pipe or box-type riser joined to a horizontal conduit (barrel) that will extend through the embankment. The horizontal pipe conduit (barrel) should be a minimum of 12 inches in diameter. The riser should be a minimum of 30 inches in diameter with a cross-sectional area of at least 1.5 times the cross-sectional area of the horizontal conduit.
- Crest Elevation: When used in combination with emergency spillways, the crest elevation of the riser should be at least 12 inches below the elevation of the control section of the emergency spillway. If no emergency spillway is provided, the crest elevation of the riser should be at least 3 feet below the crest elevation of the embankment.
- Perforated Riser: The upper portion of the riser should be perforated with 1.5- to 4-inch-diameter holes staggered and spaced 8 inches vertically and 10 to 12 inches horizontally. The perforated portion should be the top one-half to two-thirds of the riser. The whole pipe length should be perforated if a gravel filter cone is placed around the bottom one-

third of the riser. Perforations should be small enough to prevent the passage of filter material.

- Antivortex Device: Install an antivortex device on the top of the riser. An approved antivortex device is a thin, vertical plate normal to the centerline of the dam and firmly attached to the top of the riser. The plate dimensions are: length = diameter of the horizontal pipe.
- Base: The riser should have a base attached with a watertight connection and should have sufficient weight to prevent flotation of the riser. Two approved bases are (1) a concrete base 18 inches thick with the riser embedded 6 inches into the base (the base should be square with each side 24 inches greater than the riser diameter), and (2) a 0.2-inch minimum thickness steel plate welded all around the base of the riser to form a watertight connection (the plate should be square with each side equal to two times the riser diameter and should have 24 inches of stone, gravel, or tamped earth placed on it to prevent flotation).
- Trash Rack: A trash rack consisting of #4 (#10M) reinforcing bars, 6 inches on center, should be welded across the top of the riser.
- Antiseep Collars: Conduits through embankments should be provided with antiseep collars. All basins should have a minimum of one antiseep collar that is rectangular, blocking all potential flow through the backfilled material and extending to the sides of the barrel trench. The horizontal dimension should be at least 24 inches larger than the barrel diameter. The bottom side of the antiseep collar should extend a minimum of 24 inches below the grade line, and the topside should extend 12 inches above the barrel.

Spillways

- The spillway should be at least 1.6 feet deep with 1H:1.5V side slopes. Two designs are (1) rigid channel liner protected spillway with discharge over the top of dam or embankment, and (2) spillway protected from erosion by riprap and erosion control geotextile or other appropriate material. The design width and entrance/exit channel slopes are critical to the ability of the spillway to successfully protect the dam with a minimum of erosion hazard to the receiving channel.
- Minimum Capacity: The spillway must be able to pass 150 percent of the peak flow from the design storm. Where emergency spillways are used, the channel bottom should have a minimum width of 8 inches.
- Maximum Allowable Velocity: Allow a maximum discharge velocity of 6 feet per second in the exit channel, based on the design frequency storm.
- Vegetative Protection: Provide appropriate vegetative cover or other suitable means of protecting the embankment and spillway.

Basin Information to Be Submitted in Final Design Plans

- Specific location of the basin.
- Plan view of dam and the storage basin.

- Cross-section of the dam, storage basin, spillway, and/or emergency spillway and profile of the emergency spillway.
- Runoff calculations including storage volumes and required capacity for local design storm standard.
- Calculations showing design of riser discharge and emergency spillway.
- An inspection and maintenance schedule including sediment removal and disposal procedures.

Construction Guidelines

The following construction criteria are critical to successful installation and operation of basins.

- Preparation
  - Prepare the dam site by clearing vegetation and removing topsoil before beginning dam construction. To facilitate cleanout and restoration, the pool area (measured at the top of the riser discharge) should also be cleared of all brush, trees, and other debris.
- Riser Discharge
  - Level the bed for the riser discharge to provide uniform support throughout its entire length under the dam.
  - Make sure there is a watertight bottom on the riser and that all pipe joints are watertight.
  - Locate the outlet invert of the riser discharge unit no more than 12 inches above the streambed and provide outlet protection measures.
  - Place the barrel on a firm foundation according to the lines and grades shown on the plans, and compact.
  - Backfill with material of the type and quality specified or with an approved equal.
- Embankment
  - Obtain material from approved materials sources.
- Spillway
  - Construct a spillway or an emergency spillway, as specified in the plans.
- Stabilization
  - Stabilize the embankment and emergency spillway using slope stabilization and re-vegetation measures.

Maintenance and Inspection

- Conduct inspections as required by the NPDES permit or contract specifications.
- Prepare an inspection and maintenance schedule including sediment removal and disposal procedures.

- Cleanout the basin when its effective storage capacity drops below 0.6 inches per 2.5 acres of drainage area. The elevation corresponding to this level should be determined and given in the design data as a distance below the top of the riser.
- Dispose of accumulated sediments in an approved area. Location of the disposal site should prevent sediments from returning to the basin or to downstream areas during storm events or snowmelt.