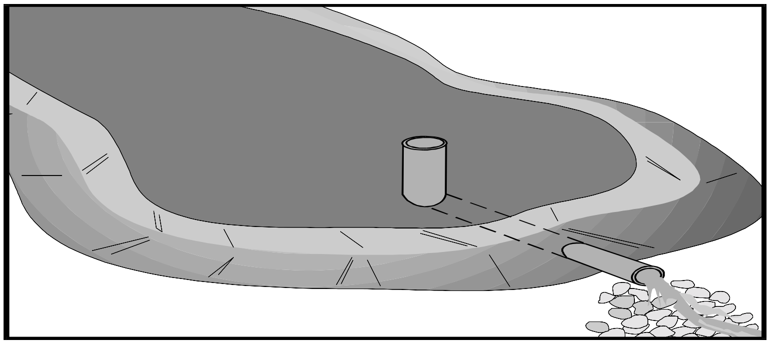
ACTIVITY: Temporary Sediment / Detention Basin

TCP – 18



Targeted Constituents				
● Significant Benefit		◗ Partial Benefit		○ Low or Unknown Benefit
● Sediment	○ Heavy Metals	○ Floatable Materials	○ Oxygen Demanding Substances	
○ Nutrients	○ Toxic Materials	○ Oil & Grease	○ Bacteria & Viruses	○ Construction Wastes
Implementation Requirements				
● High		◗ Medium		○ Low
○ Capital Costs	◗ O & M Costs	○ Maintenance	○ Suitability for Slopes >5%	○ Training

Description

An impoundment created by excavating or constructing an embankment. It is designed to detain runoff sufficiently to allow excessive sediment to settle. This management practice is likely to create a significant reduction in sediment.

Suitable Applications

- At the outlet of all disturbed watersheds 5 acres (2 ha) or larger.
- At the outlet of smaller severely disturbed watersheds, or where soil conditions suggest severe erosion potential.
- Where permanent detention basins will be located.
- Should be used in association with dikes, temporary or permanent channels, and pipes used to divert disturbed areas into the basin and divert undisturbed areas around the basin.
- Where sediment-laden stormwater may exit the construction site or enter the storm drain system or natural watercourses.

Installation/ Application Criteria

- Shall be designed by a licensed professional civil engineer.
- A sediment basin is a controlled stormwater release structure formed by excavation or by constructing an embankment of compacted soil across a drainageway, or other suitable location. Its purpose is to collect and store sediment from sites cleared and/or graded during construction or for extended periods of time before reestablishment of permanent vegetation and/or construction of permanent drainage structures. It is intended to trap sediment before it leaves the construction site. The basin is a temporary measure (with a design life of 12 to 18 months) and is to be maintained until the site area is permanently protected against erosion or a permanent detention basin is constructed. However, some basins are designed to

serve as permanent facilities that treat stormwater quantity and/or quality. If this is the case, then the facility should be designed to meet both the construction phase sediment control and the permanent quantity and/or quality requirements presented in the Stormwater Management Manual. The completed volume should be surveyed to ensure the permanent facility design requirements have been achieved.

- Sedimentation basins are suitable for nearly all types of construction projects. Whenever possible, construct the sedimentation basins before clearing and grading work begins. Basins should be located at the stormwater outlet from the site, but not in any natural or undisturbed stream. A typical application would include temporary dikes, pipes, and/or channels to divert runoff to the basin inlet.

- Construct before clearing and grading work begins.

- Do not locate in a stream.

- Large basins with either an embankment taller than 20 feet (6.1 m) or a capacity, at maximum water storage elevation, of 30 acre-feet (48,400 y^3) or more, are subject to the Tennessee Safe Dams Act of 1973.

- Securely anchor and install an anti-seep collar on the outlet pipe/riser, and provide an emergency spillway for passing storm events larger than the 2-year storm event. If this pond is to be used as a permanent basin then it may be advisable to install a permanent bypass sized for a 10-year storm and a bypass for a 2-year storm (while site is under construction). See next bullet item.

- The total volume of the sediment basin treatment area shall be at least 134 yd^3/acre (3618 ft^3/acre) of drainage. This total volume is based upon two major components, wet and dry storage. A wet storage volume of 67 yd^3/acre or 1809 ft^3/acre must be provided to establish the permanent pool and sediment storage zone. The volume below the permanent pool shall be measured from the lowest point of the basin up to the bottom elevation of the dewatering device. The dry storage volume should have a minimum volume of 67 yd^3/acre (1809 ft^3/acre) for the settling zone. The top of the dry storage defines the principal spillway riser crest and establishes a minimum volume for treatment in the sediment basin. The dry storage volume is to be dewatered down to the permanent pool in 72 hours.

- The total volume of the sediment basin treatment area should not be confused with detention described in Permanent Treatment Management Practices (PTPs).

- Basin inlets should be located to maximize travel distance to the basin outlet. The length to width ratio should be greater than at least 4:1, or baffles are required to prevent short-circuiting.

- Where practical, contributing areas shall be subdivided into smaller areas, and multiple sediment traps shall be used in lieu of sediment basins. Alternatively, sediment traps can be used as forebays to a sediment basin thereby reducing the required size of the sediment basin. A forebay, constructed upstream of the basin is designed to remove debris and larger particles. See TCP-17: Sediment Traps.

- Basin shall be located: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where post-construction (permanent) detention basins will be constructed, (3) where failure would not cause loss of life or property damage, and (4) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.

- Areas under embankments, structural works, and sediment basin must be cleared, stripped of vegetation.

- Baffles shall be constructed of 4 inch x 4 inch (10.2 cm x 10.2 cm) posts and 4 ft. x 8 ft. x 0.5 inch (1.26 m x 2.51 m x 1.3 cm) exterior plywood. Posts shall be set at least 3 ft. (0.94 m) into the ground, no further apart than 8 ft. (1.26 m) center to center and shall reach a height of 6-inches (15.2 cm) below the riser crest elevation.

- Rock, geotextiles, or vegetation shall be used to protect the basin inlet and slopes against erosion.

- The principal outlet shall consist of a "V" notched weir with a trash rack or a corrugated metal or reinforced concrete riser pipe with dewatering holes and an anti-vortex device and trash rack attached to the top of the riser. The trash rack is intended to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure should be designed to accommodate the inflow design storm.

- The outlet structure shall be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.

- Attach the riser pipe (watertight connection) to a horizontal pipe (barrel) which extends through the embankment to toe of fill. Provide anti-seep collars on the barrel.

- Cleanout level shall be clearly marked on the riser pipe. This should be at the lowest ⅓ depth.

- One of the following dewatering configurations for the principal outlet shall be used:

  Outlet #1 (Preferred if going to serve as a permanent facility)
  - "V" notch weir.
  - The bottom of the "V" notch should be at the top of the temporary/permanent sediment storage depth as appropriate.
  - See Figure TCP-18-1.
  - See PTP-02 or 03 for sizing criteria.

  Outlet #2 - see following page

Outlet #2

- Perforate the top one-third of the riser with 0.5-inch (1.3-cm) diameter holes spaced 8 inches (20.3 cm) vertically and 10 to 12 inches (25.4 to 30.5 cm) horizontally.
- Wrap with well-secured filter fabric.
- Place 0.75 inches (19 mm) gravel over perforated holes to approximately 2 inches (50 mm) minimum thickness to assist in prevention of clogging of dewatering holes. Gravel will naturally settle into a cone surrounding the riser pipe.
- See Figure TCP-18-2.
- See PTP-02 or 03 for sizing criteria.

■ Spillway control section which is a level portion of the spillway channel at the highest elevation in the channel, shall be a minimum of 20 ft. (6.3 m) in length.

■ Use outlet protection at the pipe outlet.

■ Standing water may cause mosquitoes or other pests to breed. Excavate a 12-inch (0.31-m) shelf at edge of the normal pool to limit this.

■ Safety fence shall be provided to prevent unauthorized entry to the basin.

Maintenance

■ Inspect temporary sediment basins weekly, before and after rainfall events. During extended rainfall events, inspect at least every 24 hours.

■ Examine basin banks for seepage and structural soundness.

■ Check outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.

■ Check outlet area for erosion and stabilize, if required.

■ Remove sediments when storage zone is one-third full (by depth).

Limitations

■ Failure of the structure must not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. Also, sediment traps and ponds are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the pond is required, the type of fence and its location shall be shown in the construction specifications.

- Generally, temporary sedimentation ponds are limited to drainage of 5 acres (2 ha) or more while sediment traps are intended for drainage of 5 acres or less. Permanent ponds can be designed to serve larger areas of 100 to 150 acres. These facilities can offer more water quality benefits. See PTP-02 and 03 for wet and dry ponds.

- Alternative BMPs must be thoroughly investigated for erosion control before selecting sediment basins.

- Sediment ponds are generally only practically effective in removing sediment down to about the medium silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) will pass through untreated emphasizing the need to stabilize the soil quickly. Sediment ponds may be capable of trapping smaller sediment particles if additional detention time is provided. However, they are cost effective when used in conjunction with other BMPs such as seeding or mulching.

- Requires large surface areas to permit settling of sediment.

- Generally not appropriate for drainage areas greater than 100 to 150 acres (40.5 to 60.7 ha).

- Not to be located in live streams.

- The basin should have shallow side slopes (minimum 4:1 (H:V)) or be fenced to prevent drowning.

- Ponds may become an "attractive nuisance" and care must be taken to adhere to all safety practices.

- Sites with very fine sediments (fine silt and clay) may require longer detention times for effective sediment removal.

- Basins in excess of certain depth and storage volume criteria must meet State Division of Safety of Dams (DSOD) and local safety requirements.

Additional Information

Sediment basins trap 70-80 percent of the sediment which flows into them if optimally sized. However, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

The settling zone volume is determined by the following equation:

$$(V) = 1.2\,(SD)Q \,/\, V_{SED}$$

Q = design inflow based on the peak discharge from a specified design storm (e.g., a 2-year, 24-hour duration design storm event) from the tributary drainage area. Provide a minimum of 134 cubic yards (103 m^3) of settling volume per acre of drainage if a design storm is not specified.

V_{SED} = the settling velocity of the design soil particle. The design particle chosen is medium silt 7.9×10^{-4} in.(0.02 mm). This has a settling velocity (V_{SED}) of

0.00096 ft./sec (3.0 x 10^{-4} m/s). As a general rule it will not be necessary to design for a particle of size less than 7.9 x 10^{-4} in. (0.02 mm), especially since the surface area requirement increases dramatically for smaller particle sizes. For example, a design particle of 3.9 x 10^{-4} in. (0.01 mm) requires about three times the surface area of 7.9 x 10^{-4} in. (0.02 mm). Note also that choosing V_{SED} of 0.00096 ft./sec (3.0 x 10^{-4} m/s) equates to a surface area (SA) of 1250 sq. ft. per cfs per of inflow.

SD = settling depth, which should be at least 2 ft. (0.63 m), and no shallower than the average distance from the inlet to the outlet of the pond (L) divided by 200 (i.e., SD>L/200).

Total sediment basin volume and dimension are determined as outlined below:

a. Determine basin geometry for the sediment storage volume calculated above using a minimum of 1 ft. (0.31 m) depth and 4:1 (H:V) side slopes from the bottom of the basin. Note, the basin bottom is level.
b. Extend the basin side slopes (at 4:1 (H:V) max.) as necessary to obtain the settling zone volume as determined above.
c. Adjust the geometry of the basin to effectively combine the settling zone volume and sediment storage volumes while preserving the depth and side slope criteria.
d. Provide an emergency spillway with a crest elevation one foot above the top of the riser pipe.
e. The ratio between the basin length and width of the pond should either be greater than at least 4:1, or baffles should be installed to prevent short-circuiting.

Primary References

California Storm Water Best Management Practice Handbooks, *Construction Handbook*, CDM et.al. for the California SWQTF, 1993.

Caltrans Storm Water Quality Handbooks, CDM et.al. for the California Department of Transportation, 1997.

Subordinate References

A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zones, Metropolitan Washington Council of Governments, March, 1992.

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Rough Draft - July 1992.

"Draft – Sedimentation and Erosion Control, An Inventory of Current Practices", U.S.E.P.A., April, 1990.

"Environmental Criteria Manual", City of Austin, Texas.

Guidelines for the Design and Construction of Small Embankment Dams, Division of Safety of Dams, California Department of Water Resources, March 1986.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, June 1981.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April, 1992.

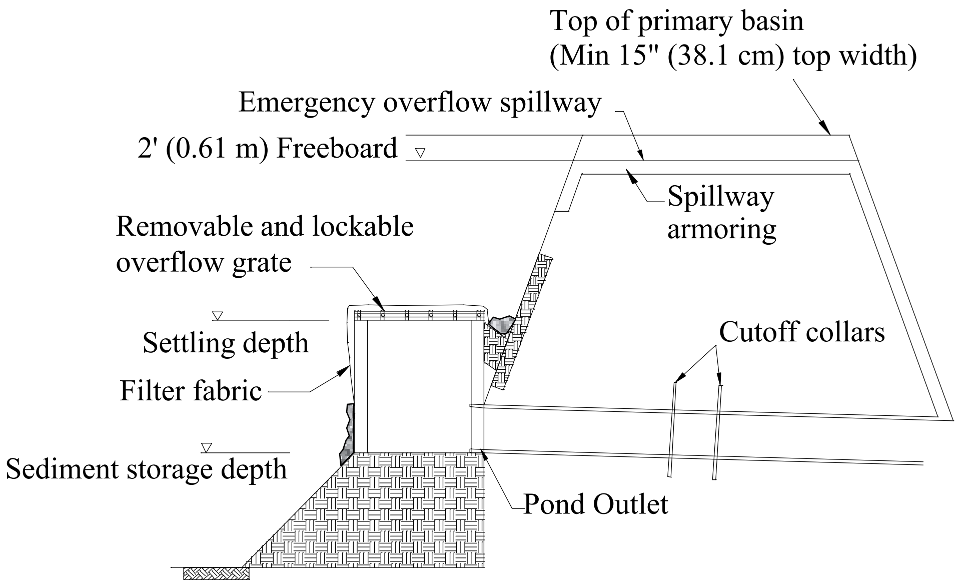
Stormwater Management Water for the Puget Sound Basin, Washington State Department of Ecology, The Technical Manual – February 1992, Publication #91-75.

Tennessee Erosion & Sediment Control Hand Book - A Stormwater Planning and Design Manual for Construction Activities, Tennessee Department of Environment and Conservation, Fourth Edition, August 2012

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency – November 1988.

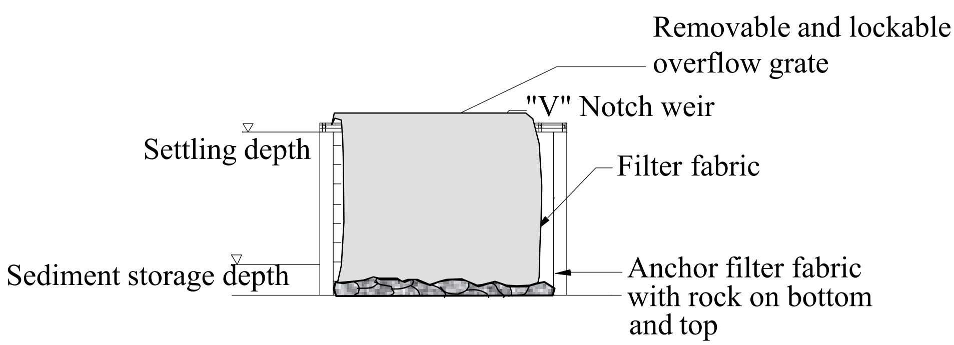
Inspection Checklist

- Does the outlet structure use a triangular-shaped filter dike, riser pipe or stone outlet designed to convey flows up to the 10-year storm event?
- Is the outlet structure stabilized to prevent erosion?
- Is there a gage indicating the depth of the basin?
- Has sediment accumulated beyond ⅓ the depth?
- If the basin failed would it result in loss of life, damage to home or buildings, or interruption in the use of public roads or utilities?
- Is the basin protected from access by children?
- Is the outlet structure clogged?
- Are there any signs of seeping through or erosion of the embankment?
- Were anti-seep collars installed and surrounding soil compacted?
- Is an overflow structure present that can convey flows beyond the 10-year storm event?



SECTION OUTLET STRUCTURE

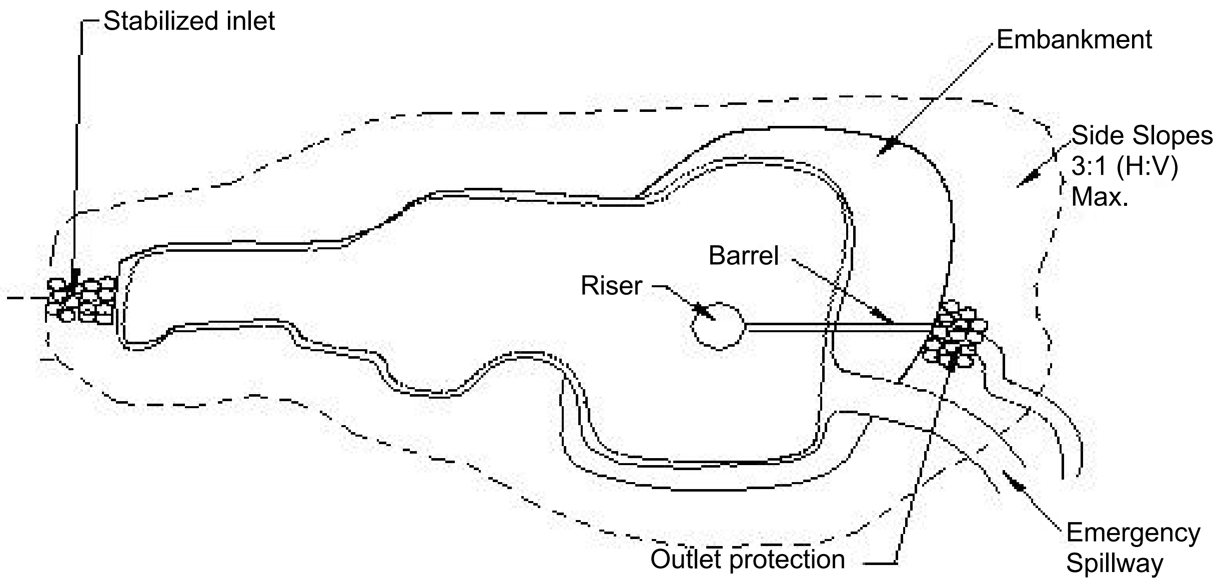
NTS



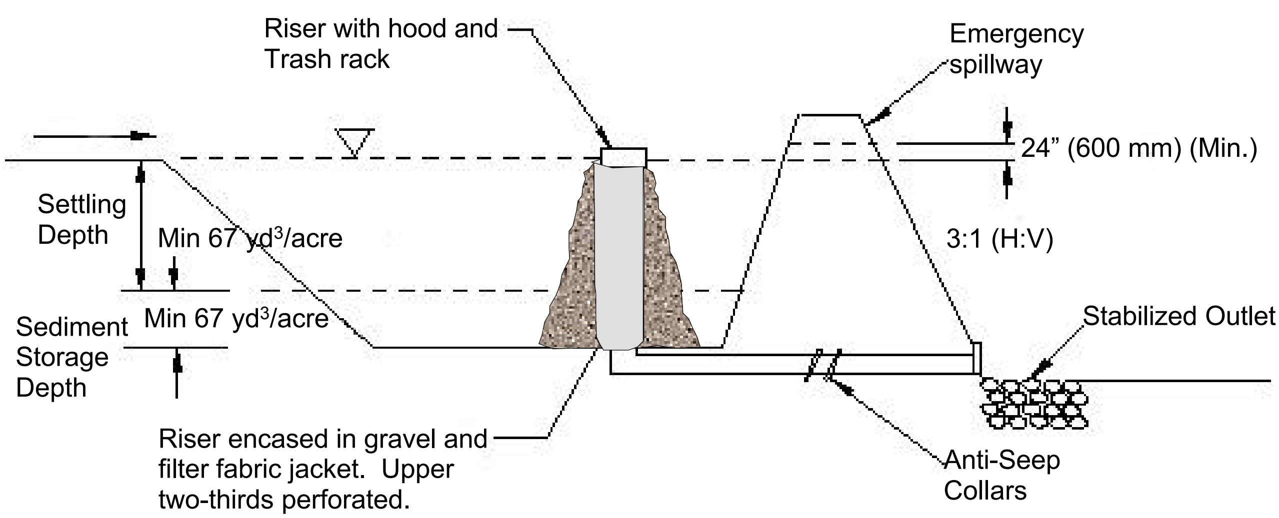
PROFILE OUTLET STRUCTURE

NTS

Figure TCP-18-1
Sediment Basin – "V" Notch Weir Outlet Structure



TOP VIEW



NOTE:
This outlet provides partial draining of pool. For temporary sediment basins, rock encasement around the riser may not be necessary, however, filter fabric must then be fastened around the riser using either staples or other manufactured fasteners.

Figure TCP-18-2
Sediment Basin – Riser Pipe Outlet Structure A

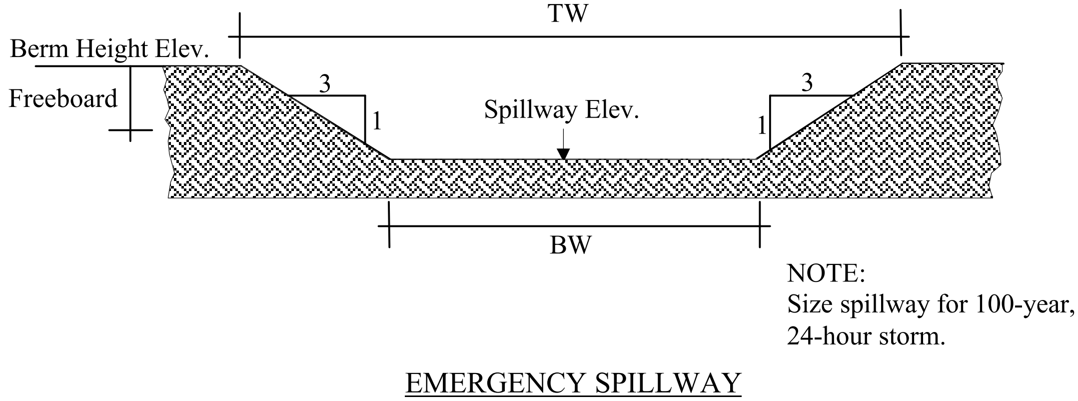


Figure TCP-18-3
Emergency Spillway