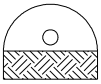
Sediment Basin

Plan Symbol



Description

A Sediment Basin collects and traps sediment laden runoff from disturbed areas and slows down the flow so that soil particles fall from suspension and deposit in the basin. Drop inlet spillways, pipe spillways, rock fill outlets and weir spillways may be used for the design of the principal spillway.

When and Where to Use It

Temporary sediment basins are designed to have an 80 percent design removal efficiency goal for total suspended solids (TSS) or 0.5 mL/L peak settleable concentration, whichever is less. on sites where 10 or more acres are disturbed and drain to a single outlet point. A temporary sediment basin should not be built in wetlands, any active or live streams, ephemeral streams, or in Waters of State (defined to be all annual or perennial water bodies designated by a solid or dashed blue-line on USGS 7.5-minute quadrangle maps). Utilize temporary sediment basins until the contributing flow areas to the basin have undergone final stabilization.

Sediment Basin Design Criteria

Safety

Follow the design criteria such as those used by the USDA Soil Conservation Service (previously the Natural Resources Conservation Service), U.S. Army Corps of Engineers and the Dam Safety regulations.

Incorporate all possible safety precautions for ponds that are readily accessible to populated areas such as signs and fencing. The recommended inside pond slopes is 3H:1V with a 2H:1V maximum.

Design Aids

The Design Aids located in this section may be used to properly size sediment basins. Sedimot III, SEDCAD4 and other computer models that utilize eroded particle size distributions to calculate a corresponding trapping efficiency may also be utilized.

Riser Structure Design

Design the outlet riser to meet the discharge capacity of the 10-year 24-hour storm event.

General Design Requirements

a. Minimum drainage area - 5 acres
b. Maximum drainage area - 150 acres
c. 80 percent design removal efficiency goal for TSS.
d. The required draw down time of the basin is the time to detain flows to meet the 80 percent design removal goal. In many cases this will result in a draw down time longer than 36 hours. The maximum draw down time is 72 hours.

e. Basin Shape - Where applicable the effective flow length is at least twice the effective flow width . **(L = 2W minimum).**

f. Account for the sediment storage volume.

g. Outlet Riser and Barrel Requirements
   1. Discharge capacity - 10-year 24-hour storm event.
   2. Minimum outlet pipe diameter of 8-inches.
   3. Required 6-inch low flow orifice at bottom of riser structure.
   4. 2-year and 10-year 24-hour storm disturbed flow rates are ≤ to the pre-disturbance peak flow rates.
   5. Anti-vortex device / trash rack required.
   6. Minimum one-foot elevation difference from the top of riser to the crest of the emergency spillway.
   7. Sediment volume storage accounted for in design volume.

h. Embankment Requirements
   1. Maximum upstream slope – 2H:1V.
   2. Maximum downstream slope – 2H:1V.
   3. Freeboard - 12 inch minimum.
   4. Antiseep collars are required on all penetrations through the dam.

Inspection and Maintenance

The key to a functional sediment basin is continual monitoring, regular maintenance and regular sediment removal. Attention to sediment accumulations within the pond is extremely important. Continually monitor sediment deposition in the basin. Owners and maintenance authorities should be aware that significant concentrations of heavy metals (e.g., lead, zinc, and cadmium) as well as some organics such as pesticides, may be expected to accumulate at the bottom of these treatment facilities.

- Remove sediment when it reaches 50 percent of storage volume or reaches the top of the designed cleanout stake where applicable.
- Remove all temporary sediment basins within 30 days after final site stabilization is achieved or after it is no longer needed.
- Remove trapped sediment from the site , or stabilize on site.
- Permanently stabilize disturbed areas resulting from the removal of the sediment basin.

Sediment Basin Design Aids

Each soil type has an eroded particle diameter. See Appendix E. This data is required to determine the settling velocity of the particle, V_{15}. Figure SV-1 plots eroded particle diameter, d_{15}, versus settling velocity. Use this figure to determine the value of V_{15}. Use the basin ratio shown in the formula below to determine trapping efficiency. Figures SB-1 and SB-2 plot trapping efficiency versus the basin ratio. The basin ratio should be less than or equal to the curve value at any given trapping efficiency. The figures depicting trapping efficiency values are for the following two separate conditions:

- SB -1,basins **not** located in low lying areas and/or not having a high water table, and
- SB-2, basins located in low lying areas and/or having a high water table.

$$\text{Basin Ratio} = \frac{q_{po}}{A\,V_{15}}$$

Where:
q_{po} = Peak outflow rate from the basin for the 10-year 24-hour storm event (cfs),
A = Surface area of the pond at riser crest (acres),
V_{15} = Characteristic settling velocity (fps) of the characteristic D_{15} eroded particle (mm).

D_{15} is read from the tables in Appendix E, or is determined from a site specific soil eroded particle size distribution analysis. Never use the primary particle size distribution.

V_{15} is calculated or read from Figure SV1.

Constraints for use of Sediment Basin Design Aids:

- Watershed area less than or equal to 30 acres
- Overland slope less than or equal to 20 percent
- Outlet diameter less than or equal to 6-feet
- Basin Ratios above the design curves are not recommended for any application of the design aids. If the basin ratio q_{po}/AV_{15} intersects the curve at a point having a trapping efficiency less than the desired value, the design is inadequate and must be revised.

- A basin **not** located in a low lying area and not having a high water table, has a basin ratio equal to 2.20 E5 at 80 percent trapping efficiency as shown in Figure SB1.

- A basin that **is** located in a low lying area or in an area that has a high water table, has a basin ratio equal to 4.70 E3 at 80 percent trapping efficiency as shown in Figure SB2.

Sediment Basin Design Example

Given: Construct a sediment basin on a 14-acre (0.0219 mi^2) disturbed site.
The site is not located in a low lying area and does not have a high water table.
Peak discharge is limited to that of the current land use, established grass.
A pond site is available with an area at the riser crest of 0.75 ac.
Soil in the area is an Edisto with a Hydrologic Soil Group Type C.

Find: Trapping efficiency for a 10-year, 24-hour Type II storm if time of concentration is 20 minutes.

Solution:

1. Estimate the peak runoff allowed. The SCS curve number is found for a hydrologic soil group C with established grass as 74. Using a 10-year, 24-hour design storm of 6.0-inches, with this curve number yields a runoff volume of 3.2-inches using the SCS curve number method.

2. Using the SCS graphical method to estimate peak flow, the I_a/P ratio computes to approximately 0.12. Combining this and an estimated time of concentration equal to 0.33 hrs yields a q_u = 650 csm/in for a Type II storm distribution.

3. The peak discharge allowed is calculated by multiplying q_u times the runoff volume times the disturbed area in mi^2 and is approximately 46 cfs.

4. D_{15} for an Edisto sub-soil 0.0128. Using this diameter, V_{15} is estimated from Figure SV-1 as 3.7E-4 ft/sec.

5. The sediment basin ratio can now be calculated by calculating

$$q_{po} / (AV_{15}) = 46 / [(0.75)(3.7E\text{-}4)] = 1.70\ E5$$

6. Using Sediment Basin Design Aid (Figure SB-1) with this sediment basin ratio, read across to the curve and then turn down to the x-axis. The trapping efficiency is estimated to be 81%.

7. If the desired trapping efficiency was not obtained, the process would need to be repeated with a larger basin or decreased discharge until the desired trapping efficiency was found.

Temporary Sediment Basin

Temporary Sediment Basin Perforated Riser

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Outlet pipe is clogged with the debris.	Clean outlet pipe. Install a trash rack around pipe to hold back larger debris particles.
Spillway erodes due to high velocity flows.	Stabilize outlet with an ECB, TRM or riprap.
Side Slope eroding.	Stabilize slopes with vegetation, ECB, TRM, riprap or equivalent method.
Excessive accumulated sediment buildup.	Remove sediment to maintain the sediment storage capacity.
The upstream drainage area is too large.	Limit the contributing drainage area or expand basin. Ensure drainage area does not exceed recommended acreage. If the drainage area does exceed this limit, install diversion ditches and add additional BMPs to accommodate the diverted flow.