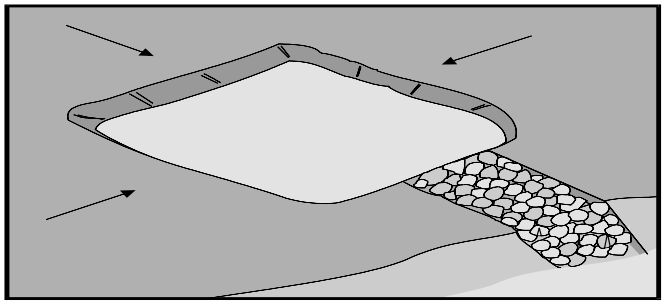
ACTIVITY: Temporary Sediment Trap | ES – 18



CITY OF KNOXVILLE

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

Description

A sediment trap is a small temporary pond that drains a disturbed area so that sediment can settle out. A sediment trap is constructed early in the construction process using natural divides and favorable topography where possible to minimize grading. This practice will significantly reduce sediment.

Suitable Applications

- Any disturbed area which is less than 5 acres.
- Along the perimeter of a project site to prevent sediment-laden runoff from being discharged.
- Immediately uphill from temporary storm drain inlet protection measures.

Approach

A temporary sediment trap is a small settling pond, built to collect and store sediment from uphill sites cleared and graded during construction. It is intended for use on small tributary areas with no unusual drainage features, and projected for a quick build-out time at the initial construction phases. The principal feature distinguishing a temporary sediment trap from a temporary sediment basin is the lack of a pipe or riser.

A sediment trap is a temporary measure with a typical design life of approximately 6 months and a maximum drainage area of 1 to 5 acres, depending on the manner of construction. The maximum life of a sediment trap shall not be more than 12 months, and also depends on the type of construction chosen. One or more temporary sediment traps are often built early in the construction process to control erosion, before a larger temporary or permanent structure (such as a sediment basin or modified detention basin) can be constructed. A sediment trap which is not carefully maintained and inspected may turn into a wetland area; wetlands are protected by state and federal laws and cannot be removed or altered without a permit from TDEC.

A temporary sediment trap is not as effective as a temporary sediment basin and therefore requires that more sediment control measures must be operative upstream. A sediment trap is effective against coarse sediment, but not against silt or clay particles that remain suspended. A temporary sediment trap requires very frequent maintenance and inspection until the site is permanently protected against erosion.

Place sediment traps at locations that will require minimal clearing and grading. Balance excavation and fill quantities when possible to minimize grading. Natural draws or swales are usually favorable places to build a sediment trap. Sediment traps should be

easily accessible for frequent maintenance and inspection, but do not locate in the middle of major construction areas. Do not locate sediment traps where failure can cause property damage or inconvenience to humans.

Undisturbed areas should generally be routed around temporary sediment traps (and also sediment basins and detention basins) early during the construction process. This can achieved by temporary diversions or by permanent channels. This allows "clean" stormwater runoff to remain clean. In addition, the total stormwater runoff volume to the sediment trap is reduced. This allows silt and clay particles to have less stormwater runoff depth to settle through, and these particles are also less likely to be resuspended.

Types of Construction

The basic principles and design guidelines are applicable to various methods for creating a temporary sediment trap. The main differences are with regards to the type of outlet structures that are chosen. The following types are identified and shown with details:

(A) Overflow (level spreader): Figure ES-18-1

(B) Rock outlet: Figure ES-18-2

(C) Combination straw bale and silt fence outlet: Figure ES-18-3

(A) An overflow sediment trap is limited to small areas less than 1 acre, typically with gentle slopes (1 or 2 percent) and without major grading operations. It functions very similarly to a level spreader. If water enters the sediment trap with very slow velocities, the same amount of water will be slowly displaced and leave the other end of the sediment trap. Silt fence, straw bale barriers or grass filter strips are used to "polish" the overflow water as it leaves the sediment trap.

(B) The rock outlet type relies on filtering through layers of aggregate, rock or riprap material to dewater the sediment trap. It is the most sturdy of the sediment trap designs and generally requires less maintenance. It can be used for drainage areas up to 5 acres and for up to 12 months.

(C) The combination straw bale and silt fence outlet uses the two most common sediment-filtering devices to dewater the sediment trap. Additional structural support, such as wood bracing or wire fence installation, is required for these two materials to resist 1 foot or more of ponded water. Straw bales are liable to rot quickly or to blow out; silt fence fabric can rip or tear. The combination straw bale and silt fence outlet should be limited to total drainage areas of less than 1 acre. This type of outlet requires frequent maintenance and adjustments to ensure that the released stormwater is free from sediment.

Volume

Minimum volume of a sediment trap shall be 67 cubic yards per acre for the total drainage area. The volume shall be measured at an elevation equivalent to the spillway invert.

Optimal design volume of sediment trap depends on type of soil, size and slope of drainage area, amount of land disturbance, desired sediment removal efficiency, and desired cleanout frequency. A recommended volume for temporary sediment trap in heavily disturbed areas is 134 cubic yards per acre, which equates to 1 inch of stormwater runoff. Optimal design of this type of sediment trap includes an upper zone of at least 67 cubic yards per acre (to be dewatered using one of the outlet design alternatives) and a lower wet zone for sediment storage and settling.

Volume of a sediment trap should generally be computed from existing and proposed contour lines, or by using measured cross sections. An approximate method for estimating volume for most sediment traps using a natural draw or swale is:

V = 0.4 x A x D

V = storage volume (below the invert of the emergency spillway)

A = surface area (at the level of the emergency spillway invert)

D = maximum depth (as measured from the emergency spillway invert)

The recommended cleanout volume is 1/4 of the total storage volume of a sediment trap. The nominal volume for sediment removal is therefore 17 cubic yards per acre (which is 1/4 x 67 cubic yards per acre). The recommended sediment depth for the cleanout volume shall be computed. A stake or post shall be installed and marked to assist in identifying the need for sediment cleanout.

Other Physical Parameters

- Maximum total drainage area to a temporary sediment trap is 5 acres, depending on the type of construction. Maximum life span of a temporary sediment trap is 12 months, again depending on the type of construction.
- Maximum height of sediment trap embankment shall not be more than 5.5 feet, as measured from the downstream toe of slope to top of berm.
- Maximum ponded depth of sediment trap shall not be more than 4 feet, as measured from the bottom of the trap to the invert of the emergency spillway.
- Maximum slopes shall be 2:1 (H:V) for excavated areas and for compacted embankments. Most side slopes should be to 3:1 (H:V) or flatter, which will allow people and equipment to safely negotiate slopes or to enter the sediment trap.
- Top width of embankment shall be at least as wide as the actual height of sediment trap embankment, with a minimum width of 3 feet.
- Stormwater travel distances should be maximized across the sediment trap. The length to width ratio must be greater than 2:1 (L:W) for the principal flowpaths in order to maximize residence time of stormwater within the sediment trap. Baffles may be required to prevent short-circuiting of flow.
- A typical baffle design is to use 4’ x 8’ sheets of exterior grade plywood ½ inch thick, mounted on 4” x 4” hard wood posts. Posts shall be firmly set at least 2 feet into the ground with maximum spacing of 8 feet. Posts and plywood shall not be lower than 6 inches below the top of embankment elevation.

Emergency Spillway

The emergency overflow outlet of the temporary sediment trap must be stabilized with rock, riprap, geotextile, vegetation or another suitable material which is resistant to erosion. A stable emergency spillway must be installed to safely convey stormwater runoff for the 10-year storm event.

An emergency overflow weir should be provided at an elevation of at least 1.5 feet below the top of embankment, with a minimum freeboard of 1 foot. The minimum bottom width of a trapezoidal section for an emergency overflow weir should be:

4 feet - 1 acre (total drainage area)

6 feet - 2 acres (total drainage area)

8 feet - 3 acres (total drainage area)

10 feet - 4 acres (total drainage area)
12 feet - 5 acres (total drainage area)

Installation Guidelines

Temporary sediment traps are usually installed at the beginning of a construction project, immediately after the perimeter erosion control measures have been performed. It is intended that grading, earthwork, trenching and other land-disturbing activities take place early in the construction process, so that the temporary sediment trap should not be necessary for more than 12 months.

Step 1: Place perimeter erosion control measures around sediment trap location. Clear and grub, particularly underneath embankments. Grade and/or excavate to construct the required volume and to provide fill material for any embankments.

Step 2: Construct any embankments needed by using fill material made of clay, which is free of roots, large rocks, and organic material. Place fill in layers 6 inches thick and then compact using a sheeps foot roller or vibratory equipment.

Step 3: Install outlet structures such as rock outlet berm, combination straw bale and silt fence outlet, or an emergency overflow weir. Install geotextile fabric and wire fencing at potential locations of stone outlet failure. Install baffles if necessary to maximize stormwater residence time within the sediment trap.

Step 4: Stabilize slopes using temporary vegetation, erosion control matting, straw mulch or other measures. Inspect final work for safety and function. Install warning signs, barricades, perimeter fence or other measures necessary to protect construction workers and equipment.

Maintenance

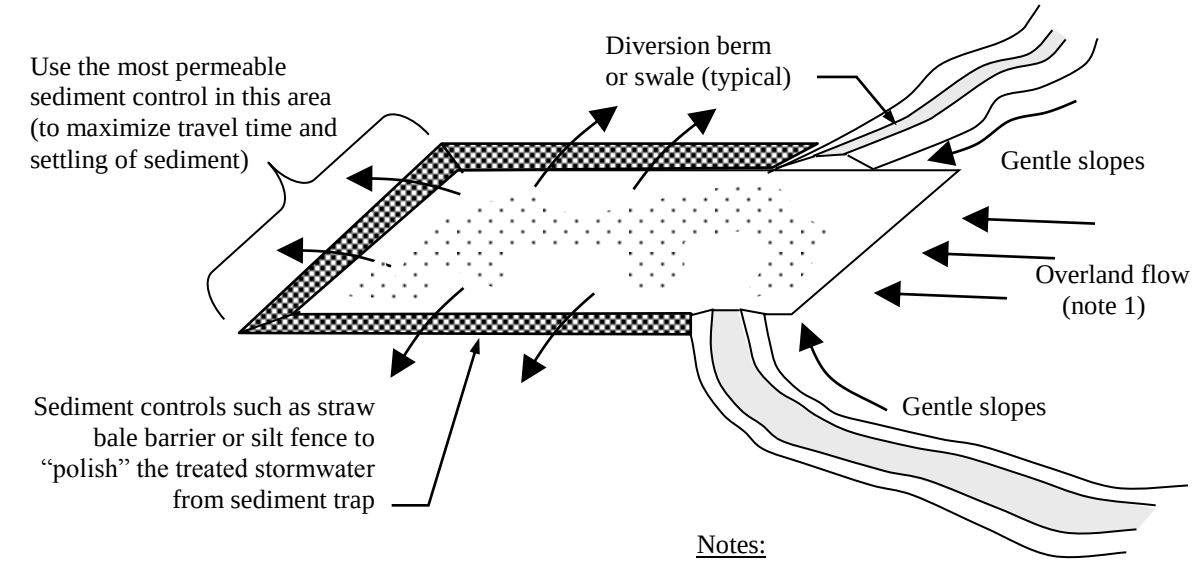
- Inspect sediment traps weekly and after each rainfall event for excessive sediment buildup, undercutting flows or seepage, slope failure, settlement and structural soundness. Regularly inspect water quality being discharged for suspended sediment and color. Identify and perform necessary repairs to improve water quality. Check downstream channel for erosion or sedimentation.
- Remove accumulated sediment whenever it reaches the designated cleanout level, which is one-fourth of the total sediment volume. The nominal volume of sediment (1/4 x 67 cubic yards = 17 cubic yards) usually requires heavy equipment and good weather for sediment cleanout. Shovel by hand adjacent to outlet control structures to prevent equipment damage in this area. Dispose of accumulated sediment onsite at a protected location to prevent resuspension of sediment.

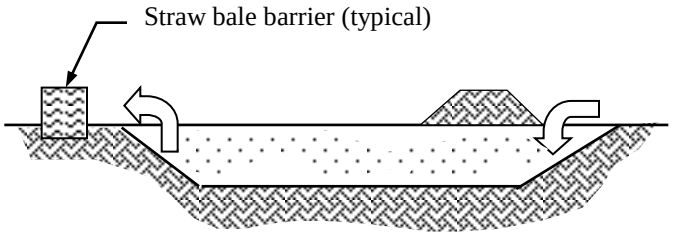
Limitations

- Temporary sediment traps shall not be used in live or continuously-flowing streams. Sediment traps may kill nearby vegetation by excessive sediment or by long periods of submergence.
- Temporary sediment traps only remove coarse particles which settle quickly. Sediment traps are not effective for fine-grained soils such as silt or clay. Additional upstream erosion control measures are necessary.
- Sediment traps can be attractive and dangerous to children. Protective fencing or other access control measures for the project site are recommended. Sediment traps with steep slopes may be difficult for someone to exit.

References

8, 9, 30, 31, 32, 33, 34, 35, 43, 114, 135, 136, 141, 144, 162, 167, 179
(see BMP Manual Chapter 10 for list)



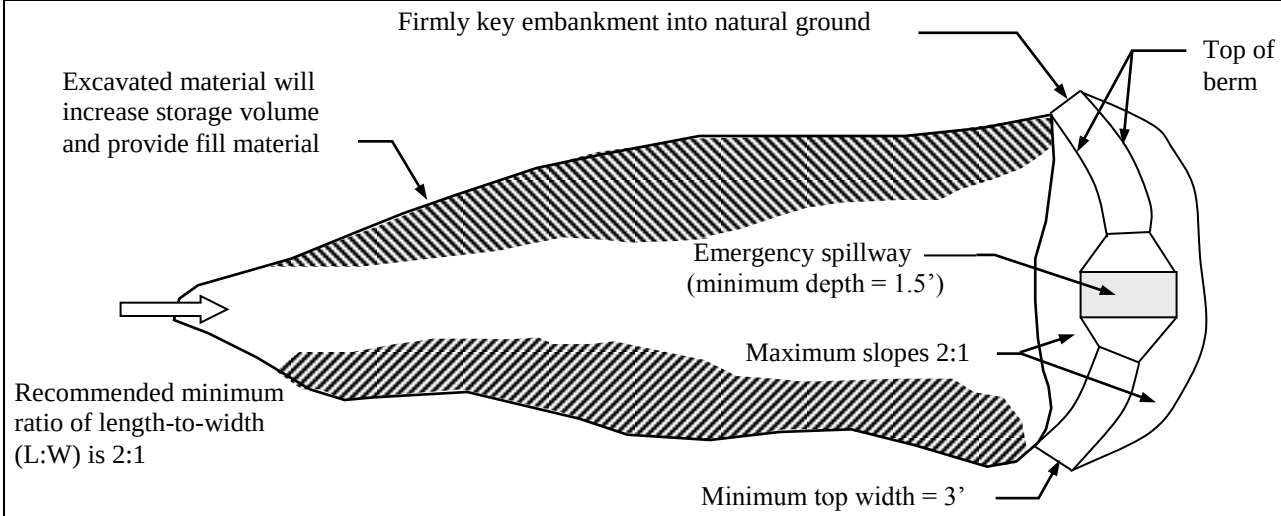


Notes:

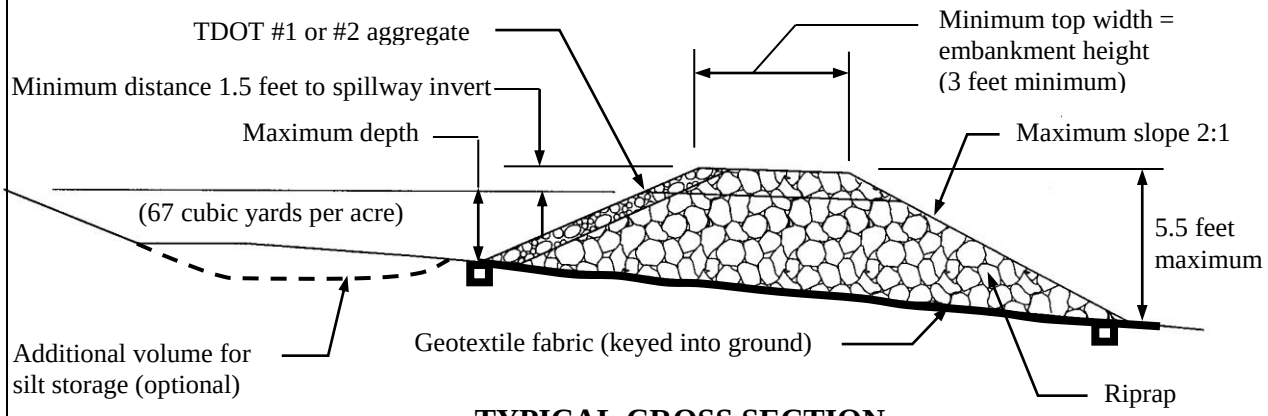
1. Maximum area for overflow sediment trap is usually 1 acre. Must have gentle slopes (less than 2% generally) and predominantly overland sheet flow.
2. Maximum permanent wet depth is 2 feet. Overflow sediment traps may not be effective for high groundwater table and inflows.

NOT TO SCALE

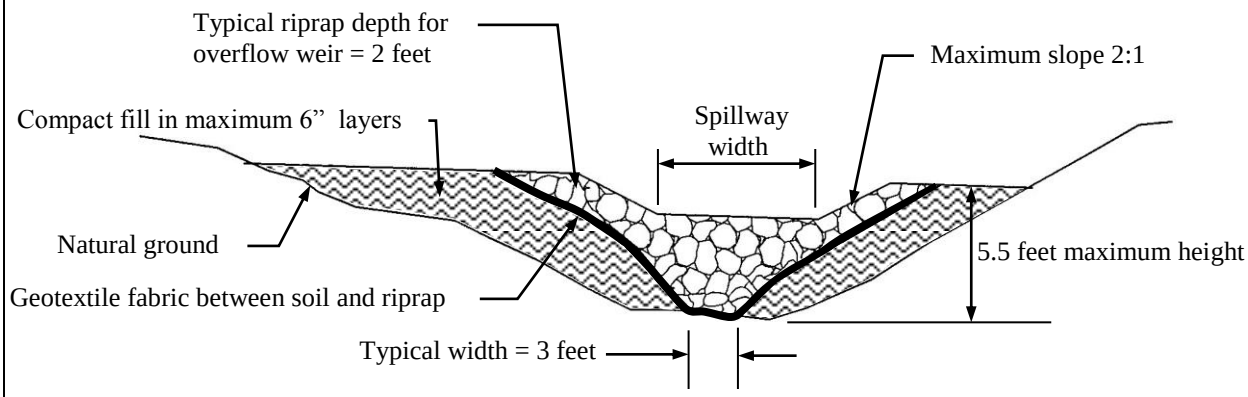
Figure ES-18-1
Temporary Sediment Trap – Overflow



TYPICAL PLAN VIEW



TYPICAL CROSS SECTION



TYPICAL PROFILE THROUGH EMBANKMENT

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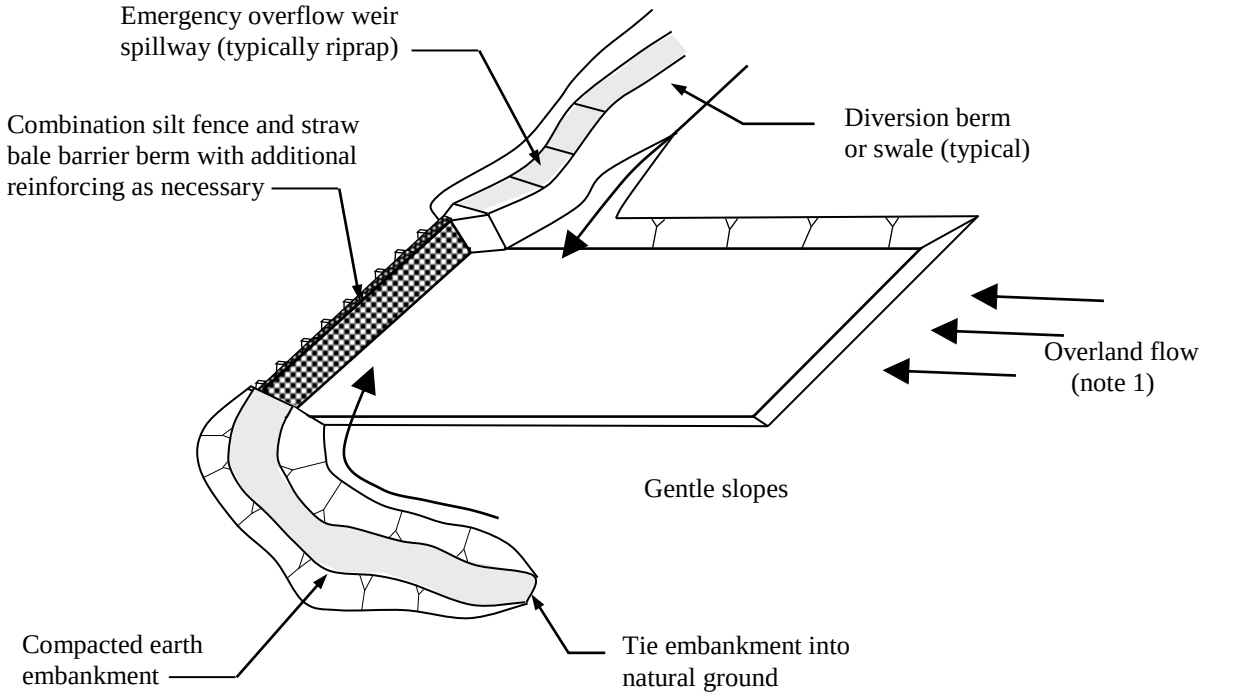
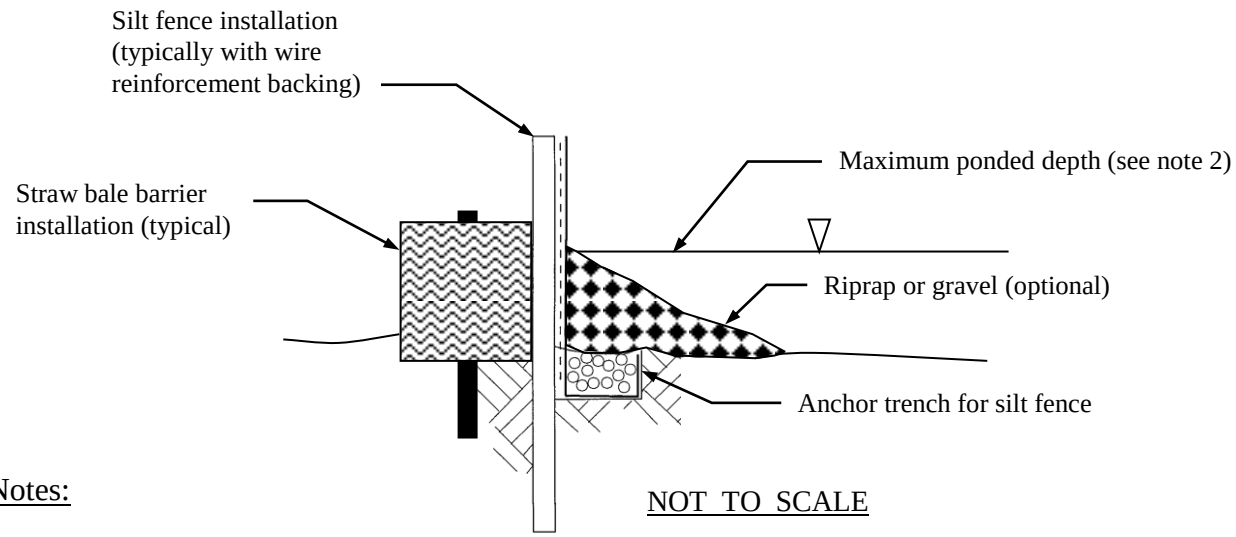
Figure ES-18-2
Temporary Sediment Trap – Rock Outlet





NOT TO SCALE

Notes:

1. Maximum area for sediment trap with a silt fence / straw bale combination outlet is usually 1 acre with gentle slopes and predominantly overland sheet flow.

2. Maximum depth of ponded water is usually 12 inches or less. Provide emergency spillway by constructing riprap channel as necessary.

Figure ES-18-3
Temporary Sediment Trap – Combination Outlet