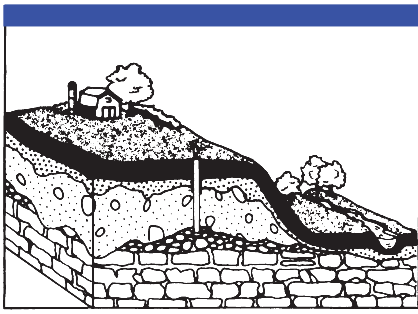

Soil Facts

Surface Outlets for Sediment Basins

Sediment basins are a temporary stormwater practice designed to pool runoff in order to deposit a portion of the sediment it carries. They often retain 50 to 60 percent of the sediment entering them. The typical outlet is either a rock dam or a perforated riser barrel, both of which allow water to leave the basin from all depths. One way to improve the sediment capture rate is to use an outlet that dewaters the basin from the top of the water column where the water is cleanest. This fact sheet describes ways to accomplish this goal.

Skimmer Option

A patented device known as the Faircloth Skimmer (Faircloth, 2008) is probably the most common way to dewater a sediment basin from the surface. It is made from polyvinyl chloride (PVC) pipe and consists of an inlet at the end of a pipe suspended by a "C" -shaped float (Figure 1). The float, or enclosure, acts both to suspend the outlet near the surface and to protect it from floating debris. The other end of the pipe is connected to a flexible hose that allows the skimmer to rise as the water rises in the basin. The hose is connected to a pipe through the dam (Figure 2) or to a solid riser barrel or similar outlet.

The basic concept is that the skimmer does not dewater the basin as fast as runoff enters it, but rather it allows the basin to fill and then slowly drain over hours or days. This has two effects. First, the sediment suspended in the runoff has more time to settle out prior to discharge. Second, a pool of water forms early in a storm event that further increases sedimentation efficiency rates in the basin. Many storms will produce runoff

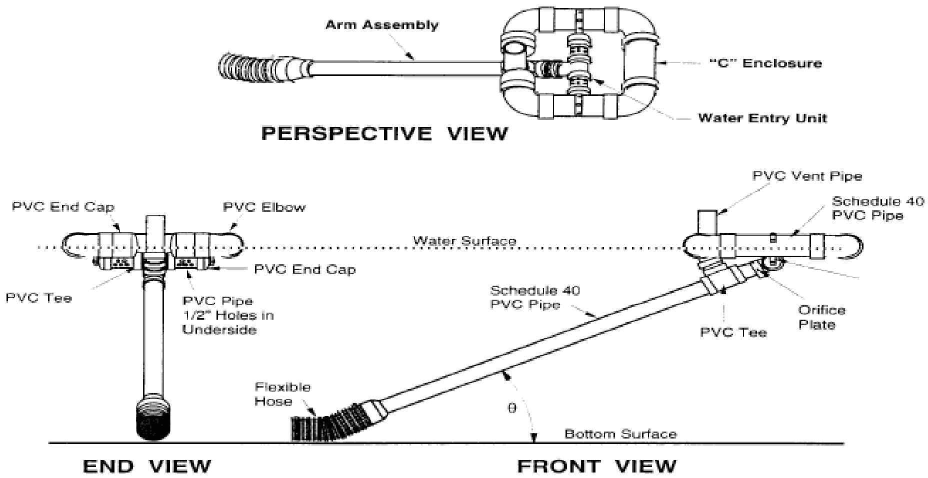

Figure 1. Views of the Faircloth skimmer. Source: Jarrett, 2008.

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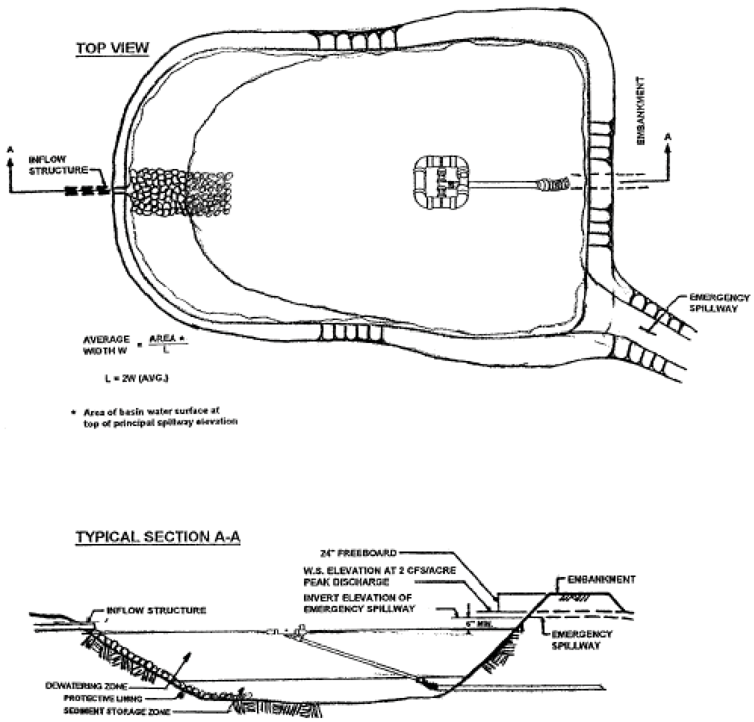

Figure 2. Example of a sediment basin with a skimmer outlet and emergency spillway. Inlet to basin should be stabilized with geotextile with or without rock (rock shown). Source: Pennsylvania Office of Water Managements, 2000.

in excess of the basin volume and flow rates in excess of the skimmer capability, resulting in flow over the emergency spillway. This water is also coming from the top of the water column and has thereby been "treated" to remove as much sediment as possible. The skimmer essentially is functions to remove the volume of water in the basin after runoff ceases.

The Faircloth Skimmer should be sized by determining the required (or desired) outflow rate. This means you must first determine the volume of water, V, to be drained from the basin in cubic feet (ft^3) and then decide how many days you want the skimmer to take to remove this volume of water, the dewatering time, t_d. With these two numbers, compute the required outflow rate, Q (in cubic feet per day, ft^3/d), as

$$Q = \frac{V}{t_d}.$$

With the required outflow rate known, select a skimmer and orifice from the Selection Charts on page 3. The skimmer selection procedure is illustrated below with an example.

Faircloth Skimmer Selection Procedure

The following data charts are recommended for selecting Faircloth Skimmers to dewater sediment control basins.

Required input data:

Basin volume = ____ $ft^3 (V)$

Desired dewatering time = ____days (t_d)

Procedure:

1. Use the basin volume (ft^3) and the desired dewatering time (days) to determine the required skimmer outflow rate in cubic feet per day (ft^3/d) from the following equation

$$Q = \frac{V}{t_d}.$$

2. Scan the Faircloth Skimmer Selection Charts (page 3) and select (a) the skimmer size and (b) the skimmer orifice diameter inches desired.

Example: Select a skimmer that will dewater a 20,000 ft^3 sediment basin in 3 days.

Solution: First compute the required outflow rate as

$$Q = \frac{V}{t_d} = \frac{20{,}000\ ft^3}{3d} = 6{,}670\ ft^3/d$$

Now go to the Selection Charts and select an appropriate skimmer. If the 2-inch skimmer with no orifice is chosen, the outflow rate will be 5,429 ft^3/day, which will require about 3.5 days to dewater the basin. An alternative might be to use a 4-inch skimmer with a 2.5-inch diameter orifice, which will have an outflow rate of 8,181 ft^3/day and dewater the basin in about 2.5 days.

Each skimmer comes with a plastic plug that can be drilled to form a hole that will limit the skimmer's outflow to any desired rate. Thus, for a specific skimmer, the orifice that will dewater a basin in a more precisely chosen time can be determined. Using the example above, we can solve the equation for the orifice diameter using the desired outflow rate (6,670 ft^3/day) and the head driving water through the skimmer (0.275 ft for a 4-inch skimmer, given as H at the top of that chart) as follows:

$$D = \sqrt{\frac{Q}{2{,}310\sqrt{H}}} = \sqrt{\frac{6{,}670}{2{,}310\sqrt{0.275}}} = 2.34\ in.$$

Thus, if the plastic plug were drilled to a 2.34-inch diameter in a 4-inch skimmer, the dewater rate would be 6,670 ft^3/day and the skimmer would

Faircloth Skimmer Selection Charts

1.5-inch skimmer (H = 0.125 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	2,079
1.0	1.5	809
0.5	1.5	193

2-inch skimmer (H = 0.167 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	5,429
1.0	2.0	924
0.5	2.0	231

2.5-inch skimmer (H = 0.167 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	9,548
1.0	1.5	1,039
0.5	1.5	250

3-inch skimmer (H = 0.25 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	10,588
1.5	3.0	2,541
1.0	3.0	1,136
0.5	3.0	289

4-inch skimmer (H = 0.275 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	16,863
2.5	4.0	8,181
2.0	4.0	5,236
1.5	4.0	2,945
1.0	4.0	1,309
0.5	4.0	327

5-inch skimmer (H = 0.333 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	26,276
3.5	4.0	16,035
3.0	4.0	11,781
2.5	4.0	8,181
2.0	4.0	5,236
1.5	4.0	3,715
1.0	4.0	1,309
0.5	4.0	327

6-inch skimmer (H = 0.417 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	44,371
4.5	5.0	29,645
4.0	5.0	23,427
3.5	5.0	17,941
3.0	5.0	13,186
2.5	5.0	9,144
2.0	5.0	5,852
1.5	5.0	3,292
1.0	5.0	1,463
0.5	5.0	366

8-inch skimmer (H = 0.5 ft)		
Orifice (in)	Head (in)	Outflow Rate (ft^3/d)
None	---	127,416
5.5	6.0	48,510
5.0	6.0	40,098
4.5	6.0	32,475
4.0	6.0	25,660
3.5	6.0	19,654
3.0	6.0	14,438
2.5	6.0	10,029
2.0	6.0	6,410
1.5	6.0	3,619
1.0	6.0	1,598
0.5	6.0	404

dewater this 20,000 ft^3 basin in 3 days.

Longer dewatering times may provide some additional sedimentation removal, but the risks involved in having standing water in a basin should be considered in doing this calculation.

Because the emergency spillway is actually used relatively frequently, it should be carefully stabilized using geotextiles, with rock if necessary, that can withstand the expected flows. The spillway should be placed as far from the inlet to the basin as possible to maximize sedimentation before discharge. It should be cut into the natural soil if at all possible to reduce the chance of instability and failure.

The cost of a skimmer system may be similar, or occasionally less, than a conventional rock outlet. With a skimmer, however, the basin will be much more efficient in removing sediment. Another advantage of the skimmer is that it can be reused on future projects, further reducing the actual cost of the initial investment. The main disadvantage of the skimmer is that it does require some maintenance, primarily in removing debris from the inlet.

Flashboard Riser Option

Perforated riser barrels are common dewatering devices for sediment basins, usually where the basin will be retained as a stormwater detention device. These are designed to dewater relatively quickly and draw water from the entire water column. A different approach is to use a flashboard riser, which forces the basin to fill to a given level before the water tops the riser (Figure 3). This approach is similar to a solid riser barrel, but with the option of being able to adjust the water level in the basin. A flashboard riser is usually fabricated as a box or as a riser barrel cut in half. The open face has slots on each side into which boards or "stop logs" are placed, forcing the water up and over them. This device should be sized the same way as a typical riser barrel. It must be anchored to prevent flotation.

Forcing the water to exit the sediment basin from the top of the water column where the water is cleanest improves sediment capture rate as discussed with the skimmer. A flashboard riser basin will have an adjustable, permanent pool, which also improves basin efficiency. This is a disadvantage when the sediment needs to be removed, however, as the operator may need to remove the boards down to the sediment level to drain the basin.

Other Outlet Options

A solid riser can also be used.This may be an attractive option if such an outlet is planned for the basin after construction, when it is converted to a stormwater pond. It would function just like the flashboard riser basin, except the only way to remove water from a solid riser basin would be to pump it out. For small drainages (1 to 2 acres or less) needing only a temporary sediment basin, another option is to excavate a basin 2 to 3 feet below grade and have it overflow through a rock dam or other stabilized outlet. These are similar to the basins that N.C. Department of Transportation refers to as "Type B" sediment traps, but excavated even deeper. Both of these options do have the liability risk of having standing water in them for long periods between storms.

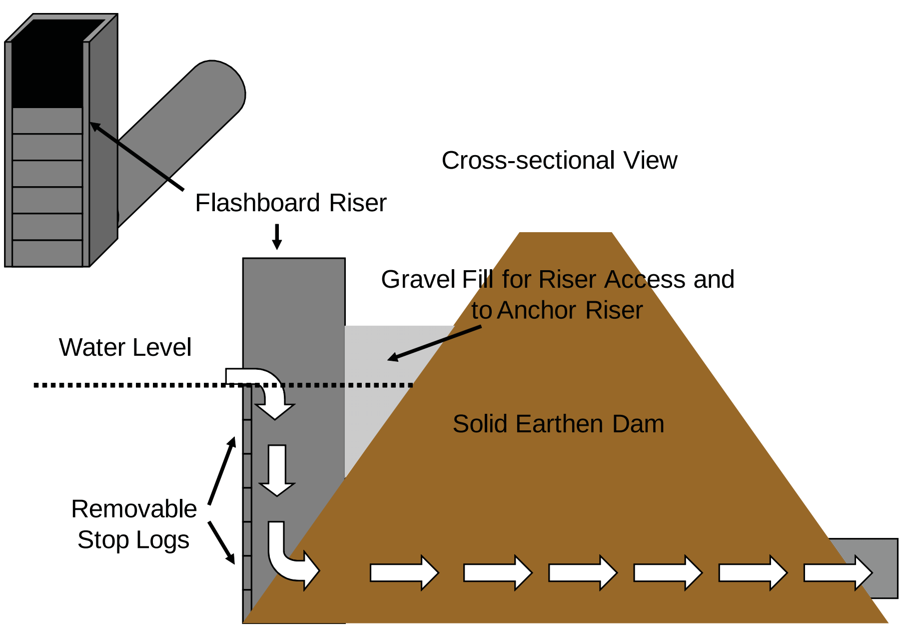

Figure 3. Example installation of a flashboard riser outlet for sediment basins.

Resources

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