Sediment Fence

SEDIMENT CONTROL TECHNIQUE

Type 1 System		Sheet Flow	✓	Sandy Soils	✓
Type 2 System		Concentrated Flow	[1]	Clayey Soils	[2]
Type 3 System	✓	Supplementary Trap		Dispersive Soils	

[1] Not recommended in areas of concentrated flow—refer to *U-Shaped Sediment Traps*.

[2] Very limited capture of fine clay particles, but still useful for trapping sand and silt.

Symbol 

or 

Photo 1 – Installation of a sediment fence

Photo 2 – Sediment fence located down-slope of multi-dwelling building site

Key Principles

1. Primarily used to collect coarse sediments. Sediment fences have a poor capture rate of the finer sediment particles, thus operators should not expect to see any significant change in the colour or turbidity of water passing through the fence.
2. Treatment is primarily achieved through gravity-induced 'settlement' resulting from the temporarily ponding of sediment-laden water up-slope of the fence. 'Filtration' is only a secondary function of the fabric, if at all.
3. Critical to the effectiveness of a sediment fence is the 'surface area' of the pond that forms up-slope of the fence. Therefore, sediment fences need to be installed such that the total surface area of ponding up-slope of the fence is maximised.
4. Optimum performance can be achieved by installing the fence in a manner that allows water to pond either:
   - uniformly along the fence (i.e. a fence located along a line of constant elevation); or
   - at regular intervals along the fence (i.e. a fence installed at a slight angle to the slope, but with regular 'returns' installed along the length of the fence).
5. Woven and composite fabrics perform slightly different tasks and their selection depends on site conditions.
6. Though often referred to as 'silt fences', a sediment fence is unlikely to trap significant quantities of fine silts (< 0.02mm), thus the term is considered an inappropriate description.
7. A sediment fence in its standard installation is only suitable for the treatment of 'sheet' flows. If concentrated flow exist, such as in a minor drain, then a *U-Shaped Sediment Trap*, or other more appropriate sediment trap should be used.

Design Information

Table 1 provides the recommended **maximum** slope length up-slope of a sediment fence.

Table 1 – Recommended maximum slope length up-slope of a sediment fence on non-vegetated slopes [1]

Batter slope			Horizontal spacing (m)	Vertical spacing (m)
Percentage	Degrees	(H):(V)		
1%	0.57	100:1	60 [2]	0.6 [2]
2%	1.15	50:1	60	1.2
4%	2.29	25:1	40	1.6
6%	3.43	16.7:1	32	1.9
8%	4.57	12.5:1	28	2.2
10%	5.71	10:1	25	2.5
15%	8.53	6.67:1	19	2.9
20%	11.3	5:1	16	3.2
25%	14.0	4:1	14	3.5
30%	16.7	3.33:1	12	3.5
40%	21.8	2.5:1	9	3.5
50%	26.6	2:1	6	3.0

[1] Maximum recommended spacings is based on minimising the risk of rill erosion on low to moderately erodible soil. In areas of highly erodible soil, the slope length may need to be reduced.

[2] Recommended maximum slope length above a sediment fence is 60m.

The maximum slope lengths presented in Table 1 for land slopes steeper than 2% may be represented by Equation 1.

$$\text{Maximum } \textbf{horizontal} \text{ slope length (m)} = 100/(\text{batter slope (\%)})^{0.64} \qquad \text{(Eqn 1)}$$

The allowable flow rate per meter length of sediment fence should, wherever possible, be determined from actual fabric testing. However, the actual flow rate at any point in time will depend on the degree of sediment blockage of the fabric.

In the absence of testing data, preliminary design flow rates can be obtained from Table 2.

Table 2 – Typical as-new and design flow rates for sediment fence fabric [1]

Depth up-slope of fence (m)	'As new' flow rate (L/s/m)		'Design' flow rate (L/s/m) [2]	
	Woven fabrics	Composite	Woven fabrics	Composite
0.2	2.6	4.8	1.3	2.4
0.4	5.6	10.6	2.8	5.3
0.6	9.0	17.8	4.5	8.9
0.8	12.6	26.2	6.3	13.1

[1] Flow rates are based on simplified test results that may not extrapolate well to actual field conditions.

[2] Suggested 'design' flow rates are based on an assumed 50% sediment blockage of the fabric.

Technical Note:

Australian Standards indicate that the flow rate through geotextiles for a given hydraulic head can be determined by extrapolating the measured flow rate at a hydraulic head of 100mm. Such analysis is **not** appropriate for woven fabrics such as sediment fence fabric. Hydraulic performance must be determined by appropriate physical testing at or above the required hydraulic head.

(a) Choice of fabric

Woven fabrics (Photo 3) are generally preferred on large sites when the service life is expected to extend over several storm events. Composite fabrics (Photo 5) are generally preferred on small soil disturbances such a building sites, or when the sediment fence is the last line of defence prior to the runoff discharging from the site or entering a water body.

Table 3 provides guidance on the selection of the preferred sediment fence fabric.

Table 3 – Preferred use of sediment fabrics

Fabric type	Preferred conditions of use
Woven fabrics	• Large sites when the service life is expected to extend over several storm events. • Up-slope of a Type 1 or Type 2 sediment trap.
Composite non-woven fabrics with a woven backing	• Small soil disturbances such a building sites. • When the sediment fence constitutes the last line of defence up-slope of a water body.

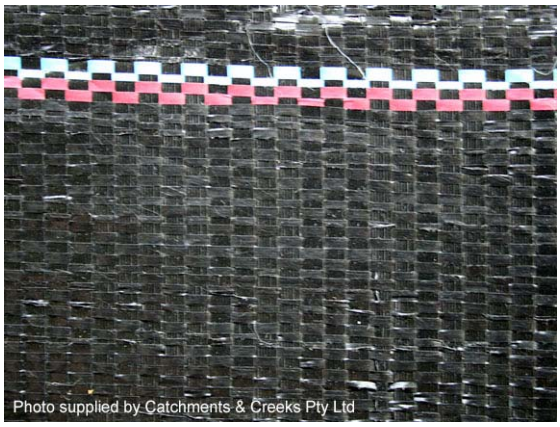

Photo 3 – Traditional woven sediment fence fabric

Photo 4 – Shade cloth MUST NOT be used

Composite fabrics, incorporating a non-woven fabric with woven fabric backing, typically have a higher flow rate (when first installed) due to the additional needle punching required to 'sew' the two fabrics together.

Composite fabrics are installed with the woven fabric as the down-slope face of the fence.

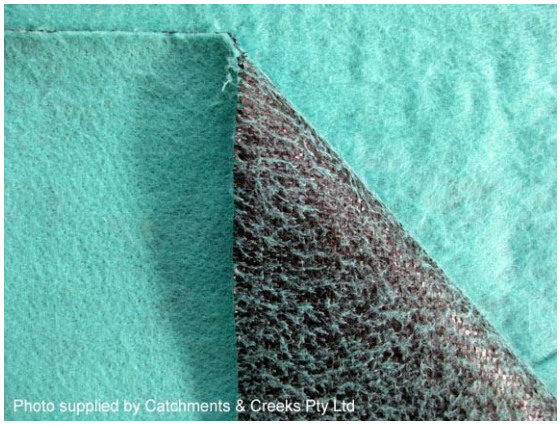

Photo 5 – Composite fabric with the woven (black) backing being the down-slope face of the sediment fence

Photo 6 – Filter cloth MUST NOT be used unless used in the construction of a 'Filter Fence' adjacent to a stockpile

Sediment fence fabric must be manufactured from either woven UV-stabilised polyester or polypropylene fabric, or a non-woven geotextile reinforced with a UV-stabilised polyester or polypropylene mesh.

Table 4 provides the recommended material properties of woven fabrics.

Table 4 – Recommended woven sediment fence material property requirements

Material property	Test method	Units	Typical value
Flow rate	AS 3706.9	$L/s/m^2$ (under 100 mm head)	15
Wide strip tensile strength	AS 3706.2	kN/m	10 both directions
Pore size (EOS) (O_{95})	AS 3706.7	mm x 10^{-3}	< 250
Mass per unit area	AS 3706.1	gsm	90
UV resistance	AS 3706.11	% retained (672 hours)	
Width	–	mm	730–910

Table 5 provides the recommended material properties of composite fabrics.

Table 5 – Recommended composite sediment fence material property requirements

Material property	Test method	Units	Typical value
Flow rate	AS 3706.9	$L/s/m^2$ (under 100 mm head)	145
Wide strip tensile strength	AS 3706.2	kN/m	17 both directions
Pore size (EOS) (O_{95})	AS 3706.7	mm x 10^{-3}	110
Mass per unit area	AS 3706.1	gsm	225
UV resistance	AS 3706.11	% retained (672 hours)	
Width	–	mm	730–910

(b) Location of a sediment fence

Wherever practical, the sediment fence should be installed along the contour, thus maintaining sheet flow conditions across the fence. If located at an angle to the contour, the fence needs to be installed with regular 'returns' to avoid water concentrating along the fence. Even if the fence is located along the contour, the use of regular returns is still recommended (refer to Figure 1).

The maximum spacing of fence 'returns' should be 20m if the fence is installed along the contour, or 5 to 10m (depending on slope) if located at an angle to the contour (Figure 2).

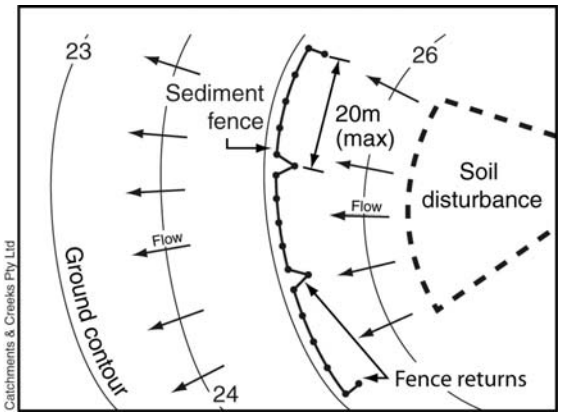

Figure 1 – Fence installed along the contour

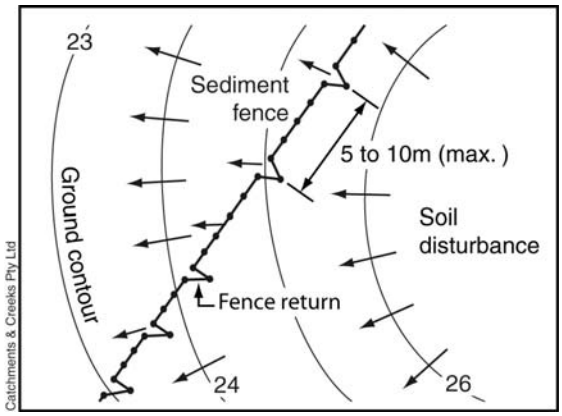

Figure 2 – Fence install down a slope

Wherever practical, allow at least 4.5m between the sediment fence and a single-storey building; 7.5m between the fence and a multiple-storey building; and at least 2m between the fence and the toe of a fill slope or stockpile (Figure 3).

A double sediment fence (Figure 4, Photo 8), or sediment fence with up-slope straw bale (Photo 7) can be used to reduce the risk of shifting fill damaging the fence.

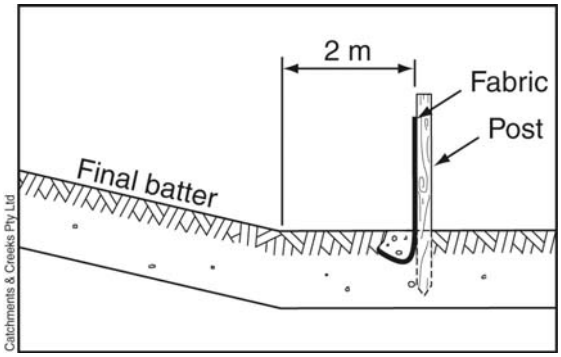

Figure 3 – Fence installation at base of slope

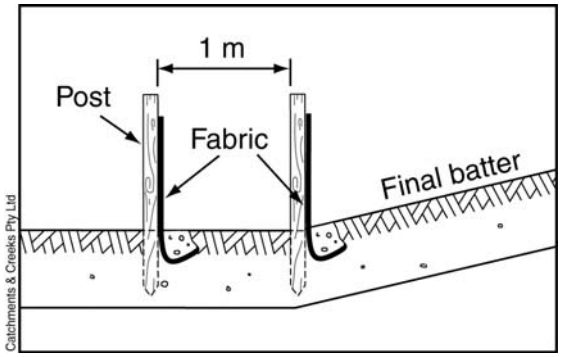

Figure 4 – Double sediment fence installed at the based of a fill slope

Photo 7 – Use of straw bales to prevent direct contact of stockpiles with the fence

Photo 8 – Double sediment fence

(c) Installation of a sediment fence

At least 300mm of fabric must be buried in either a 200mm trench (Figure 8, Photo 13), or under a continuous 100mm high layer of sand or aggregate (Photo 15), but **not** earth.

Straw bales can be placed up-slope of the fence (Figure 9) to retain settled sediment away from the fabric, thus improving the ease of ongoing maintenance (i.e. sediment removal). Alternatively, a small trench can be formed along the contour, up-slope of the fence.

Both ends of the fence should be turned up the slope to minimise the risk of flow bypassing around the ends of the fence (Figure 5, Photo 21).

Support posts should be spaced no greater than 3m if the fence is supported by a top support wire or weir mesh backing (Figure 7), otherwise no greater than 2m (Figure 6). The recommended maximum spacing of support posts is summarised in Table 6.

Table 6 – Maximum spacing of support post

Maximum post spacing	Installation condition
2m	No support wire or backing mesh.
3m	Support weir attached along top of the fabric at 1m intervals. Wire mesh or PVC safety mesh backing.

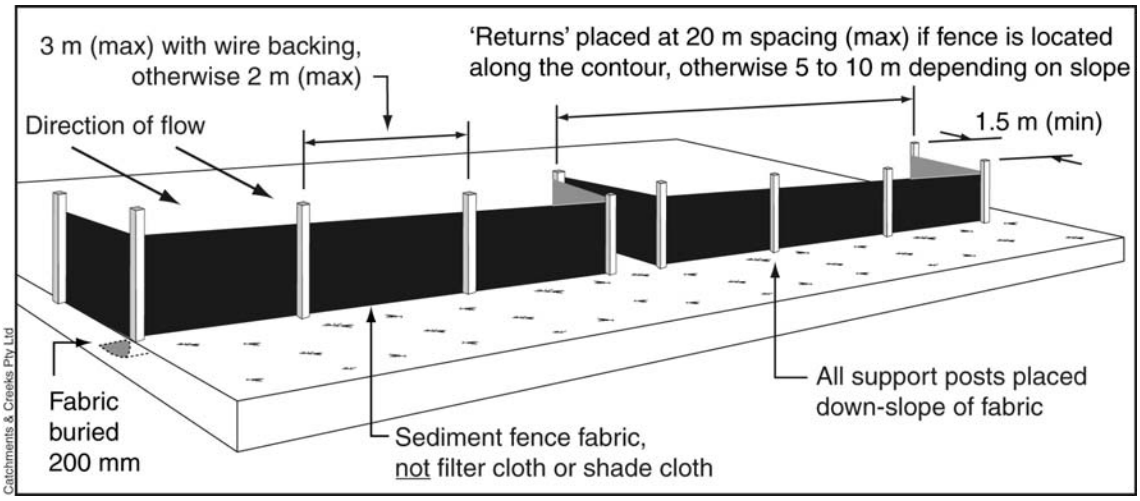

Figure 5 – Typical installation of a sediment fence

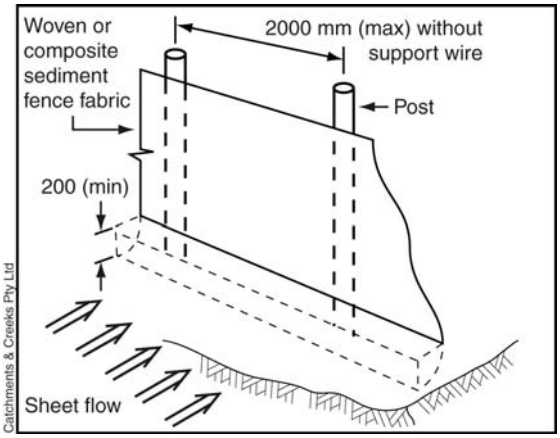

Figure 6 – Installation of a sediment fence without wire backing

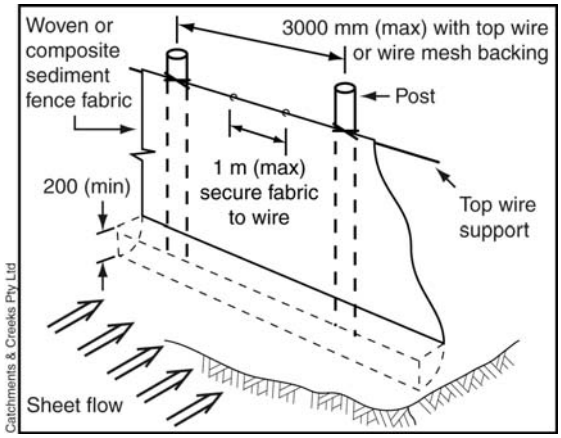

Figure 7 – Installation of a sediment fence with top wire support

Wherever possible, construct the sediment fence from a continuous roll. To join fabric either attach each end to individual stakes (Figure 10), holding the stakes together, rotate the stakes 180 degrees, then drive the two stakes into the ground; or overlap the fabric to the next support post (Figure 11).

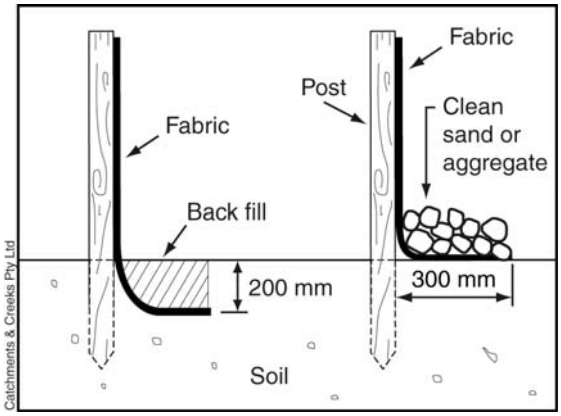

Figure 8 – Anchoring the fabric

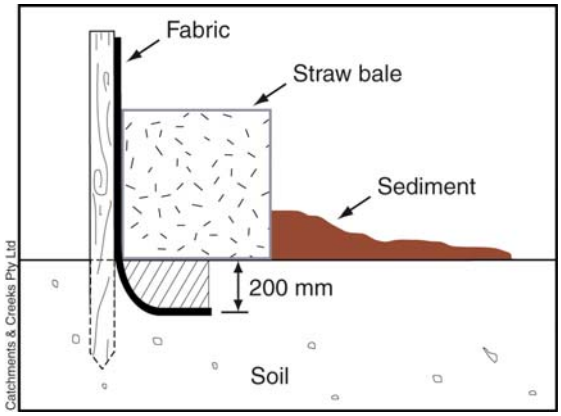

Figure 9 – Use of straw bales as a fabric-sediment separator

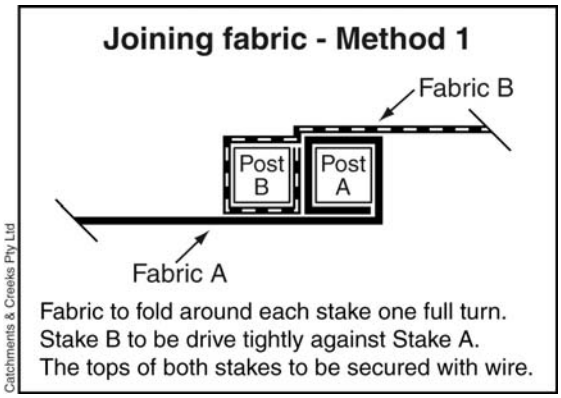

Figure 10 – Joining fabric (Option 1)

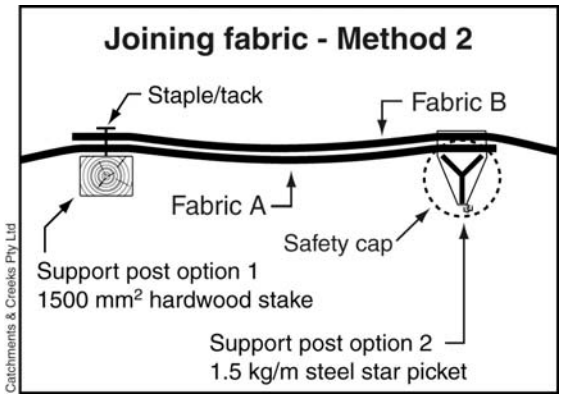

Figure 11 – Overlapping fabric (Option 2)

Photo 9 – Sediment fence placed along the contour

Photo 10 – Use of fence 'returns'

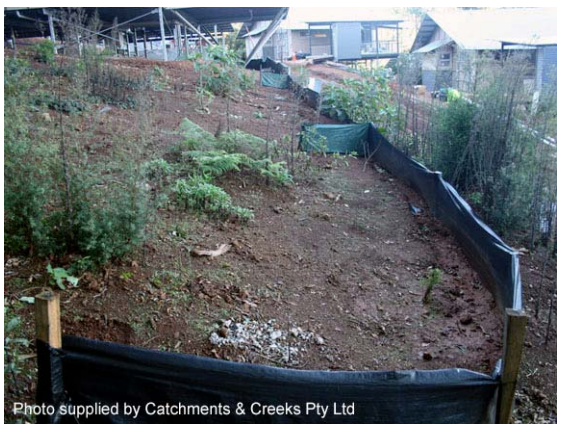

Photo 11 – Placement of fence off the contour with regular fence 'returns'

Photo 12 – Alternative design of a fence 'return'

Photo 13 – Trenching the fabric

Photo 14 – Inappropriate installation

Photo 15 – Bottom of fabric buried under aggregate

Photo 16 – Inappropriate use of sand to bury the fabric

Photo 17 – Straw bales placed up-slope of fence to separate sediment and fabric

Photo 18 – Inappropriate installation of the posts up-slope of the fabric

Photo 19 – Inappropriate junction

Photo 20 – Gaps in fence are not allowed

Photo 21 – Installation without backing weir/mesh

Photo 22 – Installation with top wire support

Photo 23 – Installation with weir mesh

Photo 24 – Installation using fence support

Photo 25 – Installation with safety fencing used as support

Photo 26 – A sediment fence braced for possible high flows

Photo 27 – Example of tacking

Photo 28 – Safety cap on a steel stake

Photo 29 – Flow diversion by fence

Photo 30 – No end return

Photo 31 – Damage by shifting fill

Photo 32 – Fence placed too close to fill

Photo 33 – Evidence of hydraulic wash-out under fence caused by poor trenching

Photo 34 – Sediment not removed after storm

Photo 35 – Flow allowed to bypass the fence

Photo 36 – Spill-through weirs must not discharge onto unstable land

(d) Use of spill-through weirs

Where appropriate, spill-through weirs can be installed into the fence to reduce hydraulic pressure and reduce the risk of hydraulic failure.

The required width (W) of the spill-through weir depends on the nominated design flow rate. The weir flow equation for a rectangular spill-through weir is provided below as Equation 2, as well as tabulated in Table 7.

$$Q = 1.7\ W\ H^{3/2} \qquad \text{(Eqn 2)}$$

where: Q = Design flow rate (usually 0.5 times the 1 in 1 year ARI peak discharge) [m^3/s]
W = Weir width [m]
H = Hydraulic head = height of upstream water level above weir crest [m]

Table 7 – Flow rates passing over a spill-through weir (m^3/s)

Hydraulic head, H (m)	Spill-through weir width, W (m)									
	0.3	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
0.10	0.016	0.027	0.054	0.081	0.108	0.134	0.161	0.188	0.215	0.242
0.15	0.030	0.049	0.099	0.148	0.198	0.247	0.296	0.346	0.395	0.444
0.20	0.046	0.076	0.152	0.228	0.304	0.380	0.456	0.532	0.608	0.684
0.25	0.064	0.106	0.213	0.319	0.425	0.531	0.638	0.744	0.850	0.956
0.30	0.084	0.140	0.279	0.419	0.559	0.698	0.838	0.978	1.12	1.26
0.35	0.106	0.176	0.352	0.528	0.704	0.880	1.06	1.23	1.41	1.58
0.40	0.129	0.215	0.430	0.645	0.860	1.08	1.29	1.51	1.72	1.94

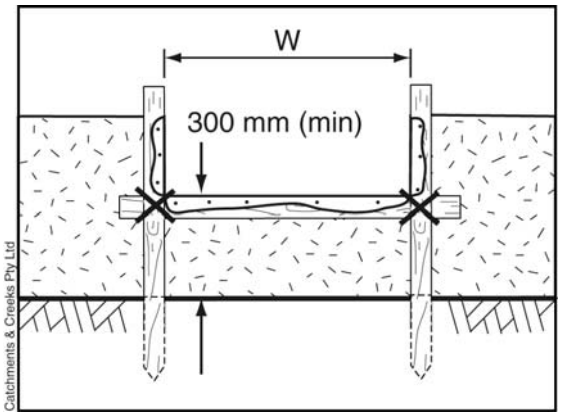

Figure 12 – Spill-through weir profile

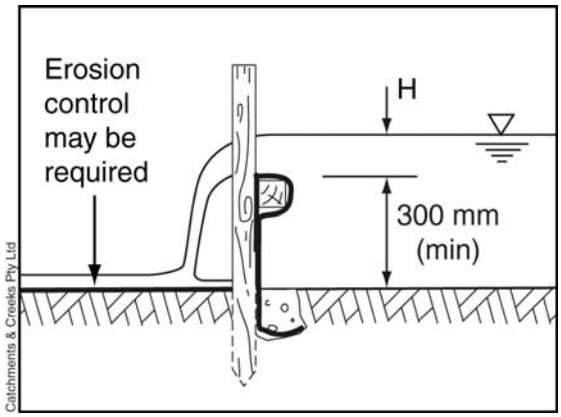

Figure 13 – Side profile of a spill-through weir

Photo 37 – Spill-through weir (down-slope side) with rock splash pad

Photo 38 – Spill-through weir with outlet chute

Photo 39 – Spill-through weir with up-slope aggregate filter

Photo 40 – Inappropriate placement of fence and installation of spill-through weir

If large sediment flows are expected, then a *Coarse Sediment Trap* can be used as an outlet structure for a sediment fence as shown in Figure 14. However, in most circumstances, a more elaborate outlet system would be required such as a Type 1 or Type 2 sediment trap.

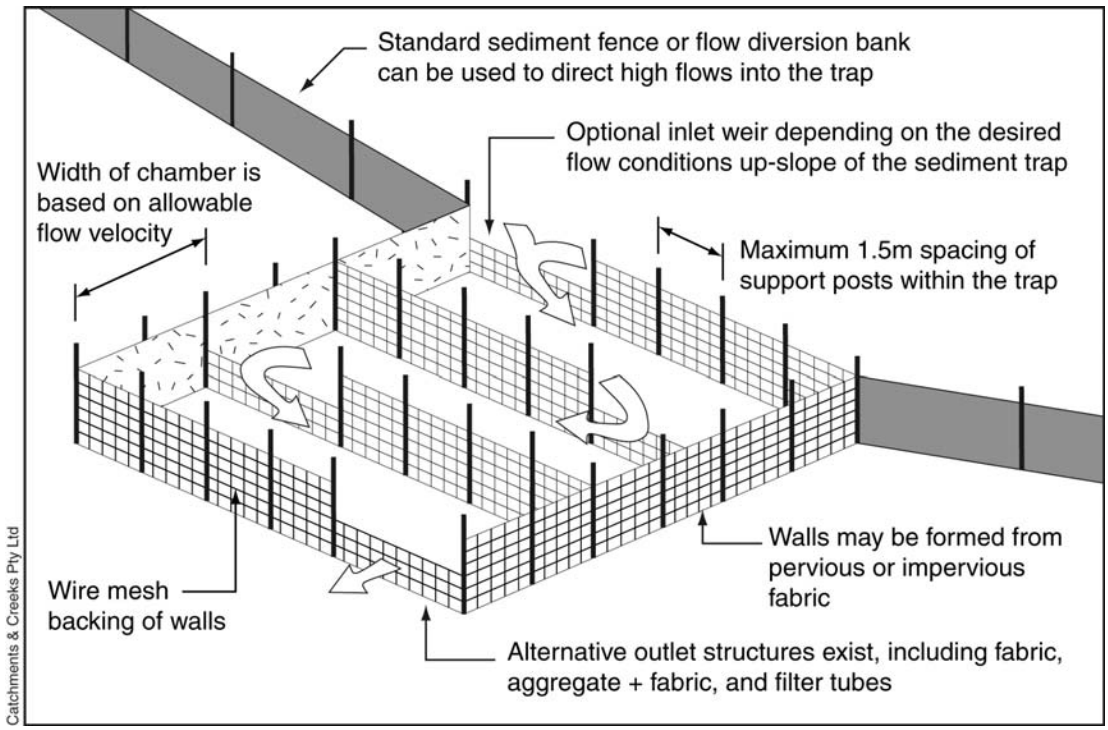

Figure 14 – Coarse sediment trap outlet structure

Description

A sediment fence consists of specially manufactured woven fabric attached to support posts. The typical height of the fence is around 600 to 700mm.

Most sediment fences are self-supporting; however, in appropriate circumstances the fence may be attached to an existing porous structure such as a property fence.

The fabric may be manufactured from either woven fabric, or a composite of woven and non-woven fabrics. The incorporation of a woven fabric is essential for the control of water flow needed to allow adequate temporary ponding up-slope of the fence.

Purpose

Used as a Type 3 sediment trap on small catchments, or as a supplement to Type 1 or 2 sediment traps on large catchments.

Limitations

Though often referred to as a 'silt fence', these Type 3 sediment traps have little impact on fine silts (< 0.02mm).

A sediment fence in its standard installation is only suitable for the treatment of 'sheet' flows. If concentrated flow exist, such as in a minor drain, then a *U-Shaped Sediment Trap*, or other more appropriate sediment trap should be used.

Most fabrics have an effective service life of around 6 months (check with manufacturer or distributor).

Advantages

Reasonably easy to install.

Has the ability to control sediment runoff close to the source of the erosion.

Disadvantages

Time-consuming to install, which often results in poor installation.

Easily damaged by construction equipment and shifting earth (Photos 31 & 32).

Can cause the concentration of stormwater runoff if poorly located, or installed.

Sediment fences are one of the most missed used sediment control devices, usually because they are either not installed in appropriate locations, or are installed in a manner that does not allow adequately water ponding up-slope of the fences.

Common Problems

If not installed along the contour, a sediment fence can result in flows being deflected along the fence (Photo 29).

If the ends of the fence are not turned up the slope, water and sediment can pass around the end of the fence (Photo 30).

If gaps exist in the fence (Photos 19 & 20), then water is prevented from ponding up-slope of the fence, thus sedimentation does not occur.

Excessive spacing between support posts is a common problem. In extreme cases this can result in the fabric sagging close to the ground.

Fabric not adequately connected to the support posts or backing wire.

The bottom of the fabric not adequately buried into the ground or under a suitable layer of sand or aggregate. If such fences are subjected to significant storms, the bottom of the fence can 'blow-out' causing erosion down-slope of the fence (Photo 33).

Spill-through weirs may not have been installed in large catchments or areas of high rainfall, thus increasing the risk of flow damage to the fence.

Crest of spill-through weir set too close to the ground (should be at least 300mm above ground level).

Crest of spill-through weir is set above the ground level at the ends of the fence, thus allowing flow bypassing rather than discharge over the weir (Photo 40).

Special Requirements

Woven fabrics are generally preferred on large sites when the service life is expected to extend over several storm events. Composite fabrics are generally preferred on small soil disturbances such a building sites, or when the sediment fence is the last line of defence prior to the runoff entering a water body.

Ideally, the sediment fence should be installed along the contour, thus maintaining sheet flow conditions across fence. If located across the contour, the fence should be installed with regular 'returns' to avoid water concentrating along the fence.

At least 300mm of fabric must be buried in either a 200mm trench, or under a continuous, 100mm high layer of sand or aggregate, but not earth.

Straw bales can be placed up-slope of the fence to retain bulk sediment away from the fabric, thus improving the ease of sediment removal. Alternatively, a small trench can be formed along the contour, up-slope of the fence. However, in all cases the aim should be to minimise high sediment flows so that such fence modifications become the exception, not the rule!

Where appropriate, spill-through weirs can be installed into the fence to reduce hydraulic pressure and reduce the risk of hydraulic failure.

Location

Install along the contour wherever possible.

Allow at least 4.5m between the fence and single-story buildings; 7.5m between the fence and multiple-story buildings; and at least 2m between the fence and the toe of a fill slope or stockpile.

Site Inspection

Ensure the sediment fence will adequately pond water up-slope of the fence.

Ensure the fabric is adequately buried.

Check the spacing of support posts/stakes.

Check for excessive sediment deposition.

Investigate the source of excessive sediment deposits.

Ensure the selection of appropriate fabric (i.e. woven or composite).

Check for damage to the fabric.

Check for erosion down-slope of any spill-through weirs.

Ensure the fence is not concentrating or diverting flows in an undesirable manner.

Materials

- Fabric: polypropylene, polyamide, nylon, polyester, or polyethylene woven or non-woven fabric, at least 700mm in width and a minimum unit weight of 140GSM. All fabrics to contain ultraviolet inhibitors and stabilisers to provide a minimum of 6 months of useable construction life (ultraviolet stability exceeding 70%).
- Fabric reinforcement: wire or steel mesh minimum 14-gauge with a maximum mesh spacing of 200mm.
- Support posts/stakes: 1500mm^2 (min) hardwood, 2500mm^2 (min) softwood, or 1.5kg/m (min) steel star pickets suitable for attaching fabric.

Installation

1. Refer to approved plans for location, extent, and required type of fabric (if specified). If there are questions or problems with the location, extent, fabric type, or method of installation contact the engineer or responsible on-site officer for assistance.
2. To the maximum degree practical, and where the plans allow, ensure the fence is located:
   (i) totally within the property boundaries;
   (ii) along a line of constant elevation wherever practical;
   (iii) at least 2m from the toe of any filling operations that may result in shifting soil/fill damaging the fence.
3. Install returns within the fence at maximum 20m intervals if the fence is installed along the contour, or 5 to 10m maximum spacing (depending on slope) if the fence is installed at an angle to the contour. The 'returns' shall consist of either:
   (i) V-shaped section extending at least 1.5m up the slope; or
   (ii) sandbag or rock/aggregate check dam a minimum 1/3 and maximum 1/2 fence height, and extending at least 1.5m up the slope.
4. Ensure the extreme ends of the fence are turned up the slope at least 1.5m, or as necessary, to minimise water bypassing around the fence.
5. Ensure the sediment fence is installed in a manner that avoids the concentration of flow along the fence, and the undesirable discharge of water around the ends of the fence.
6. If the sediment fence is to be installed along the edge of existing trees, ensure care is taken to protect the trees and their root systems during installation of the fence. Do not attach the fabric to the trees.
7. Unless directed by the site supervisor or the approved plans, excavate a 200mm wide by 200mm deep trench along the proposed fence line, placing the excavated material on the up-slope side of the trench.

8. Along the lower side of the trench, appropriately secure the stakes into the ground spaced no greater than 3m if supported by a top support wire or weir mesh backing, otherwise no greater than 2m.
9. If specified, securely attach the support wire or mesh to the up-slope side of the stakes with the mesh extending at least 200mm into the excavated trench. Ensure the mesh and fabric is attached to the up-slope side of the stakes even when directing a fence around a corner or sharp change-of-direction.
10. Wherever possible, construct the sediment fence from a continuous roll of fabric. To join fabric either:
    (i) attach each end to two overlapping stakes with the fabric folding around the associated stake one turn, and with the two stakes tied together with wire (Method 1); or
    (ii) overlap the fabric to the next adjacent support post (Method 2).
11. Securely attach the fabric to the support posts using 25 x 12.5mm staples, or tie wire at maximum 150mm spacing.
12. Securely attach the fabric to the support wire/mesh (if any) at a maximum spacing of 1m.
13. Ensure the completed sediment fence is at least 450mm, but not more than 700mm high. If a spill-though weir is installed, ensure the crest of the weir is at least 300mm above ground level.
14. Backfill the trench and tamp the fill to firmly anchor the bottom of the fabric and mesh to prevent water from flowing under the fence.
15. If it is not possible to anchor the fabric in an excavated trench, then use a continuous layer of sand or aggregate to hold the fabric firmly on the ground.

Additional requirements for the installation of a spill-through weir

1. Locate the spill-through weir such that the weir crest will be lower than the ground level at each end of the fence.
2. Ensure the crest of the spill-through weir is at least 300mm the ground elevation.
3. Securely tie a horizontal cross member (weir) to the support posts/stakes each side of the weir. Cut the fabric down the side of each post and fold the fabric over the cross member and appropriately secure the fabric.
4. Install a suitable splash pad and/or chute immediately down-slope of the spill-through weir to control soil erosion and appropriately discharge the concentrated flow passing over the weir.

Maintenance

1. Inspect the sediment fence at least weekly and after any significant rain. Make necessary repairs immediately.
2. Repair any torn sections with a continuous piece of fabric from post to post.
3. When making repairs, always restore the system to its original configuration unless an amended layout is required or specified.
4. If the fence is sagging between stakes, install additional support posts.
5. Remove accumulated sediment if the sediment deposit exceeds a depth of 1/3 the height of the fence.
6. Dispose of sediment in a suitable manner that will not cause an erosion or pollution hazard.
7. Replace the fabric if the service life of the existing fabric exceeds 6-months.

Removal

1. When disturbed areas up-slope of the sediment fence are sufficiently stabilised to restrain erosion, the fence must be removed.
2. Remove materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Rehabilitate/revegetate the disturbed ground as necessary to minimise the erosion hazard.