Level Spreaders

DRAINAGE CONTROL TECHNIQUE

Low Gradient	✓	Velocity Control		Short Term	✓
Steep Gradient	[1]	Channel Lining		Medium-Long Term	✓
Outlet Control	✓	Soil Treatment		Permanent	✓

[1] Level spreaders can release sheet flow down steep slopes, but the level spreader itself must be constructed across a level gradient.

Symbol 

Photo 1 – Diversion drains (centre) collect stormwater from roadside table drains, then releases the water as sheet flow via a level spreader

Photo 2 – Level spreader established to discharge stormwater from a diversion drain into the roadside property

Key Principles

1. Flow must be released from the level spreader as *sheet flow*.
2. Flow must be released over a stable, well-grassed surface that will maintain suitable flow conditions down the slope.
3. Critical design parameter is the length of the outlet sill.
4. Critical operational parameter is the level construction of the outlet sill.

Design Information

The length of the outlet sill (weir) of the level spreader is governed by the design discharge, and the allowable flow velocity of the down-slope area.

Allowable flow velocity for grassed surfaces can be determined from Table 1.

Minimum dimension can be determined from Tables 2 and 3.

Minimum sill length is 4 metres.

Maximum sill length is 25 metres. If a longer sill length is required, then the inflow must be spilt and released through more than one level spreader.

Up-slope channel grade should not exceed 1% for the last 6 metres before entering the level spreader.

Discharge must release evenly along a level surface (sill) of 0% cross gradient.

Caution the use of a design discharge exceeding 0.85 m^3/s.

Caution the release of water onto grass slopes steeper than 10%.

Table 1 – Allowable flow velocity (m/s) for grassed surfaces [1]

Percentage grass cover	Gradient of grass surface (%)									
	1	2	3	4	5	6	8	10	15	20
70% [2]	2.0	1.8	1.7	1.6	1.6	1.5	1.5	1.4	1.3	1.3
100% [3]	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.8	1.7
Poor soils [3]	1.5	1.4	1.3	1.2	1.2	1.1	1.1	1.1	1.0	0.9

[1] Maximum allowable flow velocity limited to 2.0m/s due to shallow water flow and resulting high shear stress. High flow velocities are allowable on reinforced grass.

[2] 70% cover would be typical for most grasses recently established by seed, but only when there is sufficient plant establishment time.

[3] "Poor soils" refers to the soil's high erosion potential, such as dispersive clays (Emerson Class 1 and 2) such as sodic, yellow and red soils. Unstable, dispersible clayey sands and sandy clays, such as yellow and grey massive earths formed on sandstones and some granites. Highly erodible soils may include: lithosols, alluvials, podzols, siliceous sands, soloths, solodized solonetz, grey podzolics, some black earths, fine surface texture-contrast soils, and Soil Groups ML and CL.

Table 2 – Level spreader sill length B metres per unit discharge (m per m;/s) [1]

Land slope (%)	Allowable down-slope velocity over well grassed surface (m/s)						
	1.0	1.2	1.5	1.8	2.0	2.2	2.5
1.0	3.5*	2.5*	1.6*	1.1*	0.9*	0.8*	0.6*
2.0	5.2	3.8*	2.5*	1.8*	1.4*	1.2*	0.9*
3.0	6.6	4.8	3.2*	2.3*	1.8*	1.5*	1.2*
4.0	7.7	5.6	3.8*	2.7*	2.2*	1.8*	1.4*
5.0	8.7	6.3	4.3*	3.1*	2.5*	2.1*	1.6*
6.0	9.5	7.0	4.7	3.4*	2.8*	2.3*	1.8*
7.0	10.3	7.6	5.2	3.7*	3.1*	2.6*	2.0*
8.0	11.0	8.2	5.6	4.0*	3.3*	2.8*	2.2*
9.0	11.8	8.7	6.0	4.3*	3.5*	3.0*	2.4*
10.0	12.4	9.2	6.3	4.6*	3.8*	3.2*	2.5*
Caution the release of water onto grass slopes steeper than 10%.							
15.0	15.2	11.3	7.8	5.7	4.8	4.0*	3.2*
20.0	17.4	13.1	9.1	6.7	5.6	4.7	3.7*
25.0	19.4	14.6	10.3	7.6	6.3	5.3	4.3*
33.3	22.1	16.8	11.9	8.8	7.4	6.2	5.0
50.0	26.6	20.3	14.5	10.8	9.1	7.8	6.3

* Sill length limited to minimum 4m for discharges less than 0.85m^3/s.

Design example:

Design a level spreader to release a flow rate of 0.5m^3/s down a 10% slope containing a good (70%) grass cover on moderately erodible soil.

Solution:

From Table 1, choose a maximum flow velocity of 1.4m/s as best representative of a good grass cover on a moderately erodible soil.

From Table 2, select a sill width per unit flow rate of 7.3m/m^3/s.

Therefore, the sill length would need to be 0.5 x 7.3 = 3.65m < 4m (minimum).

Conclusion, specify a sill length of 4m.

The minimum sill lengths presented in Table 2 have been determined assuming a Manning's roughness for 50-150mm (Class D) grassed surfaces based on Equation 1. The sill length is sensitive to the selection of Manning's roughness. Variations between Table 2 and other published design tables for is due to variations in the assumed Manning's roughness, which is highly variable depending on the type and length of grass, and local growing conditions.

Class D roughness:
$$n = \frac{R^{1/6}}{5124 + 20.77\log_{10}(R^{1.4}.S^{0.4})} \quad \text{(Eqn 1)}$$

Table 3 – Minimum dimension of level spreader

Discharge (m^3/s)	Entrance width (m)	Depth (m)	End width (m)
0 to 0.28	3.0	0.15	0.9
0.29 to 0.57	4.9	0.18	0.9
0.58 to 0.85	7.3	0.21	0.9

Construction of a level spreader may require formation of flow control banks as shown in Figures 1 to 3.

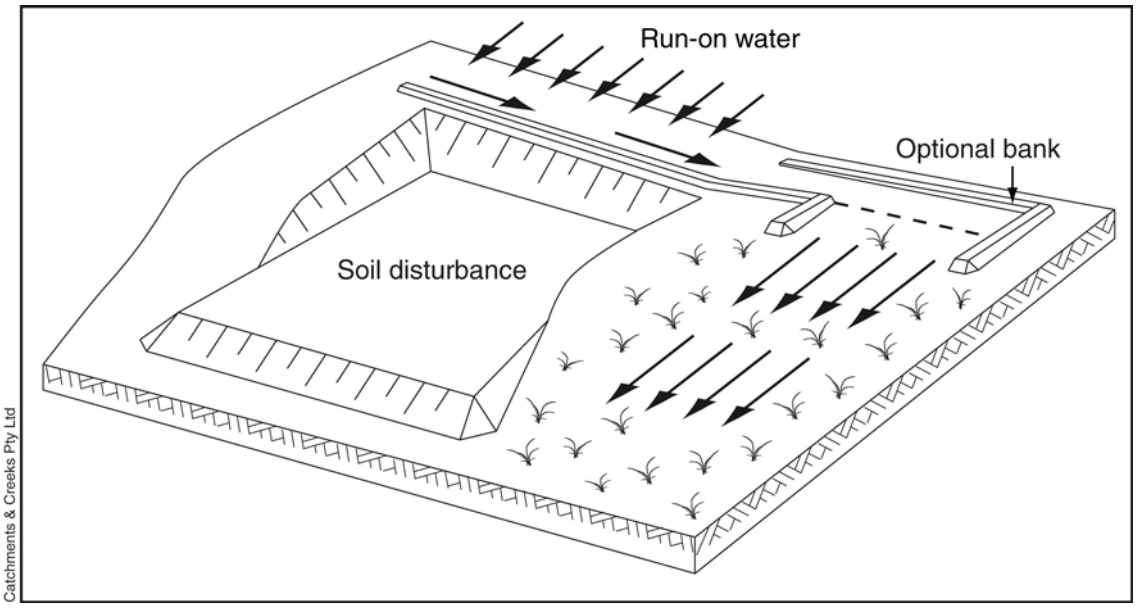

Figure 1 – Example of a level spreader used for flow diversion around a soil disturbance

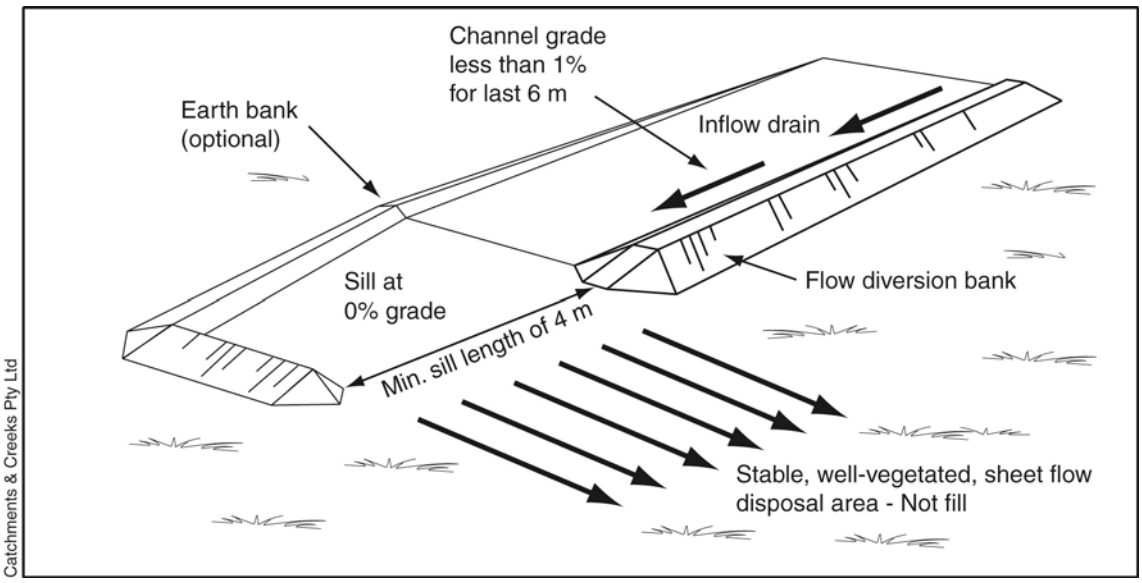

Figure 2 – Typical layout of level spreader

Description

Level spreaders consist of a level, grassed, side-flow weir (i.e. water discharges at 90 degrees to the inflow direction) constructed along the contour.

Purpose

Used to allow concentrated inflow to be released as *sheet flow* down a stable, vegetated slope.

Can be used as an outlet for *Catch Drains* and *Flow Diversion Banks*.

Level spreaders are commonly used in rural areas to discharge stormwater from roadside table drains into an adjacent property (Photos 1 & 2).

Limitations

Minimum sill length of 4m.

Maximum sill length of 25m.

Maximum discharge of around 0.85 m^3/s.

Must only be used where the outflow can be discharged to an undisturbed, stable, grassed surface.

Construction traffic should be prohibited from the area of the level spreader.

Not suitable for highly erosive soils, dispersive soils, or soils with poor vegetation cover.

Advantages

Inexpensive to construct and maintain.

Disadvantages

Can be difficult to construct the outlet sill to the required precision.

May require a considerable width of undisturbed land.

May require the land to be free of trees, shrubs and other surface irregularities to avoid local erosion problems.

Common Problems

The most common problems result from damage to the outlet sill either from erosion, sedimentation, or stock.

Other problems can result from water flow concentrating below the level spreader due to the existence of a concave surface, vehicular tracks, or uneven vegetation cover.

Special Requirements

Outlet area must be free of depressions that may concentrate the outflow.

Extra erosion protection using jute mesh, *Erosion Control Mats*, turf, rock etc. may be required at the sill (Figure 4).

Generally constructed by bozers no larger than D5 or equivalent.

Extreme caution must be exercised when attempting to discharge *sheet flow* down a steep gradient (>10%) to ensure that the sedimentation or damage to the outlet sill does not concentrate the outflow.

Site Inspection

Check for sediment build-up on the sill, or the concentration of outflow.

Check for erosion down-slope of the sill.

Installation

1. Refer to approved plans for location, dimensions and construction details. If there are questions or problems with the location, dimensions, or method of installation contact the engineer or responsible on-site officer for assistance.
2. Wherever practical, locate the level spreader on undisturbed, stable soil.
3. Ensure flow discharging from the level spreader will disperse across a properly stabilised slope not exceeding 10:1 (H:V) and sufficiently even in grade across the slope to avoid concentrating the outflow.
4. The outlet sill of the spreader should be protected with erosion control matting to prevent erosion during the establishment of vegetation. The matting should be a minimum of 1200mm wide extending at least 300mm upstream of the edge of the outlet crest and buried at least 150mm in a vertical trench. The downstream edge should be securely held in place with closely spaced heavy-duty wire staples at least 150mm long.
5. Ensure that the outlet sill (crest) is level for the specified length.
6. Immediately after construction, turf, or seed and mulch where appropriate, the level spreader.

Maintenance

1. Inspect the level spreader after every rainfall event until vegetation is established.
2. After establishment of vegetation over the level spreader, inspections should be made on a regular basis and after runoff-producing rainfall.
3. Ensure that there is no soil erosion and that sediment deposition is not causing the concentration of flow.
4. Ensure that there is no soil erosion or channel damage upstream of the level spreader, or soil erosion or vegetation damage downstream of the level spreader.
5. Investigate the source of any excessive sedimentation.
6. Maintain grass in a health condition with no less than 90% cover unless current weather conditions require otherwise.
7. Grass height should be maintained at a minimum 50mm blade length within the level spreader and downstream discharge area, and a maximum blade length no greater than adjacent grasses.

Removal

1. Temporary level spreaders should be decommissioned only after an alternative stable outlet is operational, or when the inflow channel is decommissioned.
2. Remove collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Remove and appropriately dispose of any exposed geotextile.
4. Grade the area and smooth it out in preparation for stabilisation.
5. Stabilise the area as specified on the approved plan.

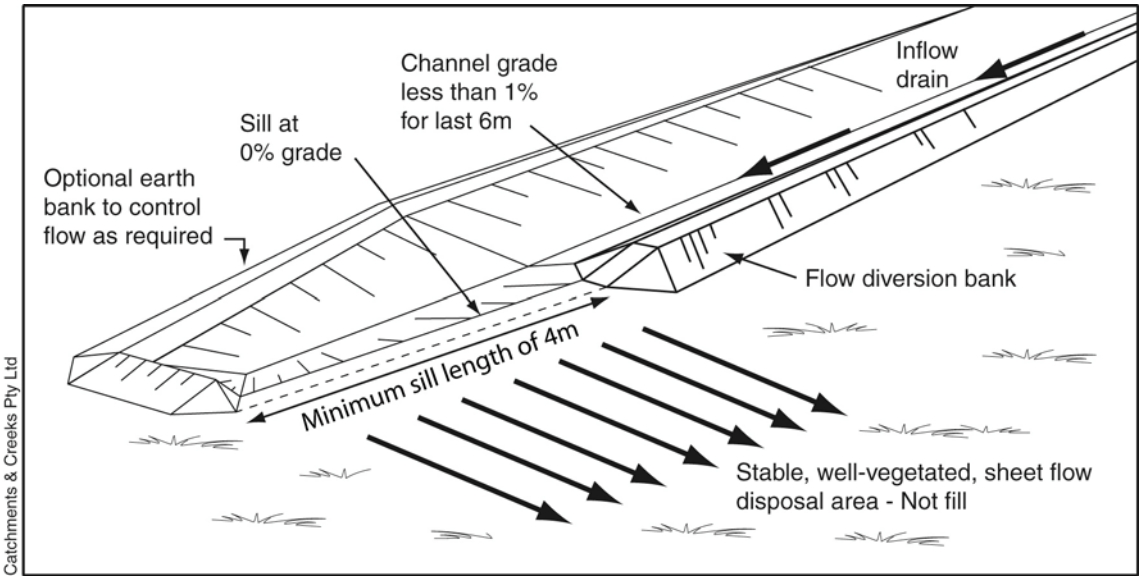

Figure 3 – Alternative level spreader layout

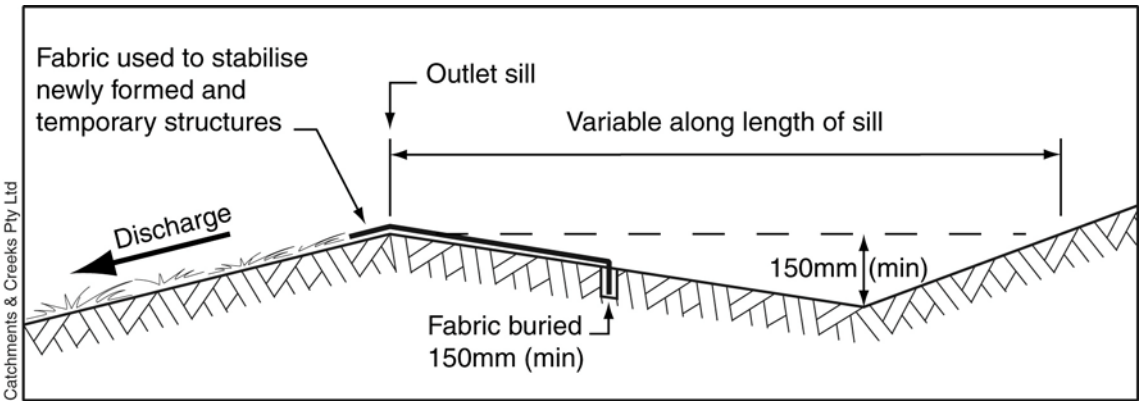

Figure 4 – Cross-sectional profile of end sill