CopperString 2.0

Concept erosion and sediment control plan

Volume 3 Appendix S

CuString Pty Ltd

CopperString 2.0 Project EIS
Concept Erosion and Sediment Control Plan (Guideline Document)

November 2020

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1. Concept erosion and sediment control plan

1.1 Introduction

1.1.1 Background information

CuString Pty Ltd (CuString) engaged GHD Pty Ltd (GHD) to assist in the preparation of the Environmental Impact Statement (EIS) and supporting technical reports, for the CopperString 2.0 Project (the Project).

The Project involves the construction and operation of approximately 1,000 km of extra high voltage overhead electricity transmission line that will extend from Mount Isa to the state grid, via a new connection point at Woodstock, south of Townsville, allowing the North West Power System to participate in the National Electricity Market.

The CopperString transmission network is divided into the following eight sections as shown in Figure 1-1:

1. Woodstock Substation
2. Renewable Energy Hub
3. CopperString Core
4. Mount Isa Augmentation
5. Southern Connection
6. Cannington Connection
7. Phosphate Hill Connection
8. Kennedy Connection (option).

1.1.2 Purpose of this plan

This Concept Erosion and Sediment Control Plan (CESCP) provides overarching strategies for erosion and sediment control principles for guidance to Project contractors. This document provides guidance with regards to the erosion and sediment control methodology required to satisfy the contractor's responsibilities for the proposed works. The control principles and management techniques outlined in this document are to be used as a guide by each contractor during the project to minimise/eliminate soil disturbance and the potential for sediment laden runoff to be discharged into the receiving environment.

The CESCP should be used by each proponent to develop a site-specific Erosion and Sediment Control Plan (ESCP) once detailed design, construction and site establishment information becomes available.

The management and mitigation strategies outlined in this CESCP have been developed with reference to the International Erosion Control Association's Best Practice Erosion and Sediment Control Guidelines (IECA 2008), (the IECA Guidelines).

1.1.3 Study area

The study area is a 5 km corridor (2.5 km either side of the corridor selection) and has been divided into the following sections for the purposes of this CESCP:

- Woodstock to Dajarra Road
- Dajarra Road to Mount Isa
- Dajarra Road to Cannington Mine
- Phosphate Hill Mine.

1.1.4 Scope

As part of the scope of works for this Project, GHD is to provide preliminary erosion and sediment control strategies in accordance with the standards outlined in the IECA Guidelines. The following outcomes will be delivered in this CESCP:

- Site assessment (locality, climate, topography, waterways, soils, ecological constraints etc.)
- An identification of erosion hazards, via erosion hazard assessments, and associated control measures (including drainage and sediment controls)
- Erosion, drainage and sediment control measures
- Site inspection and monitoring
- Site maintenance
- Incident reporting and staff training procedures.

This document should be reviewed and updated as new Project information becomes available (e.g. after detailed design is completed).

1.1.5 Assumptions

GHD has made the following assumptions in the development of this CESCP:

- The information obtained on bore logs are a true representation of the soils encountered during any geotechnical investigation.
- This report is to provide a conceptual set of overarching erosion and sediment control principles, concept layout plans, standard drawings and preliminary calculations only as a guide. It is the Contractor's responsibility to develop a site-specific ESCP for respective work sections of the Project.

1.1.6 Statement of limitations

This report has been prepared by GHD for CuString Pty Ltd and may only be used and relied on by CuString Pty Ltd for the purpose agreed between GHD and the CuString Pty Ltd as set out in section 1.1.2 of this report.

GHD otherwise disclaims responsibility to any person other than CuString Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

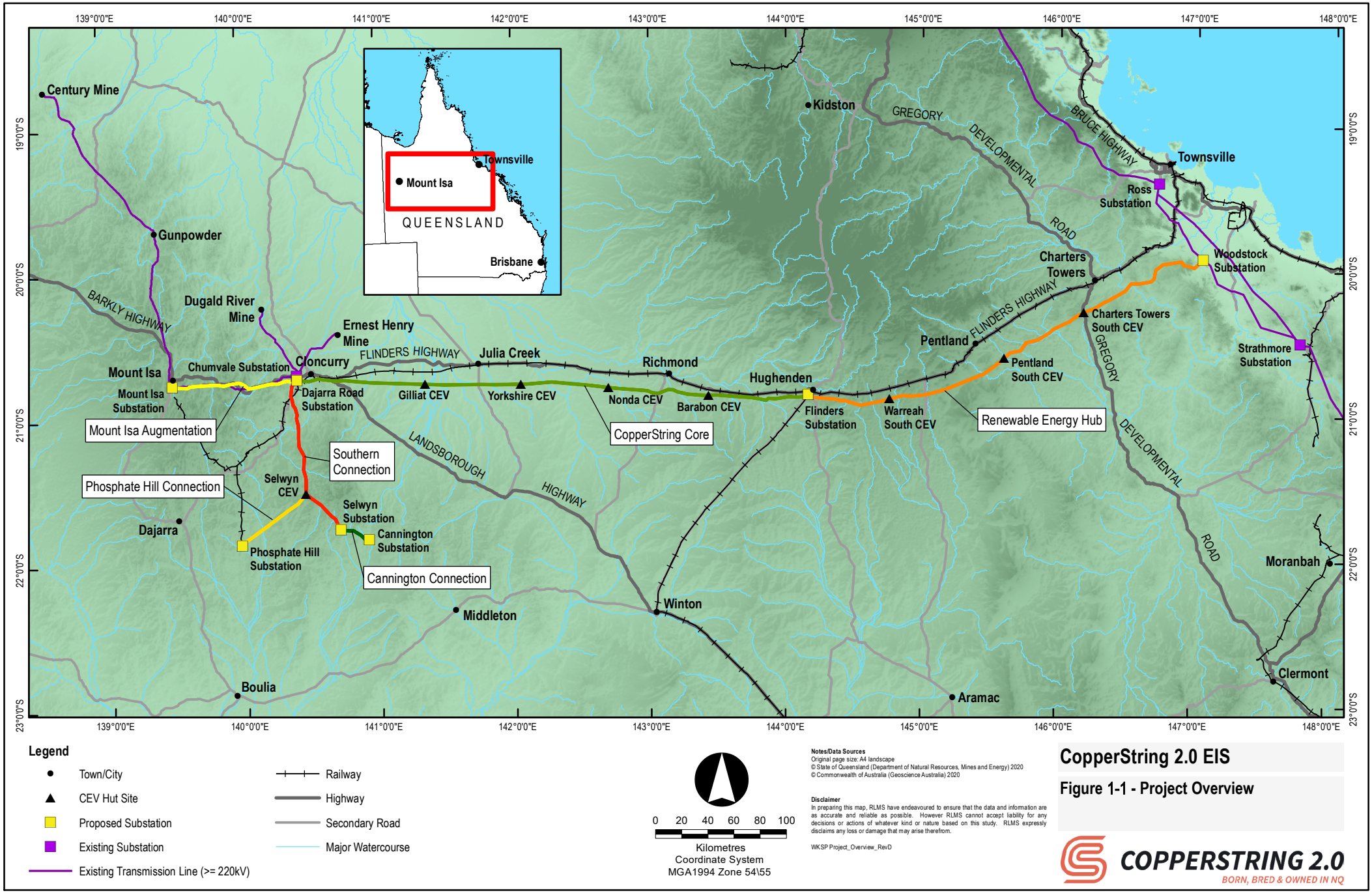
The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by CuString Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.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Dugald River Mine
Ernest Henry Mine
Mount Isa
Mount Isa Substation
Chumvale Substation
Cloncurry
Dajarra Road Substation
Julia Creek
Richmond
Hughenden
Flinders Substation
Kidston
Townsville
Ross Substation
Woodstock Substation
Charters Towers
Charters Towers South CEV
Pentland
Pentland South CEV
Warreah South CEV
Strathmore Substation
Gilliat CEV
Yorkshire CEV
Nonda CEV
Barabon CEV
Selwyn CEV
Selwyn Substation
Cannington Substation
Phosphate Hill Substation
Dajarra
Winton
Middleton
Boulia
Aramac
Moranbah
Clermont
Mount Isa
Townsville
Brisbane
QUEENSLAND
BARKLY HIGHWAY
FLINDERS HIGHWAY
LANDSBOROUGH HIGHWAY
GREGORY DEVELOPMENTAL ROAD
BRUCE HIGHWAY
Mount Isa Augmentation
Phosphate Hill Connection
Southern Connection
Cannington Connection
CopperString Core
Renewable Energy Hub
Legend
Town/City
CEV Hut Site
Proposed Substation
Existing Substation
Existing Transmission Line (>= 220kV)
Railway
Highway
Secondary Road
Major Watercourse
0 20 40 60 80 100
Kilometres
Coordinate System
MGA1994 Zone 54\55
Notes/Data Sources
Original page size: A4 landscape
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CopperString 2.0 EIS
Figure 1-1 - Project Overview
COPPERSTRING 2.0
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1.2 Approach and methodology

1.2.1 Site-specific background documents

This CESCP has been developed with reference to the following:

- Coffey Geotechnics Pty Ltd, 2010. CopperString Environmental Impact Statement Topography, Geology, Geomorphology and Soils Assessment, Queensland
- RLMS, 2010. CopperString Environmental Impact Statement – Volume 2 Chapter 4 – Land
- Volume 1 Chapter 2 Project description
- Volume 1 Chapter 3 Site description and climate
- Volume 2 Chapter 6 Geology and soils
- Volume 2 Chapter 7 Flora and fauna
- Volume 2 Chapter 9 Water resources and water quality
- Volume 3 Appendix R Field development plan
- Volume 3 Appendix T Concept rehabilitation plan

1.2.2 Legislative framework

The following legislative framework is relevant to the development of erosion and sediment control requirements:

- *Environmental Protection Act 1994* (EP Act)
- *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*
- *Planning Act 2016* (Planning Act)
- *Planning Regulation 2017* (Planning Regulation)

The relevant sections of the legislation are outlined below.

Environmental Protection Act 1994

All persons have a legal duty under the EP Act (s319) to take all reasonable and practicable measures to minimise or prevent environmental harm. Such harm can be caused if sediment from building sites enters (washes, blows, falls or otherwise) stormwater drains, roadside gutters or waterways. Stormwater run-off must be managed so that it is not released into waters, a roadside gutter, or stormwater drain in a state that results in the build-up of earth. Under s443 of the EP Act, a person must not cause or allow a contaminant to be placed in a position where it could reasonably be expected to cause serious or material environmental harm or environmental nuisance (e.g. placing a stockpile adjacent to a waterway).

In addition, people who are concerned with management in a corporation have an additional duty to ensure their corporation complies with the EP Act. This means supervisors need to take reasonable and practicable steps to ensure that the people under their control do not breach environmental laws. People who become aware of environmental harm in association with their work (e.g. loss of sediment from their site into a watercourse) have a legal duty under the EP Act to notify the Queensland Department of Environment and Science.

Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* achieves the EP Act's objective to protect Queensland's waters through identifying environmental values for waters and wetlands and through associated water quality objectives. These are utilised when

determining environmental harm and to inform other statutory and non-statutory decisions. These water quality objectives assist in identifying whether environmental values are protected. These values and objectives should be utilised when determining risk of environmental harm from water releases or run-off, and when implementing appropriate erosion and sediment controls.

Planning Act 2016 and Planning Regulation 2017

The Planning Act and Planning Regulation are mechanisms for assessing all development within Queensland. The Planning Act establishes the process for sustainable planning and development assessment in an ecologically sustainable way. Under the Planning Act, it is a serious offence to breach development conditions, including those relating to erosion and sediment control or stormwater quality.

1.2.3 Standards and guidelines

The following standards and guidelines have been reviewed and will form the basis of the CESCP:

- The IECA Guidelines
- Carey BW, Stone B, Norman PL, Shilton P (2015). Soil conservation guidelines for Queensland, Department of Science, Information Technology and Innovation, Brisbane
- Catchments & Creeks Pty Ltd (2017). Erosion and Sediment Control – A Field Guide for Construction Site Managers
- Catchments & Creeks Pty Ltd (2013). Erosion and Sediment Control Field Guide for Builders
- Catchments & Creeks Pty Ltd (2017). Erosion and Sediment Control for Road Construction Part 1 – General Construction
- Catchments & Creeks Pty Ltd (2017). Erosion and Sediment Control for Road Construction Part 2 – Erosion and Sediment Control Plans & Bridge and Culvert Construction
- Department of Environment and Resource Management (2010). Urban Stormwater Quality Planning Guidelines 2010

1.2.4 Contractor responsibilities

As stated, this document does not prescribe or locate any permanent or temporary drainage, sediment or erosion control measures in detail, but provides guidance with regards to the control methodology which may be required for the Project.

The Contractor(s) will be responsible for developing site-specific ESCPs, taking into consideration detailed staging of works. As such, the Project's Contractor(s) will need to consider the following when developing site-specific ESCPs:

- Local climate and meteorological conditions
- Local topography
- Soils characteristics likely informed by geotechnical investigations for project design
- Local watercourses
- Local ecological constraints
- Cultural heritage management
- Management of the discovery of fossils

Further discussion of these topics is included in the following sections; however, this CESCP should not be used solely when making decisions related to site-specific erosion and sediment control.

1.3 Existing environment

1.3.1 Overview

Table 1-1 provides a summary of site information relied upon in development of this CESCP, which is expanded on further in the following subsections. More information relating to the site assessment is included in Appendix A.

Table 1-1 Site assessment relevant information sources

Site details	Source	Document utilisation
Climate/ Rainfall	Volume 2 Chapter 10 Air and greenhouse gas	Informs erosion risk rating
Topography	Google Earth long sections Further information provided in: Volume 1 Chapter 3 Site description and climate	Informs erosion hazard assessment
Hydrology	Volume 2 Chapter 10 Water resources and water quality	Informs erosion hazard assessment
Geology/Soils	Volume 2 Chapter 6 Geology and soils	Informs erosion hazard assessment
Ecology	Volume 2 Chapter 7 Flora and Fauna	To be considered when developing site-specific ESCP.

1.3.2 Climate and rainfall

The climate and rainfall pattern across the Study area remains generally consistent with low rainfall during the winter period and high rainfall during the summer period. However, the average rainfall towards the east coast is considerably greater than that received inland.

The average monthly rainfall for a number of key Project localities is detailed in Table 1-2 whilst the average number of rainfall days is shown in Table 1-3. Rainfall data in Table 1-2 and Table 1-3 shows long-term averages using data collected from the relevant meteorological monitoring stations over periods varying from 19 years to more than 100 years.

The majority of the rain across the Study area falls between December and March, with the highest mean rainfall occurring in January/February, and the lowest mean rainfall occurring in August/September.

Table 1-2 Average monthly rainfall (BOM, 2019)

Monitoring station	Average monthly rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ayr DPI Research Station	221.6	234.5	153.4	46.8	40.2	24.0	15.2	15.3	9.8	26.3	44.4	98.7
Townsville Aero	269.2	304.6	193.7	64.5	32.9	20.6	14.7	15.5	10.2	24.1	57.1	125.3
Woolshed	273.9	328.3	151.3	63.4	28.2	29.4	22.6	12.8	14.0	29.3	59.2	99.1
Charters Towers Airport	151.9	144.2	76.4	26.2	22.8	20.1	20.1	15.0	9.1	17.7	61.5	77.7
Hughenden Airport	118.3	86.5	32.6	19.2	5.0	20.4	13.2	7.8	7.9	15.4	44.3	63.0
Richmond Post Office	122.1	104.9	62.1	22.0	14.7	15.3	9.9	4.1	6.2	15.7	30.6	69.6
Julia Creek Airport	130.2	109.9	76.9	12.4	8.0	16.1	8.5	3.8	2.9	10.1	27.7	56.7
Cloncurry Airport	161.6	104.5	77.9	16.6	7.0	7.5	3.5	3.2	6.0	16.4	32.7	72.4
Mount Isa Aero	116.2	101.9	65.4	13.6	11.9	6.4	5.8	3.4	8.1	18.2	37.7	71.2

Table 1-3 Average number of rainfall days (BOM, 2020)

Monitoring station	Average number of days of rain > 1 mm											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ayr DPI Research Station	9.6	10.3	7.9	3.5	3.1	2.4	1.6	1.6	1.2	2.2	4.0	5.6
Townsville Aero	11.6	12.6	9.7	5.3	3.6	2.4	1.9	1.4	1.3	2.8	4.8	7.2
Woolshed	11.7	12.4	9.2	5.5	3.9	3.9	2.4	1.5	1.9	3.0	6.1	6.5
Charters Towers Airport	8.8	8.5	6.2	3.3	2.7	2.7	1.7	1.2	1.3	2.1	4.7	5.6
Hughenden Airport	7.9	5.9	3.8	1.4	0.9	1.4	0.9	0.7	0.8	1.8	3.8	4.8
Richmond Post Office	7.8	6.7	4.2	1.7	1.2	1.1	0.9	0.6	0.7	1.8	3.2	5.4
Julia Creek Airport	8.5	6.1	4.1	1.0	0.8	1.1	0.7	0.6	0.5	1.4	2.9	4.7
Cloncurry Airport	8.2	6.4	4.0	1.4	0.8	0.7	0.5	0.4	1.0	1.7	3.6	5.3
Mount Isa Aero	7.9	7.1	4.1	1.4	1.2	0.7	0.6	0.5	0.9	2.3	3.9	5.8

1.3.3 Topography

The Project is situated within six different bioregions that are characterised by broad, landscape-scale natural features and environmental processes that influence the functions of ecosystems. Bioregions capture large-scale geophysical patterns across the land.

The topography across the corridor selection varies from relatively flat to hilly terrains.

Preliminary calculations for the average slope of disturbance area across each section were determined by considering topographic long sections (Google Earth):

- Woodstock to Dajarra – 0.68%
- Dajarra Road to Cannington Mine – 1.45%
- Dajarra Road to Mount Isa – 5.41%
- Phosphate Hill Mine – 0.44%.

These slope calculations will be assessed further during detailed design.

1.3.4 Hydrology

A large number of waterways are present along the corridor selection. It is understood that all receiving waterways are known to be freshwater bodies and are typically ephemeral.

As part of the proposed work, access tracks are likely to traverse a number of these waterways to follow the transmission line easement. It is not anticipated that any new waterway crossings will be constructed at this stage as it is expected that all construction related vehicles can cross waterway banks. In the instance that a steep waterway bank is encountered, and there are no existing crossings within a reasonable distance, earthmoving equipment may be utilised to establish a more suitable bank slope for vehicles, which will require erosion and sediment controls, where necessary.

1.3.5 Geology and soils

Geology across the corridor selection is highly complex and ranges from resistant basement rocks, comprising granite and mixed volcanic rocks, to intensely weathered sandstone and marine sediments to resistant igneous rocks interspersed with metamorphosed sediments. A wide range of soil types are also found in the Study area, with varying levels of erodibility. Soil erodibility is a function of the rate of infiltration at the surface, permeability of the soil and the coherence of the soil particles. Sodic and dispersive soils found in the Study area are highly prone to water erosion. Substantial areas of sheet, rill and gully erosion have previously been identified in the Study area (Coffey Geotechnics, 2010).

To assist with the determination of soil erodibility, a number of field and/or laboratory tests can be undertaken including tests for dispersion, pH and sodicity.

Geotechnical investigations will be undertaken before the detailed design phase of the Project and will identify soil properties.

Sub-surface geology requires identification and characterisation prior to the development of the ESCP by the Contractor, to appropriately identify highly erodible soils within the Project area and to implement erosion and sediment controls accordingly.

1.3.6 Ballara Nature Refuge

The Ballara Nature Refuge (Plan Number AP21339) has been identified as a sensitive environmental area potentially requiring particular management strategies due to susceptibility to erosion and environmental values. Desktop soil analysis (Australian Soil Resource

Information System (ASRIS)) identified sandy to sandy loam soils in areas where the Ballara Nature Refuge intersected with the corridor selection (with an estimated maximum K value of approximately 0.03). Erosion risk is discussed in further detail at Section 1.4.4. However, it is noted that the Project does not involve significant ground disturbance or earthworks.

1.4 Erosion hazard assessment

1.4.1 Overview

While the Project is a major infrastructure project, the construction methodology is not technically complex, and the sequence of tasks is repetitive for both the transmission line and substation construction processes. Transmission towers and associated infrastructure will be located outside of active water features. Where the corridor selection crosses large braided ephemeral systems, some of which are more than 1km wide, tower sites have been individually selected to avoid existing channels and the tower design will be sufficient to withstand seasonal flows or larger flooding events. No water features will require instream modification (i.e. extraction or placement of fill material) during construction or permanently resulting from the installation of Project infrastructure.

It is intended to utilise the existing road network and private access tracks, though some new tracks will be required to provide access for construction and maintenance teams. The access tracks for the Project will be constructed to a standard suitable for dry weather use for 4WDs at low speed.

Where tracks are to be constructed as part of the Project, they will generally be unsealed tracks that follow the natural ground contours. Access constraints may require some landform re-shaping to construct a safe access track. Access tracks will be of a suitable width to allow the safe movement, including turning, of construction and maintenance equipment and vehicles.

Typically, where formed access tracks are constructed, they will be 7 m wide tracks to allow the safe movement of construction and maintenance equipment and vehicles. The road bed itself will be 5 m wide with 1 m wing ditches on each side of the track, to direct surface run-off from both sides of the track away and into undisturbed areas.

Construction phase and permanent tracks would be constructed to meet DAF Accepted development requirements for operational work that is constructing or raising waterway barrier works relevant to the specific waterway barrier works category.

1.4.2 Proposed works and impacts

The proposed scope of works across the Project includes:

- Vegetation trimming and clearing within the corridor selection
- Construction of transmission towers
- Construction of substations at Woodstock, Hughenden, Dajarra Road (Cloncurry), Mount Isa, Selwyn, Cannington Mine and Phosphate Hill Mine
- Construction of access tracks
- Construction of laydown areas and fly yards
- Construction of temporary construction camps.

All infrastructure relating to this Project and the anticipated ground disturbance impacts are detailed in Table 1-4. Indicative locations and site plans are included in Volume 3 Appendix I Indicative infrastructure layout and cross-section drawings. It is noted that the nature of the

development does not involve significant ground disturbance or earthworks and that site selection avoids steep slopes or areas of soil instability/unsuitability.

Table 1-4 Project infrastructure and indicative ground disturbance impacts

Proposed infrastructure	Temporary/ Permanent	Indicative impact
Transmission line easement	Permanent	Clearing/felling/trimming anything over 5 m high within easement (up to 60 m wide). Clearing/felling/trimming anything within 45 degrees from 10 m above ground at edges of 60 m wide easement.
Tower footprint	Permanent (tower) Temporary (construction pad)	Minimum temporary ground disturbance footprint: approximately 600 m_2 Maximum temporary ground disturbance footprint: approximately 2,000 m_2
Access track	Permanent (easement) Temporary (off easement)	7 m maximum wide ground disturbance
CEV Hut	Permanent	60 m x 65 m (0.39 ha) consisting of CEV hut area of 15 m x 16 m (without solar PV) or 20 m x 30 m (with solar PV), fenced area buffered by fire break
Brake and winch site	Temporary	Temporary ground disturbance footprint: every 5 km to 10 km with a 60 m x 250 m (1.5 ha) area about 100 to 200 m away from tower on each side under the transmission line. This footprint can be contained within the cleared easement if the line is straight at the site, or possibly out of easement in the direction of the pull/brake, if the site is on a bend in the transmission line (roughly every 70 km).
Substation	Permanent	Up to 32 ha plus a 25 ha laydown area
Laydown areas (transmission line)	Temporary	Temporary disturbance footprint 250 x 250 m (6.25 ha)
Fly yard (helicopter landing area)	Permanent (pad at substation) Temporary (construction pad)	Permanent disturbance footprint: 100 m x 100 m (1 ha) Temporary disturbance footprint: 6 ha
Construction camps	Temporary	Temporary disturbance footprint: 8 ha 350 person camp estimated at 110 demountable buildings each, unless existing camps are identified.

1.4.3 Preliminary erosion hazard assessment

A preliminary erosion hazard assessment (refer Appendix A) has been undertaken as part of this CESCP to provide an indication of the erosion hazard associated with the Project and to inform erosion and sediment control measures that may be required. The assessment is based on the 'point score hazard assessment system' established in the IECA Guidelines (IECA, 2008).

The preliminary erosion hazard assessment was completed for the four key sections of the corridor selection:

- Woodstock to Dajarra Road
- Dajarra Road to Cannington Mine
- Dajarra Road to Mount Isa
- Selwyn to Phosphate Hill Mine.

Key inputs required for the assessment include those detailed in Section 1.3, as well as a number of assumptions that will require refinement throughout subsequent project phases. It is also important to note that this high-level erosion hazard assessment considers infrastructure as prescribed in Section 1.4.1 collectively within these four sections of the corridor, which will not be the case during the construction phase. As such, these preliminary assessment scores should be considered conservative in nature and are a guide only for developing site and stage specific ESCPs.

The total scores outlined in Table 1-5 were determined from the erosion hazard assessment.

Table 1-5 Erosion hazard assessment total scores

Sector	Total Score	Trigger vales scored/exceeded
Woodstock to Dajarra Road	24	Yes
Dajarra Road to Cannington	24	
Dajarra Road to Mt Isa	26	
Phosphate Hill	24	

As a result of the assessment, the Project is classed as a "high risk" erosion/sediment related activity, as the total scores are greater than 17. Additionally, considering the trigger values exceeded in the assessments, the following key elements of concern were identified for all sectors:

- Duration of soil disturbance
- Area of disturbance
- Waterway disturbance

As such, these elements should be of particular focus when determining erosion and sediment control measures adopted on site.

As the preliminary erosion hazard assessment of the proposed construction identifies that the project is 'high risk', a revised universal soil loss equation (RUSLE) analysis is required to deduce relevant sediment control types.

Table 1-6 outlines the method for identifying sediment control types considered best practice with respect to RUSLE calculated soil loss rates.

Table 1-6 Sediment control standard (default) based on soil loss rate areas > 2,500 m2

Area limit (m2)	Soil loss rate limit (t/ha/yr)		
	Type 1	Type 2	Type 3
>2500	>150	150	75

1.4.4 Soil loss estimation (RUSLE)

The RUSLE is used as an “indicator” of potential soil loss for the purpose of deriving sediment control standards. It is important to note that RUSLE only assists in identifying relevant sediment controls and does not provide an accurate assessment of annual soil loss rates.

A RUSLE analysis has been conducted for major infrastructure associated with the project in an effort to identify necessary sediment control methods. Details on these control methods are provided in Section 1.5.5 and 1.5.6.

Note that the RUSLE equations below consider 2 year, 6 hour storms, however, with the primary control being dry season construction and closure of open areas over wet periods this is seen as a conservative approach and calculated soil loss (t/ha/yr) would be significantly less given low average rainfall in dry months for the majority of the corridor selection. Generally, Type 3 controls will be implemented.

With respect to the Ballara Nature Refuge, indicative soil K values would result in Type 3 sediment controls being required associated with Project disturbance footprints e.g. transmission towers. However, further consideration would be required within site specific Erosion and Sediment Control Plans to specific soil types and characteristics, local hydrology and receiving environment values.

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CEV huts (permanent)

Table 1-7 CEV Hut annual soil loss rates

Infrastructure	Latitude/Longitude	Approx. Area (m^2)	IFD (2-year, 6 hour storm (mm/h))	R	ASRIS Clay Content	K	LS	C	P	A (t/Ha/yr)	Sediment control type
Yorkshire CEV	-20.79834,142.05162	3000	9.91	2330	57% (Medium clay, medium heavy clay, heavy clay)	0.015	0.18	1	1.3	8	Type 3
Warreah south CEV	-20.90639,144.76306	4000	10.2	2290	6% (Sand, loamy sand or clayey sand)	0.025	0.18	1	1.3	13	Type 3
Selwyn CEV	-21.53241,140.45462	3000	8.69	1750	15% (Sandy loam)	0.03	0.18	1	1.3	12	Type 3
Pentland south CEV	-20.61930,145.60581	3000	10.7	2500	15% (Sandy loam)	0.03	0.18	1	1.3	18	Type 3
Nonda CEV	-20.82406,142.69489	4000	10	2210	57% (Medium clay, medium heavy clay, heavy clay)	0.015	0.19	1	1.3	8	Type 3
Gilliat CEV	-20.78973,141.34522	3000	9.67	2020	57% (Medium clay, medium heavy clay, heavy clay)	0.015	0.18	1	1.3	7	Type 3
Charters Towers south CEV	-20.29986,146.18415	3000	11.2	2720	23% (loam, silty loam or sandy clay loam)	0.055	0.18	1	1.3	35	Type 3
Barabon CEV	-20.88601,143.43014	3000	9.83	2150	57% (Medium clay, medium heavy clay, heavy clay)	0.015	0.18	1	1.3	8	Type 3

Substations (permanent)

Table 1-8 Substation annual soil loss rates

Infrastructure	Latitude/Longitude	Approx. Area (m^2)	IFD (2-year, 6 hour storm (mm/h))	R	ASRIS Clay Content	K	LS	C	P	A (t/Ha/yr)	Sediment control type
Woodstock substation	-19.92814,147.05280	362000	16	5830	22% (loam, silty loam or sandy clay loam)	0.055	0.58	1	1.3	242	Type 1
Selwyn substation	-21.78525,140.70318	360000	7.97	1520	19% (Sandy loam)	0.03	1	1	1.3	59	Type 3
Phosphate Hill substation	-21.87857,139.98047	10000	8.33	1630	38% (Light clay or light medium clay)	0.025	0.24	1	1.3	13	Type 3
Mt Isa substation	-20.77354,139.49019	70000	9.36	1970	8% (Sand, loamy sand or clayey sand)	0.025	0.24	1	1.3	15	Type 3
Flinders substation	-20.87978,144.16836	858000	9.85	2150	61% (Medium clay, medium heavy clay, heavy clay)	0.015	0.24	1	1.3	10	Type 3
Dajarra Road substation	-20.74978,140.40919	820000	10.1	2250	15% (Sandy loam)	0.03	1	1	1.3	88	Type 2
Cannington substation	-21.85713,140.91830	10000	7.82	1480	53% (Medium clay, medium heavy clay, heavy clay)	0.015	0.24	1	1.3	7	Type 3

Construction camps/laydown areas (temporary)

Table 1-9 Construction camp/laydown area annual soil loss rates

Infrastructure	Latitude/Longitude	Approx. Area (m^2)	IFD (2-year, 6 hour storm (mm/h))	R	ASRIS Clay Content	K	LS	C	P	A (t/Ha/yr)	Sediment control type
ACCOM1	-19.32573,146.76089	142500		8220	13% (Sandy loam)	0.03	0.24	1	1.3	78	Type 2
CAMP2	-20.08070,146.24192			2810	29% (loam, silty loam or sandy clay loam)	0.055	0.24	1	1.3	48	Type 3
CAMP3	-20.55536,145.44585			2450	12% (Sandy loam)	0.03	0.24	1	1.3	23	Type 3
CAMP4	-20.82209,144.18400			2170	25% (loam, silty loam or sandy clay loam)	0.055	0.24	1	1.3	37	Type 3
CAMP5	-20.73470,143.15487			2210	49% (Medium clay, medium heavy clay, heavy clay)	0.015	0.24	1	1.3	10	Type 3
CAMP6	-20.64243,141.73379			2210	57% (Medium clay, medium heavy clay, heavy clay)	0.015	0.24	1	1.3	10	Type 3
CAMP7	-20.68291,140.53567			2290	15% (Sandy loam)	0.03	0.24	1	1.3	21	Type 3
ACCOM8	-20.73829,139.46781			1920	15% (Sandy loam)	0.03	0.24	1	1.3	18	Type 3
CAMP9	-21.62713,140.48096			1720	15% (Sandy loam)	0.03	0.24	1	1.3	16	Type 3

1.5 Erosion and sediment control mitigation and management

1.5.1 Environmental Management Plan (EMP) framework

Volume 3 Appendix Q Framework environmental management plan establishes the following for the Project:

- An environmental management strategy including requirements for:
  - Environmental risk assessment and management
  - Identification of approvals and legal requirements
  - Allocation of roles and responsibilities
  - Contractor management
  - Communications and environmental reporting
  - Training, awareness and inductions
  - Emergency contacts and procedures
  - Monitoring, inspections and audits (including continuous improvement)
  - Incidents and complaints
  - Non-conformity, corrective and preventative actions.
- Environmental values, performance objectives, monitoring and management requirements.

The construction contractor will be required to prepare additional, site specific environmental management documentation, inclusive of procedures, protocols and Environmental and Safe Work Method Statements, compliant with these requirements. The construction contractor is responsible for implementing all erosion and sediment control measures, and these must be implemented in accordance with best practice principles. The erosion, sediment and drainage control measures set out in this section are applicable across the entire Project site. Standard drawings (where available) for the indicative erosion and sediment controls, detailed below, are provided in Appendix B.

Erosion, sediment and drainage control measures that are required only for the construction phase of the Project will remain in place until the applicable construction works are completed and surfaces are stabilised and revegetated. Note that these construction works are anticipated to occur in the dry season. The timeframe for such controls will vary as the Project construction phase is expected to take 31 months, with a staged approach across the 1,000 km corridor selection.

Some erosion, sediment and drainage control measures are an integral part of the transmission line infrastructure and will remain in place permanently, namely those associated with permanent infrastructure.

1.5.2 Erosion and sediment control management strategies

Induction and training

Staff training is essential for the effective operation of erosion and sediment control measures. Field training starts by advising all site workers, subcontractors and delivery drivers of their responsibility for minimising potential for soil erosion and other forms of pollution. It is noted that appropriate warning and educational signs may be required throughout the site, especially at site entry/exit points. Additionally, engineers, supervisors and machinery operators need to have a basic knowledge of soils, at least to the extent of recognising different soil types and those most susceptible to erosion. This training should be complemented with an understanding of the

basic soil and water management techniques and the environmental problems associated with mismanagement.

Formal environmental site induction procedures should be established for all site personnel, including subcontractors. These documented procedures should include a register of training and induction activities.

It is the responsibility of the site/project manager to take appropriate steps to ensure that site staff, including subcontractors, are suitably qualified and experienced enough to meet their erosion and sediment control obligations.

Note that site managers in particular must also be familiar with the following principles of on-site erosion and sediment control:

- Appropriately integrate the development into the site.
- Integrate erosion and sediment control issues into site and construction planning.
- Develop effective and flexible ESCPs based on anticipated soil, weather and construction conditions.
- Minimise the extent and duration of soil disturbance.
- Control water movement through the site.
- Minimise soil erosion.
- Promptly stabilise disturbed areas.
- Maximise sediment retention on-site.
- Maintain all erosion and sediment control measures in proper working order at all times.
- Monitor the site and adjust erosion and sediment control practices to maintain the required performance standard.

Ultimately, all personnel must collectively have the following capabilities:

- An understanding of the local environmental values that could potentially be affected by the proposed works.
- A good working knowledge of the site's erosion and sediment control issues and potential environmental impacts, that is commensurate with the complexity of the site and the degree of environmental risk.
- A good working knowledge of current best practice erosion and sediment control measures for the given site conditions and type of works.
- Ability to appropriately monitor, interpret, and report on the site's erosion and sediment control performance, including the ability to recognise poor performance and potential erosion and sediment control problems.
- Ability to provide advice and guidance on appropriate measures and procedures to maintain the site, at all times, in a condition representative of current best practice, and that is reasonably likely to achieve the required erosion and sediment control standard.
- A good working knowledge of the correct installation, operational and maintenance procedures for the full range of erosion and sediment control measures used on the site.

1.5.3 Construction staging and timing

Construction staging

Staging of works can be the most effective tool to minimise erosion risk, however, ultimately, the Contractor will be responsible for determining appropriate construction staging. For the purposes of this preliminary assessment, it is proposed that the following work activities are undertaken with respect to the CESCP:

- No go areas to be marked with flagging tape to ensure that all work activities remain within the designated work site.
- Utilities and services to be installed for construction camps, if necessary, considering all necessary erosion and sediment controls.
- Proposed temporary access tracks are to be marked out. Where re-grading of waterway banks is required, exposed banks are to be covered/stabilised as soon as practicable with appropriate material.
- Vegetation trimming and clearing within transmission corridor, substation and proposed laydown footprints. Where soil disturbance is required, upslope diversion bunds and downslope sediment fencing is to be installed to divert clean runoff around the construction area and to capture potentially sediment laden runoff from impacting the surrounding environment.
- Clearing of vegetation and topsoil along the proposed access tracks and pads to be undertaken during periods of minimal or no forecast rainfall (less than 5 mm rainfall). Where clearing of waterways and adjoining banks are required, they are to be left undisturbed for as long as practicable and rehabilitated as soon as construction works have been completed.
- Progressive stabilisation of work areas and disturbed areas in accordance with permanent stabilisation treatments, as soon as practicable.

Figure 1-2 and Figure 1-3 provide an outline of the current indicative Project construction zone staging process.

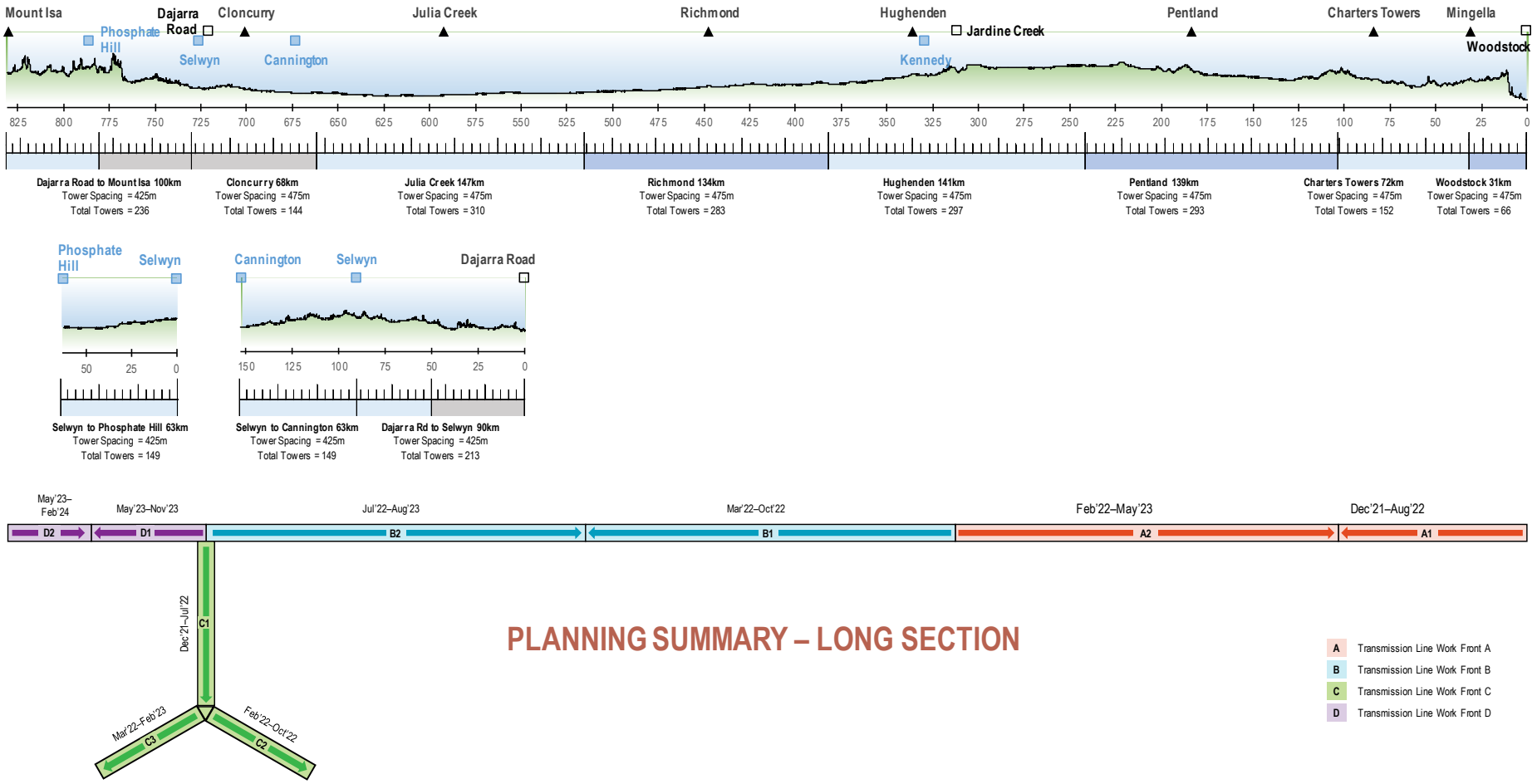


Figure 1-2 Indicative transmission line construction zone staging

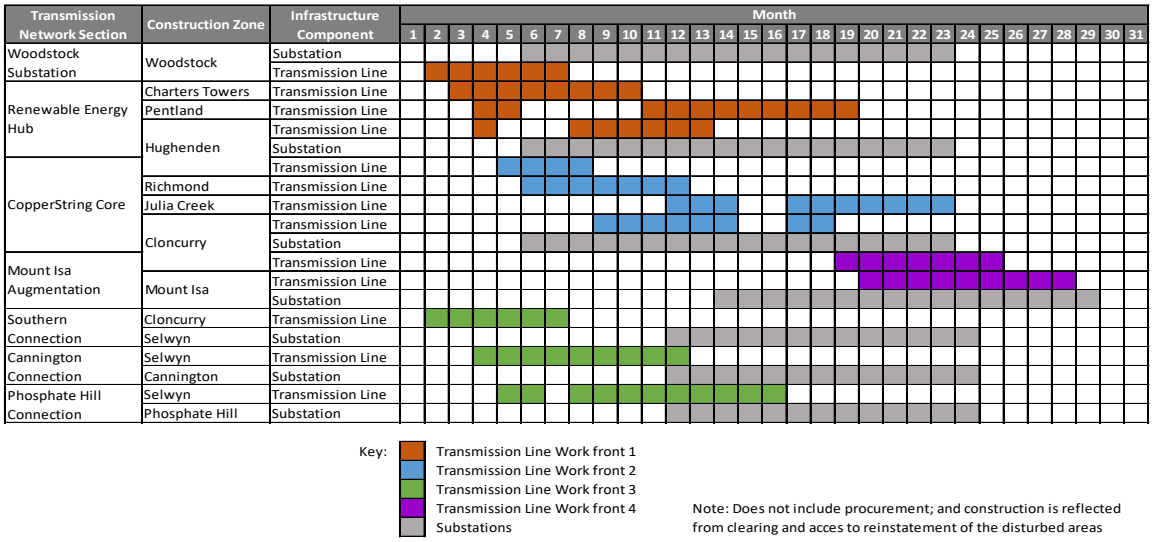


Figure 1-3 Indicative Project construction zone staging

Construction timing

The works schedule for each construction stage shall take into consideration the expected and predicted rainfall forecast for the region. In particular, clearing and rehabilitation activities shall aim to avoid periods of predicted significant rainfall. These factors are of the greatest importance when works are programmed to occur within or adjacent to sensitive areas, i.e. works near waterways or access tracks traversing waterways. Clearing and revegetation activities shall be halted during periods of significant rainfall, and appropriate temporary control measures may be required to be implemented and closely monitored during these events. Daily records of weather forecasts shall be obtained, recorded and kept on site at all times during project works.

The erosion risk rating for average monthly rainfall is set out in Table 33 of the IECA Guidelines (IECA 2008), and is outlined in Table 1-10.

Table 1-10 Erosion risk rating based on average monthly rainfall (IECA, 2008)

Erosion risk rating[1]	Expected 24 hour rainfall	Average monthly rainfall
Very low	0 to 2 m	0 to 30 mm
Low	2+ to 10 mm	30+ to 45 mm
Moderate	10+ to 25 mm	45+ to 100 mm
High	25+ to 100 mm	100+ to 225 mm
Extreme	> 100 mm	> 225 mm

[1]Erosion risk rating based on worst case of expected rainfall within any 24-hour period or average monthly rainfall.

Construction periods for Project components, with the exception of substations, will be less than six months. The construction period for the substations is likely to be 18 months, however earthworks will only be undertaken for a minor period of the total construction timeframe. All construction works should be staged in a way that minimises earthworks within or near waterways during the wet season to avoid the potential risk of increased soil erosion.

The Contractor shall ensure implementation of erosion and sediment controls and shall also keep a record of rainfall forecast for the following week. Rainfall events in excess of 10 mm significantly increases erosion risk. Therefore, the Contractor will have to ensure that there are

no unprotected exposed surfaces, and that all sediment controls are functioning and have the required capacity prior to predicted (greater than 50% chance) rainfall events of greater than or equal to 10 mm.

1.5.4 Site access and establishment

The following site establishment procedures will apply. Note that not all of the following will apply to each stage of the Project.

- Obtain all necessary permits and plan approvals prior to site establishment.
- Ensure the approved ESCP is available on site.
- Review the development/contract conditions, Stormwater Management Plan and ESCP including all technical notes associated with the ESCP.
- Prepare a formal monitoring and maintenance program prior to site establishment (refer to Section 1.5.8 for further details regarding monitoring).
- Where appropriate, establish perimeter fencing to manage public safety and unauthorised material dumping.
- Establish the site compound erosion and sediment controls, installing all necessary drainage. When establishing the site compound, the following must be considered:
  - Establish only the minimum number of site entry/exit points
  - Ensure sediment control devices at entry/exit points are appropriate for the site conditions
  - Take appropriate steps to minimise risk of exiting vehicles being able to bypass entry/exit sediment control devices
  - Ensure the site office and carpark are established in locations that minimise safety risks to site visitors (locating close to site entry points to reduce visitor movement through active work areas)
  - Wherever reasonable and practicable, locate the site office and carpark up-slope of soil disturbances and any soil, earth or sand stockpiles that may allow sediment-laden runoff to flow through these areas
  - Wherever reasonable and practicable, locate the site compound so that all sediment-laden runoff can be fully contained and treated on-site
  - Ensure roof water from buildings and sheds will not cause unnecessary erosion or soil saturation around common traffic areas (vehicular or pedestrian)
  - Use gravelling techniques to minimise soil compaction and the generation of excessive mud around the site compound
  - Ensure the appropriate storage of chemical and fuels (as per AS1940).
- Construct and stabilise site entry/exit points, including appropriate control measures.
- Establish stockpile areas, including all necessary drainage and sediment controls.
- Stockpile materials necessary for the installation and ongoing maintenance of erosion and sediment control measures including those materials necessary for emergency erosion and sediment control activities in the event of imminent rainfall.
- Install or establish waste receptors for building waste, including litter and rubbish bins and concrete waste receptors.
- Establish any non-disturbance or exclusion areas identified within the ESCP.

- Implement remaining erosion and sediment control measures in accordance with the specified installation sequence.

1.5.5 Erosion, sediment and drainage control for temporary infrastructure

The majority of temporary infrastructure (as outlined in Table 1-4) does not present an extensive risk regarding erosion and sedimentation. Construction works are staged and planned for occurrence during the dry season with the construction staging schedule having been developed with reference to the seasonal rainfall anticipated during the summer months. Additionally, rehabilitation will occur progressively as detailed within in Volume 3 Appendix T Concept rehabilitation plan. All construction works are also constructed on relatively “flat” land. As such, erosion and sedimentation processes are considered low risk for most temporary infrastructure. Gravelling and drainage control will be required at temporary construction camps and for some permanent infrastructure (e.g. Substations).

As identified in Section 1.4.4, the RUSLE equation has identified Type 3 sediment controls as necessary for all temporary infrastructure works apart from:

- Woodstock substation which requires Type 1 sediment controls
- Dajarra Road Substation and ACCOM1 construction camp/laydown facility which requires Type 2 controls

As such, the following sediment controls should be implemented as applicable to specific infrastructure locations. Note that standard drawings for all below controls are provided (where available) in Appendix B. Note that all erosion, sediment and drainage controls must be designed by a suitably qualified engineer.

Type 1, 2 and 3 Sediment controls

- Filter fence
- Sediment fence
- Mulch filter berm
- Buffer zones
- Check dam
- Sediment basin

Note that unless otherwise noted in this document or specified by the regulatory authority, the design storm for sediment traps must be taken as 0.5 times the 1 in 1 year ARI peak discharge.

In addition to the above, the following control measures should also be considered when planning the management of sediment control for the Project. Note that all controls must be designed by a suitably qualified engineer.

Dust suppression

The most effective control measure against wind erosion is revegetation, however in some cases this is not reasonably practicable until the end of the construction period. In the interim, water tankers shall be employed to suppress dust on site during construction periods and other times, as necessary. Exposed channel surfaces must be rehabilitated as soon as practicable to minimise the potential environmental risk.

Stockpile management

Stockpiling sites and site facilities are to be located off site, above flood extents and within close proximity to the Project area where practicable. Sediment fencing is to be implemented

downslope of stockpiles, and bunds or diversion drains are to be implemented upslope of stockpiles, if demanded by the site conditions.

Drainage control

The following control measures should be considered when planning the management of drainage control for the Project. Where required (e.g. where potential exists to impact on other properties or infrastructure such as roads and rail) controls must be designed by a suitably qualified engineer.

- Provide diversion channels to direct undisturbed water flows from external catchments upslope of works areas towards existing discharge points.
- Provide diversion works (disturbed water channels) to direct disturbed water flows from ground disturbance catchments towards sediment treatment devices, where necessary.
- Provide temporary diversion bunds upslope of stockpile locations.
- Rock check dams are to be placed within the cleared areas on slopes, to reduce runoff velocities and minimise soil erosion caused during rainfall runoff events.

The following drainage control techniques are suitable for low-gradient slopes:

- Catch Drain
- Compost Berm
- Diversion Channel
- Flow Diversion Bank
- Straw Bale Flow Diversion Bank

Additionally, outlet structures for temporary drainage works are as follows:

- Level Spreader
- Outlet Structure

Regarding velocity control structures for channels and drains, the following techniques may be utilised:

- Fibre Roll
- Rock Check Dam
- Sandbag Check Dam

The following channel and chute lining options should be considered:

- Cellular Confinement System
- Erosion Control Mat
- Rock Mattress
- Rock Lining

Construction camp/laydown facilities

Temporary construction camp/laydown facilities will undergo a detailed design phase in which erosion and sediment control measures are considered at an engineering design level. However, some additional erosion and sediment control processes will be required as follows due to the nature of the infrastructure.

- Clean water diversion around the facility via channels/bunds

- Capture and treatment of dirty water before release into an excavated sediment trap or local stormwater management systems
- Sediment fence around perimeter of facility

Watercourse crossings

Watercourses may be defined as waterways for waterway barrier works, under the Queensland *Fisheries Act 1994*. Most waterways along the proposed route flow intermittently or are ephemeral. As works in these areas are generally programmed for the dry season, it is expected most waterways will be dry when crossed. Where this is not the case, and for larger water crossings, the access to transmission tower sites will use only existing crossings and no new waterway crossing will be constructed, unless for safety reasons. If new waterway crossings are required, they will be designed within the Department of Agriculture and Fisheries' Accepted development requirements for operational work that is constructing or raising waterway barrier works. Ensuring crossings meet these requirements is critical to ensuring appropriate erosion and sediment controls are taken into account.

Additionally, where riparian zones contain vegetation that is at risk of significant disturbance from manual line stringing, the conductor draw lines and OPGW stringing activities across the watercourse will be performed by helicopter.

1.5.6 Erosion, sediment and drainage control for permanent infrastructure

Permanent infrastructure, as outlined in Table 1-4, is not anticipated to require extensive erosion, sediment or drainage control measures. These structures will undergo a detailed design process in which these factors are accounted for at an engineering design level. Detailed flood/stormwater analysis would be required in the detailed design phase to confirm the required flood immunity is provided to infrastructure and in isolated cases where Project infrastructure may change existing flood behaviours. The latter would only be expected to potentially arise at buildings in proximity to local or State controlled roads and railways or other adjoining buildings and infrastructure where local hydrologic and hydraulic modelling and reporting to facilitate approvals would be required. Although permanent infrastructure will undergo detailed design, drainage controls as outlined in Section 1.5.5 may still apply. Likewise, gravelling will occur at all permanent infrastructure sites (e.g. Substations), access roads and in temporary camp laydowns to protect against potential erosion.

1.5.7 Maintenance of erosion and sediment control measures

All erosion and sediment control measures must be maintained in proper working order at all times during their required operational life. Temporary erosion and sediment control measures should be removed, and the affected land stabilised as soon as possible after the satisfactory completion of the defined "maintenance period", which may be a contracted maintenance period, or a period specified by a regulatory authority.

Note that associated best practice site management involving maintenance of erosion and sediment control measures includes:

- Ensuring all material removed from erosion and sediment control devices during maintenance, whether solid or liquid, is disposed of in a manner that does not cause ongoing soil erosion or environmental harm.
- Ensuring all sediment removed from roads or from sediment control measures at stormwater inlets is disposed of in a manner that does not cause ongoing soil erosion or environmental harm.

- Not using “poisons” to control excess vegetation in drainage lines unless by approval of the regulatory authority through the development of an approved Vegetation Management Plan.
- Maintaining the hydraulic capacity of heavily vegetated open drains by selectively cutting and trimming so as to leave a short, dense, live ground cover for the purpose of minimising soil erosion.
- Ensuring maintenance mowing of grassed road shoulders, table drains, batters and other surfaces likely to erode, aiming to leave grass leaf length no shorter than 50 mm wherever practicable.
- Clearly defining and documenting who is responsible for maintaining those erosion and sediment control measures installed during the life of the Project.
- Ensuring appropriate written records are kept on all erosion and sediment control monitoring and maintenance activities conducted during the life of the Project.

1.5.8 Performance criteria

- Discharging CuString’s general environmental obligation not to cause serious or material environmental harm or environmental nuisance under the EP Act.
- All personnel inducted prior to commencement of construction works.
- Construction contractor’s specific ESCP developed and implemented prior to construction.
- Erosion and sediment controls established and constructed prior to commencement of construction.
- No unresolved non-vexatious complaints regarding impacts from erosion and sedimentation from neighbouring properties.
- No increase in erosion or sedimentation or exacerbation of existing erosion control areas.

1.5.9 Monitoring and reporting

ESCPs are living documents that should be modified as site conditions change or if adopted measures fail to achieve the required treatment standard. When a site inspection detects a notable failure in the adopted erosion and sediment control measures, the source of this failure must be investigated, and appropriate amendments made to the site and plans.

Monitoring the effectiveness of an ESCP through a combination of site inspections and water quality monitoring is essential. Monitoring may include specific water quality sampling and detailed logbook entries of the site’s monitoring and maintenance activities, however given that the Project traverses nearly 82 watercourses, which are mostly ephemeral, water quality sampling is not feasible at all locations.

All erosion and sediment control measures should be inspected:

- At least daily when rain is occurring.
- At least weekly during construction (even if work is not occurring on-site).
- Within 24 hours prior to expected rainfall.
- Within 18 hours of a rainfall event of sufficient intensity and duration to cause on-site runoff.

As outlined in section 1.5.4, a formal monitoring and maintenance program should be prepared prior to site establishment. Personnel preparing and/or supervising the preparation of this program must collectively have the following capabilities:

- An understanding of the local environmental values that could potentially be affected by the proposed works.
- A good working knowledge of the site's erosion and sediment control issues and potential environmental impacts that is commensurate with the complexity of the site and the degree of environmental risk.
- A good working knowledge of current best practice erosion and sediment control measures appropriate for the given site conditions and type of works.
- A good working knowledge of the correct installation, operational and maintenance procedures for the full range of erosion and sediment control measures used on site.

1.5.10 Inspection requirements

All drainage, erosion and sediment control measures must be maintained in a manner that prevents or minimises safety risks. Similarly, all site inspection and maintenance activities must be conducted only when it is safe to do so, and only in a manner that minimises safety risks to site personnel and the general public.

Table 1-11 outlines inspection requirements in relation to erosion and sediment control and must be checked in relation to the specified inspection types.

Table 1-11 Inspection requirements

Inspection	Inspection items
Daily site inspections during periods of runoff-producing rainfall	• All drainage and erosion and sediment control measures. • Occurrences of excessive erosion or sediment deposition (whether on-site or off-site). • All site discharge points.
Weekly site inspections	• Full perimeter of each active construction site, even when works are not occurring • All drainage, erosion and sediment control measures. • Occurrences of excessive erosion or sediment depositions (whether on-site or off-site). • Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements. • Litter and waste receptors. • Oil, fuel and chemical storage facilities.
Site inspections immediately prior to anticipated runoff-producing rainfall and within 18 hours of a rainfall event of sufficient intensity and duration to cause on-site runoff	• Treatment and de-watering requirements of sediment basins. • Sediment deposition within sediment basins and the need for its removal. • All drainage, erosion and sediment control measures. • Occurrences of excessive sediment deposition (whether on-site or off-site). • Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements.

Inspection	Inspection items
	• Occurrences of excessive erosion, sedimentation, or mud generation around the site office, car park and/or material storage areas.
Monthly site inspections	• Surface coverage of finished surfaces (both area and percentage cover). • Health of recently established vegetation on rehabilitated areas. • Proposed staging of future land clearing, earthworks, and site/soil stabilisation.

In addition to the requirements of Table 1-11, the following inspection procedures should be adhered to:

- The full perimeter of each active construction site should be inspected at least weekly, even if work is not occurring on site.
- If excessive sediment is leaving the site, investigate and, where possible, record (by sample or photograph) the extent of sedimentation and associated environmental harm (time, date, location and extent must be noted in the inspection report).
- The need for control measure maintenance must be noted and conveyed to the appropriate (appropriate level of accountability in relation to financial and contractual matters) site personnel.
- Where possible, determine reasons for non-compliance.

1.5.11 Non-conformances and corrective actions

Where an environmental non-conformance occurs regarding erosion and sediment control (loss of sediment from the site, accidental discharge of sediment into adjacent waterways, riparian zones or drainage lines), the Site Manager shall immediately inform CuString of the incident. The Site Manager must also prepare a monthly report detailing any incidents of environmental nuisance and non-conformance for review by the Department of Environment and Science, if requested. The Contractor has a responsibility to report to CuString all major environmental incidents that risk causing environmental harm under the EP Act.

Non-conformance reports should be also prepared to:

- Identify, record and notify regulators and project managers of the non-conformance.
- Determine the cause of non-conformance.
- Determine required corrective actions.
- Recommend long-term preventative measures.

Where an environmental incident occurs, the following mitigation strategies shall be adopted as a minimum:

- All non-conformances and incidents are to be corrected as soon as possible and strategies implemented to reduce the likelihood of the incident reoccurring.
- Containment of the incident/spill using bunds, approved chemicals and containment areas on-site.
- The environmental representative is to review the erosion and sediment control measures in place for effectiveness and check maintenance records.

- An incident/accident report is to be completed for all accidents, incidents and non-conformances.

Where incidents have occurred, the Contractor shall ensure that all reasonable and practical control measures are implemented for future operations. This may include reviewing monitoring data, where exceedances have been found, and implementing additional and/or alternative controls to achieve the required environmental outcomes.

Incident reporting

Best practice site management requires establishment and clear documentation of incident reporting procedures. These procedures should clearly outline:

- The chain of responsibility
- Procedures for recording areas of non-compliance
- Monthly reporting procedures (if required)
- Procedures for recording corrective actions
- Internal recording and filing procedures.

Appendices

Appendix A – Erosion hazard assessments

Erosion Hazard Assessment Form – Woodstock to Dajarra Road

Condition	Points	Score	Trigger value
AVERAGE SLOPE OF DISTURBANCE AREA [1]			
• not more than 3% [3% . 33H:1V]	0		
• more than 3% but not more than 5% [5% = 20H:1V]	1	**0**	**4**
• more than 5% but not more than 10% [10% = 10H:1V]	2		
• more than 10% but not more than 15% [15% . 6.7H:1V]	4		
• more than 15%	6		
SOIL CLASSIFICATION GROUP (AS1726) [2]			
• GW, GP, GM, GC	0		
• SW, SP, OL, OH	1	**-**	
• SM, SC, MH, CH	2		
• ML, CL, or if *imported fill* is used, or if soils are untested	3		
EMERSON (DISPERSION) CLASS NUMBER [3]			
• Class 4, 6, 7, or 8	0		
• Class 5	2	**4**	**6**
• Class 3, (default value if soils are untested)	4		
• Class 1 or 2	6		
DURATION OF SOIL DISTURBANCE [4]			
• not more than 1 month	0		
• more than 1 month but not more than 4 months	2	**6**	**6**
• more than 4 months but not more than 6 months	4		
• more than 6 months	6		
AREA OF DISTURBANCE [5]			
• not more than 1000 m^2	0		
• more than 1000 m^2 but not more than 5000 m^2	1	**6**	**4**
• more than 5000 m^2 but not more than 1 ha	2		
• more than 1 ha but not more than 4 ha	4		
• more than 4 ha	6		
WATERWAY DISTURBANCE [6]			
• No disturbance to a watercourse, open drain or channel	0	**2**	**2**
• Involves disturbance to a constructed open drain or channel	1		
• Involves disturbance to a natural watercourse	2		
REHABILITATION METHOD [7]			
Percentage of area (relative to total disturbance) revegetated by seeding without light mulching (i.e. worst-case revegetation method).			
• not more than 1%	0	**-**	
• more than 1% but not more than 5%	1		
• more than 5% but not more than 10%	2		
• more than 10%	4		
RECEIVING WATERS [8]			
• Saline waters only	0	**2**	
• Freshwater body (e.g. creek or freshwater lake or river)	2		
SUBSOIL EXPOSURE [9]			
• No subsoil exposure except of service trenches	0	**0**	
• Subsoils are likely to be exposed	2		
EXTERNAL CATCHMENTS [10]			
• No external catchment	0	**1**	
• External catchment diverted around the soil disturbance	1		
• External catchment not diverted around the soil disturbance	2		
ROAD CONSTRUCTION [11]			
• No road construction	0	**2**	
• Involves road construction works	2		
pH OF SOILS TO BE REVEGETATED [12]			
• more than pH 5.5 but less than pH 8	0	**1**	
• other pH values, or if soils are untested	1		
Total Score [13]		**24**	

Explanatory notes

Requirements: Specific issues or actions required by the proponent.

Warnings: Issues that should be considered by the proponent.

Comments: General information relating to the topic.

[1] **REQUIREMENTS:**
For sites with an average slope of proposed land disturbance greater than 10%, a preliminary ESCP must be submitted to the regulatory authority for approval during planning negotiations.

Proponents must demonstrate that adequate erosion and sediment control measures can be implemented on-site to effectively protect downstream environmental values.

If site or financial constraints suggest that it is not reasonable or practicable for the prescribed water quality objectives to be achieved for the proposal, then the proponent must demonstrate that alternative designs or construction techniques (e.g. pole homes, suspended slab) cannot reasonably be implemented on the site.

WARNINGS:
Steep sites usually require more stringent drainage and erosion controls than flatter grade sites.

COMMENTS:
The steeper the land, the greater the need for adequate drainage controls to prevent soil and mulch from being washed from the site.

[2] **REQUIREMENTS:**
If the actual soil K-factor is known from soil testing, then the Score shall be determined from Table 1.

If a preliminary ESCP is required during planning negotiations, then it must be demonstrated that adequate space is available for the construction and operation of any major sediment traps, including the provision for any sediment basins and their associated embankments and spillways. It must also be demonstrated that all reasonable and practicable measures can be taken to divert the maximum quantity of sediment-laden runoff (up to the specified design storm) to these sediment traps throughout the construction phase and until the contributing catchment is adequately stabilised against erosion.

WARNINGS:
The higher the point score, the greater the need to protect the soil from raindrop impact and thus the greater the need for effective erosion control measures. A point score of 2 or greater will require a greater emphasis to be placed on revegetation techniques that do not expose the soil to direct rainfall contact during vegetation establishment, e.g. turfing and *Hydromulching*.

COMMENTS:
Table 2 provides an *indication* of soil conditions likely to be associated with a particular Soil group based on a statistical analysis of soil testing across NSW. This table provides only an initial estimate of the likely soil conditions.

The left-hand-side of the table provides an indication of the type of sediment basin that will be required (Type C, F or D). The right-hand-side of the table provides an indication of the likely erodibility of the soil based on the Revised Universal Soil Loss Equation (RUSLE) K-factor.

Table 3 provides some general comments on the erosion potential of the various soil groups.

Table 1 – Score if soil K-factor is known

	RUSLE soil erodibility K-factor			
	K < 0.02	**0.02<K<0.04**	**0.04<K<0.06**	**K > 0.06**
Score	0	1	2	3

Table 2 – Statistical analysis of NSW soil data [1]

Unified Soil Class System	Likely sediment basin classification (%)			Probable soil erodibility K-factor (%) [2]			
	Dry	Wet		Low	Moderate	High	Very High
	Type C	Type F	Type D	K < 0.02	0.02<K<0.04	0.04<K<0.06	K > 0.06
GM	30	**58**	12	12	**51**	26	12
GC	**42**	33	25	13	**71**	17	0
SW	40	**48**	12	**49**	39	12	0
SP	**53**	32	15	**76**	18	5	1
SM	21	**67**	12	26	**48**	25	1
SC	26	**50**	24	16	**64**	18	2
ML	5	**63**	32	4	35	**45**	16
CL	9	**51**	39	12	**56**	19	13
OL	2	**80**	18	34	**61**	5	1
MH	12	41	**48**	15	19	**41**	25
CH	5	44	**51**	39	**43**	11	7

Notes: [1] Analysis of soil data presented in Landcom (2004).
[2] Soil erodibility based on Revised Universal Soil Loss Equation (RUSLE) K-factor.

Unified Soil Classification System (USCS)

GW Well graded gravels, gravel-sand mixtures, little or no fines
GP Poorly graded gravels, gravel-sand mixture, little or no fines
GM Silty gravels, poorly graded gravel-sand-silt mixtures
GC Clayey gravels, poorly graded gravel-sand-clay mixtures
SW Well graded sands, gravelly sands, little or no fines
SP Poorly graded sands, gravelly sands, little or no fines
SM Silty sands, poorly graded sand-silt mixtures
SC Clayey sands, poorly graded sand-clay mixtures
ML Inorganic silts & very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL Inorganic clays, low–medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL Organic silts and organic silt-clays of low plasticity
MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH Inorganic clays of high plasticity, fat clays
OH Organic clays of medium to high plasticity

Table 3 – Typical properties of various soil groups [1]

Soil Groups	Typical properties [2]
GW, GP	• Low erodibility potential.
GM, GC	• Low to medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
SW, SP	• Low to medium erodibility potential.
SM, SC	• Medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
MH, CH	• Highly variable (low to high) erodibility potential. • Will generally create turbid runoff if disturbed.
ML, CL	• High erodibility potential. • Tendency to be dispersive. • May create some turbidity in runoff if disturbed.

Note: [1] After Soil Services & NSW DLWC (1998).
[2] Any soil can represent a high erosion risk if the binding clays or silts are unstable.

Table 4 provides **general** guidelines on the suitability of various soil groups to various engineering applications.

Table 4 – Engineering suitability based on Unified Soil Classification [1]

Unified Soil Class	USC Group	Embankments		Fill	Slope stability	Untreated roads
		Water retaining	Non water retaining			
Well graded gravels	GW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded gravel	GP	Unsuitable	Average	Excellent	Average	Unsuitable
Silty gravels	GM	Unsuitable	Average	Good	Average	Average
Clayey gravels	GC	Suitable	Average	Good	Average	Excellent
Well graded sands	SW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded sands	SP	Unsuitable	Average	Good	Average	Unsuitable
Silty sands	SM	Suitable [2]	Average	Average	Average	Poor
Clayey sands	SC	Suitable	Average	Average	Average	Good
Inorganic silts	ML	Unsuitable	Poor	Average	Poor	Unsuitable
Inorganic clays	CL	Suitable [2]	Good	Average	Good	Poor
Organic silts	OL	Unsuitable	Unsuitable	Poor	Unsuitable	Unsuitable
Inorganic silts	MH	Unsuitable	Poor	Poor	Poor	Unsuitable
Inorganic clays	CH	Suitable [2]	Average	Unsuitable	Average	Unsuitable
Organic clays	OH	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable
Highly organic soils	Pt	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable

Notes: [1] Modified from Hazelton & Murphy (1992)
[2] Suitable only after modifications to soil such as compaction and/or erosion protection

[3] If the soils have not been tested for Emerson Class, then adopt a score of 4.

REQUIREMENTS:
Works proposed on sites containing Emerson Class 1 or 2 soils have a very high pollution potential and must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

WARNINGS:
Class 3 and 5 soils disturbed by cut and fill operations or construction traffic are highly likely to discolour stormwater (i.e. cause turbid runoff). Chemical stabilisation will likely be required if these soils are placed immediately adjacent to a retaining wall. Any disturbed Class 1, 2, 3 and 5 soils that are to be revegetated must be covered with a non-dispersive topsoil as soon as possible (unless otherwise agreed by the regulatory authority).

Class 1 and 2 soils are highly likely to discolour (pollute) stormwater if exposed to rainfall or flowing water. Treatment of these soils with gypsum (or other suitable substance) will most likely be required. These soils should not be placed directly behind a retaining wall unless it has been adequately treated (stabilised) or covered with a non-dispersible soil.

[4] The duration of disturbance refers to the total duration of soil exposure to rainfall up until a time when there is at least 70% coverage of all areas of soil.

REQUIREMENTS:
All land developments with an expected soil disturbance period greater than 6 months must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

COMMENTS:
Construction periods greater than 3 months will generally experience at least some significant storm events, independent of the time of year that the construction (soil disturbance) occurs.

[5] **REQUIREMENTS:**
Development proposals with an expected soil disturbance in excess of 1ha must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

The area of disturbance refers to the total area of soil exposed to rainfall or dust-producing winds either as a result of:

(a) the removal of ground cover vegetation, mulch or sealed surfaces;
(b) past land management practices;
(c) natural conditions.

WARNINGS:
A *Sediment Basin* will usually be required if the disturbed area exceeds 0.25ha (2500m^2) within any sub-catchment (i.e. land flowing to one outlet point).

COMMENTS:
For soil disturbances greater than 0.25ha, the revegetation phase should be staged to minimise the duration for which soils are exposed to wind, rain and concentrated runoff.

[6] **REQUIREMENTS:**
All developments that involve earthworks or construction within a natural watercourse (whether that watercourse is in a natural or modified condition) must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

Permits and/or licences may be required from the State Government, including possible submission of the ESCP to the relevant Government department.

[7] **REQUIREMENTS:**
No areas of soil disturbance shall be left exposed to rainfall or dust-producing winds at the end of a development without an adequate degree of protection and/or an appropriate action plan for the establishment of at least 70% cover.

COMMENTS:
Grass seeding without the application of a light mulch cover is considered the least favourable revegetation technique. A light mulch cover is required to protect the soil from raindrop impact, excessive temperature fluctuations, and the loss of essential soil moisture.

[8] **COMMENTS:**
All receiving waters can be adversely affected by unnatural quantities of sediment-laden runoff. Freshwater ecosystems are generally more susceptible to ecological harm resulting from the inflow of fine or dispersible clays than saline water bodies. The further inland a land disturbance is, the greater the potential for the released sediment to cause environmental harm as this sediment travels towards the coast.

For the purpose of this clause it is assumed that all sediment-laden runoff will eventually flow into saline waters. Thus, sediment-laden discharges that flow first into freshwater are likely to adversely affect both fresh and saline water bodies and are therefore considered potentially more damaging to the environment.

This clause does **not** imply that sediment-laden runoff will not cause harm to saline waters.

[9] **COMMENTS:**
This clause refers to subsoils exposed during the construction phase either as a result of past land practices or proposed construction activities. The exposure of subsoils resulting from the excavation of minor service trenches should not be considered.

[10] **WARNINGS:**
The greater the extent of external catchment, the greater the need to divert up-slope stormwater runoff around any soil disturbance.

COMMENTS:
The ability to separate “clean” (i.e. external catchment) stormwater runoff from “dirty” site runoff can have a significant effect on the size, efficiency and cost of the temporary drainage, erosion, and sediment control measures.

[11] **REQUIREMENTS:**
Permission must be obtained from the owner of a road reserve before placing any erosion and sediment control measures within the road reserve.

WARNINGS:
Few sediment control techniques work efficiently when placed on a road and/or around roadside stormwater inlets. Great care must be taken if sediment control measures are located on a public roadway, specifically:

- safety issues relating to road users;
- the risk of causing flooding on the road or within private property.

The construction of roads (whether temporary or permanent) will usually modify the flow path of stormwater runoff. This can affect how "dirty" site runoff is directed to the sediment control measures.

COMMENTS:
"On-road" sediment control devices are at best viewed as secondary or supplementary sediment control measures. Only in special cases and/or on very small projects (e.g. kerb and channel replacement) might these controls be considered as the "primary" sediment control measure.

[12] **WARNINGS:**
Soils with a pH less than 5.5 or greater than 8 will usually require treatment in order to achieve satisfactory revegetation. Soils with a pH of less than 5 (whether naturally acidic or in acid sulfate soil areas) may also limit the choice of chemical flocculants (e.g. Alum) for use in the flocculation of *Sediment Basins*.

[13] **REQUIREMENTS:**
A preliminary ESCP must be submitted to the local government for approval during the planning phase for any development that obtains a total point score of 17 or greater or when any trigger value is scored or exceeded.

Erosion Hazard Assessment Form – Dajarra Road to Mt Isa

Condition	Points	Score	Trigger value
AVERAGE SLOPE OF DISTURBANCE AREA [1]			
• not more than 3% [3% . 33H:1V]	0		
• more than 3% but not more than 5% [5% = 20H:1V]	1	**2**	**4**
• more than 5% but not more than 10% [10% = 10H:1V]	2		
• more than 10% but not more than 15% [15% . 6.7H:1V]	4		
• more than 15%	6		
SOIL CLASSIFICATION GROUP (AS1726) [2]			
• GW, GP, GM, GC	0		
• SW, SP, OL, OH	1	**-**	
• SM, SC, MH, CH	2		
• ML, CL, or if *imported fill* is used, or if soils are untested	3		
EMERSON (DISPERSION) CLASS NUMBER [3]			
• Class 4, 6, 7, or 8	0		
• Class 5	2	**4**	**6**
• Class 3, (default value if soils are untested)	4		
• Class 1 or 2	6		
DURATION OF SOIL DISTURBANCE [4]			
• not more than 1 month	0		
• more than 1 month but not more than 4 months	2	**6**	**6**
• more than 4 months but not more than 6 months	4		
• more than 6 months	6		
AREA OF DISTURBANCE [5]			
• not more than 1000 m^2	0		
• more than 1000 m^2 but not more than 5000 m^2	1	**6**	**4**
• more than 5000 m^2 but not more than 1 ha	2		
• more than 1 ha but not more than 4 ha	4		
• more than 4 ha	6		
WATERWAY DISTURBANCE [6]			
• No disturbance to a watercourse, open drain or channel	0	**2**	**2**
• Involves disturbance to a constructed open drain or channel	1		
• Involves disturbance to a natural watercourse	2		
REHABILITATION METHOD [7]			
Percentage of area (relative to total disturbance) revegetated by seeding without light mulching (i.e. worst-case revegetation method).			
• not more than 1%	0	**-**	
• more than 1% but not more than 5%	1		
• more than 5% but not more than 10%	2		
• more than 10%	4		
RECEIVING WATERS [8]			
• Saline waters only	0	**2**	
• Freshwater body (e.g. creek or freshwater lake or river)	2		
SUBSOIL EXPOSURE [9]			
• No subsoil exposure except of service trenches	0	**0**	
• Subsoils are likely to be exposed	2		
EXTERNAL CATCHMENTS [10]			
• No external catchment	0	**1**	
• External catchment diverted around the soil disturbance	1		
• External catchment not diverted around the soil disturbance	2		
ROAD CONSTRUCTION [11]			
• No road construction	0	**2**	
• Involves road construction works	2		
pH OF SOILS TO BE REVEGETATED [12]			
• more than pH 5.5 but less than pH 8	0	**1**	
• other pH values, or if soils are untested	1		
Total Score [13]		**26**	

Explanatory notes

Requirements: Specific issues or actions required by the proponent.

Warnings: Issues that should be considered by the proponent.

Comments: General information relating to the topic.

[1] **REQUIREMENTS:**
For sites with an average slope of proposed land disturbance greater than 10%, a preliminary ESCP must be submitted to the regulatory authority for approval during planning negotiations.

Proponents must demonstrate that adequate erosion and sediment control measures can be implemented on-site to effectively protect downstream environmental values.

If site or financial constraints suggest that it is not reasonable or practicable for the prescribed water quality objectives to be achieved for the proposal, then the proponent must demonstrate that alternative designs or construction techniques (e.g. pole homes, suspended slab) cannot reasonably be implemented on the site.

WARNINGS:
Steep sites usually require more stringent drainage and erosion controls than flatter grade sites.

COMMENTS:
The steeper the land, the greater the need for adequate drainage controls to prevent soil and mulch from being washed from the site.

[2] **REQUIREMENTS:**
If the actual soil K-factor is known from soil testing, then the Score shall be determined from Table 1.

If a preliminary ESCP is required during planning negotiations, then it must be demonstrated that adequate space is available for the construction and operation of any major sediment traps, including the provision for any sediment basins and their associated embankments and spillways. It must also be demonstrated that all reasonable and practicable measures can be taken to divert the maximum quantity of sediment-laden runoff (up to the specified design storm) to these sediment traps throughout the construction phase and until the contributing catchment is adequately stabilised against erosion.

WARNINGS:
The higher the point score, the greater the need to protect the soil from raindrop impact and thus the greater the need for effective erosion control measures. A point score of 2 or greater will require a greater emphasis to be placed on revegetation techniques that do not expose the soil to direct rainfall contact during vegetation establishment, e.g. turfing and *Hydromulching*.

COMMENTS:
Table 2 provides an *indication* of soil conditions likely to be associated with a particular Soil group based on a statistical analysis of soil testing across NSW. This table provides only an initial estimate of the likely soil conditions.

The left-hand-side of the table provides an indication of the type of sediment basin that will be required (Type C, F or D). The right-hand-side of the table provides an indication of the likely erodibility of the soil based on the Revised Universal Soil Loss Equation (RUSLE) K-factor.

Table 3 provides some general comments on the erosion potential of the various soil groups.

Table 1 – Score if soil K-factor is known

	RUSLE soil erodibility K-factor			
	K < 0.02	**0.02<K<0.04**	**0.04<K<0.06**	**K > 0.06**
Score	0	1	2	3

Table 2 – Statistical analysis of NSW soil data [1]

Unified Soil Class System	Likely sediment basin classification (%)			Probable soil erodibility K-factor (%) [2]			
	Dry	Wet		Low	Moderate	High	Very High
	Type C	Type F	Type D	K < 0.02	0.02<K<0.04	0.04<K<0.06	K > 0.06
GM	30	**58**	12	12	**51**	26	12
GC	**42**	33	25	13	**71**	17	0
SW	40	**48**	12	**49**	39	12	0
SP	**53**	32	15	**76**	18	5	1
SM	21	**67**	12	26	**48**	25	1
SC	26	**50**	24	16	**64**	18	2
ML	5	**63**	32	4	35	**45**	16
CL	9	**51**	39	12	**56**	19	13
OL	2	**80**	18	34	**61**	5	1
MH	12	41	**48**	15	19	**41**	25
CH	5	44	**51**	39	**43**	11	7

Notes: [1] Analysis of soil data presented in Landcom (2004).

[2] Soil erodibility based on Revised Universal Soil Loss Equation (RUSLE) K-factor.

Unified Soil Classification System (USCS)

GW Well graded gravels, gravel-sand mixtures, little or no fines
GP Poorly graded gravels, gravel-sand mixture, little or no fines
GM Silty gravels, poorly graded gravel-sand-silt mixtures
GC Clayey gravels, poorly graded gravel-sand-clay mixtures
SW Well graded sands, gravelly sands, little or no fines
SP Poorly graded sands, gravelly sands, little or no fines
SM Silty sands, poorly graded sand-silt mixtures
SC Clayey sands, poorly graded sand-clay mixtures
ML Inorganic silts & very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL Inorganic clays, low–medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL Organic silts and organic silt-clays of low plasticity
MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH Inorganic clays of high plasticity, fat clays
OH Organic clays of medium to high plasticity

Table 3 – Typical properties of various soil groups [1]

Soil Groups	Typical properties [2]
GW, GP	• Low erodibility potential.
GM, GC	• Low to medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
SW, SP	• Low to medium erodibility potential.
SM, SC	• Medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
MH, CH	• Highly variable (low to high) erodibility potential. • Will generally create turbid runoff if disturbed.
ML, CL	• High erodibility potential. • Tendency to be dispersive. • May create some turbidity in runoff if disturbed.

Note: [1] After Soil Services & NSW DLWC (1998).
[2] Any soil can represent a high erosion risk if the binding clays or silts are unstable.

Table 4 provides **general** guidelines on the suitability of various soil groups to various engineering applications.

Table 4 – Engineering suitability based on Unified Soil Classification [1]

Unified Soil Class	USC Group	Embankments		Fill	Slope stability	Untreated roads
		Water retaining	Non water retaining			
Well graded gravels	GW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded gravel	GP	Unsuitable	Average	Excellent	Average	Unsuitable
Silty gravels	GM	Unsuitable	Average	Good	Average	Average
Clayey gravels	GC	Suitable	Average	Good	Average	Excellent
Well graded sands	SW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded sands	SP	Unsuitable	Average	Good	Average	Unsuitable
Silty sands	SM	Suitable [2]	Average	Average	Average	Poor
Clayey sands	SC	Suitable	Average	Average	Average	Good
Inorganic silts	ML	Unsuitable	Poor	Average	Poor	Unsuitable
Inorganic clays	CL	Suitable [2]	Good	Average	Good	Poor
Organic silts	OL	Unsuitable	Unsuitable	Poor	Unsuitable	Unsuitable
Inorganic silts	MH	Unsuitable	Poor	Poor	Poor	Unsuitable
Inorganic clays	CH	Suitable [2]	Average	Unsuitable	Average	Unsuitable
Organic clays	OH	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable
Highly organic soils	Pt	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable

Notes: [1] Modified from Hazelton & Murphy (1992)
[2] Suitable only after modifications to soil such as compaction and/or erosion protection

[3] If the soils have not been tested for Emerson Class, then adopt a score of 4.

REQUIREMENTS:
Works proposed on sites containing Emerson Class 1 or 2 soils have a very high pollution potential and must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

WARNINGS:
Class 3 and 5 soils disturbed by cut and fill operations or construction traffic are highly likely to discolour stormwater (i.e. cause turbid runoff). Chemical stabilisation will likely be required if these soils are placed immediately adjacent to a retaining wall. Any disturbed Class 1, 2, 3 and 5 soils that are to be revegetated must be covered with a non-dispersive topsoil as soon as possible (unless otherwise agreed by the regulatory authority).

Class 1 and 2 soils are highly likely to discolour (pollute) stormwater if exposed to rainfall or flowing water. Treatment of these soils with gypsum (or other suitable substance) will most likely be required. These soils should not be placed directly behind a retaining wall unless it has been adequately treated (stabilised) or covered with a non-dispersible soil.

[4] The duration of disturbance refers to the total duration of soil exposure to rainfall up until a time when there is at least 70% coverage of all areas of soil.

REQUIREMENTS:
All land developments with an expected soil disturbance period greater than 6 months must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

COMMENTS:
Construction periods greater than 3 months will generally experience at least some significant storm events, independent of the time of year that the construction (soil disturbance) occurs.

[5] **REQUIREMENTS:**
Development proposals with an expected soil disturbance in excess of 1ha must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

The area of disturbance refers to the total area of soil exposed to rainfall or dust-producing winds either as a result of:

(a) the removal of ground cover vegetation, mulch or sealed surfaces;
(b) past land management practices;
(c) natural conditions.

WARNINGS:
A *Sediment Basin* will usually be required if the disturbed area exceeds 0.25ha (2500m^2) within any sub-catchment (i.e. land flowing to one outlet point).

COMMENTS:
For soil disturbances greater than 0.25ha, the revegetation phase should be staged to minimise the duration for which soils are exposed to wind, rain and concentrated runoff.

[6] **REQUIREMENTS:**
All developments that involve earthworks or construction within a natural watercourse (whether that watercourse is in a natural or modified condition) must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

Permits and/or licences may be required from the State Government, including possible submission of the ESCP to the relevant Government department.

[7] **REQUIREMENTS:**
No areas of soil disturbance shall be left exposed to rainfall or dust-producing winds at the end of a development without an adequate degree of protection and/or an appropriate action plan for the establishment of at least 70% cover.

COMMENTS:
Grass seeding without the application of a light mulch cover is considered the least favourable revegetation technique. A light mulch cover is required to protect the soil from raindrop impact, excessive temperature fluctuations, and the loss of essential soil moisture.

[8] **COMMENTS:**
All receiving waters can be adversely affected by unnatural quantities of sediment-laden runoff. Freshwater ecosystems are generally more susceptible to ecological harm resulting from the inflow of fine or dispersible clays than saline water bodies. The further inland a land disturbance is, the greater the potential for the released sediment to cause environmental harm as this sediment travels towards the coast.

For the purpose of this clause it is assumed that all sediment-laden runoff will eventually flow into saline waters. Thus, sediment-laden discharges that flow first into freshwater are likely to adversely affect both fresh and saline water bodies and are therefore considered potentially more damaging to the environment.

This clause does **not** imply that sediment-laden runoff will not cause harm to saline waters.

[9] **COMMENTS:**
This clause refers to subsoils exposed during the construction phase either as a result of past land practices or proposed construction activities. The exposure of subsoils resulting from the excavation of minor service trenches should not be considered.

[10] **WARNINGS:**
The greater the extent of external catchment, the greater the need to divert up-slope stormwater runoff around any soil disturbance.

COMMENTS:
The ability to separate “clean” (i.e. external catchment) stormwater runoff from “dirty” site runoff can have a significant effect on the size, efficiency and cost of the temporary drainage, erosion, and sediment control measures.

[11] **REQUIREMENTS:**
Permission must be obtained from the owner of a road reserve before placing any erosion and sediment control measures within the road reserve.

WARNINGS:
Few sediment control techniques work efficiently when placed on a road and/or around roadside stormwater inlets. Great care must be taken if sediment control measures are located on a public roadway, specifically:

- safety issues relating to road users;
- the risk of causing flooding on the road or within private property.

The construction of roads (whether temporary or permanent) will usually modify the flow path of stormwater runoff. This can affect how "dirty" site runoff is directed to the sediment control measures.

COMMENTS:
"On-road" sediment control devices are at best viewed as secondary or supplementary sediment control measures. Only in special cases and/or on very small projects (e.g. kerb and channel replacement) might these controls be considered as the "primary" sediment control measure.

[12] **WARNINGS:**
Soils with a pH less than 5.5 or greater than 8 will usually require treatment in order to achieve satisfactory revegetation. Soils with a pH of less than 5 (whether naturally acidic or in acid sulfate soil areas) may also limit the choice of chemical flocculants (e.g. Alum) for use in the flocculation of *Sediment Basins*.

[13] **REQUIREMENTS:**
A preliminary ESCP must be submitted to the local government for approval during the planning phase for any development that obtains a total point score of 17 or greater or when any trigger value is scored or exceeded.

Erosion Hazard Assessment Form – Dajarra Road to Cannington Road

Condition	Points	Score	Trigger value
AVERAGE SLOPE OF DISTURBANCE AREA [1]			
• not more than 3% [3% . 33H:1V]	0		
• more than 3% but not more than 5% [5% = 20H:1V]	1	**0**	**4**
• more than 5% but not more than 10% [10% = 10H:1V]	2		
• more than 10% but not more than 15% [15% . 6.7H:1V]	4		
• more than 15%	6		
SOIL CLASSIFICATION GROUP (AS1726) [2]			
• GW, GP, GM, GC	0		
• SW, SP, OL, OH	1	**-**	
• SM, SC, MH, CH	2		
• ML, CL, or if *imported fill* is used, or if soils are untested	3		
EMERSON (DISPERSION) CLASS NUMBER [3]			
• Class 4, 6, 7, or 8	0		
• Class 5	2	**4**	**6**
• Class 3, (default value if soils are untested)	4		
• Class 1 or 2	6		
DURATION OF SOIL DISTURBANCE [4]			
• not more than 1 month	0		
• more than 1 month but not more than 4 months	2	**6**	**6**
• more than 4 months but not more than 6 months	4		
• more than 6 months	6		
AREA OF DISTURBANCE [5]			
• not more than 1000 m^2	0		
• more than 1000 m^2 but not more than 5000 m^2	1	**6**	**4**
• more than 5000 m^2 but not more than 1 ha	2		
• more than 1 ha but not more than 4 ha	4		
• more than 4 ha	6		
WATERWAY DISTURBANCE [6]			
• No disturbance to a watercourse, open drain or channel	0	**2**	**2**
• Involves disturbance to a constructed open drain or channel	1		
• Involves disturbance to a natural watercourse	2		
REHABILITATION METHOD [7]			
Percentage of area (relative to total disturbance) revegetated by seeding without light mulching (i.e. worst-case revegetation method).			
• not more than 1%	0	**-**	
• more than 1% but not more than 5%	1		
• more than 5% but not more than 10%	2		
• more than 10%	4		
RECEIVING WATERS [8]			
• Saline waters only	0	**2**	
• Freshwater body (e.g. creek or freshwater lake or river)	2		
SUBSOIL EXPOSURE [9]			
• No subsoil exposure except of service trenches	0	**0**	
• Subsoils are likely to be exposed	2		
EXTERNAL CATCHMENTS [10]			
• No external catchment	0	**1**	
• External catchment diverted around the soil disturbance	1		
• External catchment not diverted around the soil disturbance	2		
ROAD CONSTRUCTION [11]			
• No road construction	0	**2**	
• Involves road construction works	2		
pH OF SOILS TO BE REVEGETATED [12]			
• more than pH 5.5 but less than pH 8	0	**1**	
• other pH values, or if soils are untested	1		
Total Score [13]		**24**	

Explanatory notes

Requirements: Specific issues or actions required by the proponent.

Warnings: Issues that should be considered by the proponent.

Comments: General information relating to the topic.

[1] **REQUIREMENTS:**
For sites with an average slope of proposed land disturbance greater than 10%, a preliminary ESCP must be submitted to the regulatory authority for approval during planning negotiations.

Proponents must demonstrate that adequate erosion and sediment control measures can be implemented on-site to effectively protect downstream environmental values.

If site or financial constraints suggest that it is not reasonable or practicable for the prescribed water quality objectives to be achieved for the proposal, then the proponent must demonstrate that alternative designs or construction techniques (e.g. pole homes, suspended slab) cannot reasonably be implemented on the site.

WARNINGS:
Steep sites usually require more stringent drainage and erosion controls than flatter grade sites.

COMMENTS:
The steeper the land, the greater the need for adequate drainage controls to prevent soil and mulch from being washed from the site.

[2] **REQUIREMENTS:**
If the actual soil K-factor is known from soil testing, then the Score shall be determined from Table 1.

If a preliminary ESCP is required during planning negotiations, then it must be demonstrated that adequate space is available for the construction and operation of any major sediment traps, including the provision for any sediment basins and their associated embankments and spillways. It must also be demonstrated that all reasonable and practicable measures can be taken to divert the maximum quantity of sediment-laden runoff (up to the specified design storm) to these sediment traps throughout the construction phase and until the contributing catchment is adequately stabilised against erosion.

WARNINGS:
The higher the point score, the greater the need to protect the soil from raindrop impact and thus the greater the need for effective erosion control measures. A point score of 2 or greater will require a greater emphasis to be placed on revegetation techniques that do not expose the soil to direct rainfall contact during vegetation establishment, e.g. turfing and *Hydromulching*.

COMMENTS:
Table 2 provides an *indication* of soil conditions likely to be associated with a particular Soil group based on a statistical analysis of soil testing across NSW. This table provides only an initial estimate of the likely soil conditions.

The left-hand-side of the table provides an indication of the type of sediment basin that will be required (Type C, F or D). The right-hand-side of the table provides an indication of the likely erodibility of the soil based on the Revised Universal Soil Loss Equation (RUSLE) K-factor.

Table 3 provides some general comments on the erosion potential of the various soil groups.

Table 1 – Score if soil K-factor is known

	RUSLE soil erodibility K-factor			
	K < 0.02	**0.02<K<0.04**	**0.04<K<0.06**	**K > 0.06**
Score	0	1	2	3

Table 2 – Statistical analysis of NSW soil data [1]

Unified Soil Class System	Likely sediment basin classification (%)			Probable soil erodibility K-factor (%) [2]			
	Dry	Wet		Low	Moderate	High	Very High
	Type C	Type F	Type D	K < 0.02	0.02<K<0.04	0.04<K<0.06	K > 0.06
GM	30	**58**	12	12	**51**	26	12
GC	**42**	33	25	13	**71**	17	0
SW	40	**48**	12	**49**	39	12	0
SP	**53**	32	15	**76**	18	5	1
SM	21	**67**	12	26	**48**	25	1
SC	26	**50**	24	16	**64**	18	2
ML	5	**63**	32	4	35	**45**	16
CL	9	**51**	39	12	**56**	19	13
OL	2	**80**	18	34	**61**	5	1
MH	12	41	**48**	15	19	**41**	25
CH	5	44	**51**	39	**43**	11	7

Notes: [1] Analysis of soil data presented in Landcom (2004).
[2] Soil erodibility based on Revised Universal Soil Loss Equation (RUSLE) K-factor.

Unified Soil Classification System (USCS)

GW Well graded gravels, gravel-sand mixtures, little or no fines
GP Poorly graded gravels, gravel-sand mixture, little or no fines
GM Silty gravels, poorly graded gravel-sand-silt mixtures
GC Clayey gravels, poorly graded gravel-sand-clay mixtures
SW Well graded sands, gravelly sands, little or no fines
SP Poorly graded sands, gravelly sands, little or no fines
SM Silty sands, poorly graded sand-silt mixtures
SC Clayey sands, poorly graded sand-clay mixtures
ML Inorganic silts & very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL Inorganic clays, low–medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL Organic silts and organic silt-clays of low plasticity
MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH Inorganic clays of high plasticity, fat clays
OH Organic clays of medium to high plasticity

Table 3 – Typical properties of various soil groups [1]

Soil Groups	Typical properties [2]
GW, GP	• Low erodibility potential.
GM, GC	• Low to medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
SW, SP	• Low to medium erodibility potential.
SM, SC	• Medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
MH, CH	• Highly variable (low to high) erodibility potential. • Will generally create turbid runoff if disturbed.
ML, CL	• High erodibility potential. • Tendency to be dispersive. • May create some turbidity in runoff if disturbed.

Note: [1] After Soil Services & NSW DLWC (1998).
[2] Any soil can represent a high erosion risk if the binding clays or silts are unstable.

Table 4 provides **general** guidelines on the suitability of various soil groups to various engineering applications.

Table 4 – Engineering suitability based on Unified Soil Classification [1]

Unified Soil Class	USC Group	Embankments		Fill	Slope stability	Untreated roads
		Water retaining	Non water retaining			
Well graded gravels	GW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded gravel	GP	Unsuitable	Average	Excellent	Average	Unsuitable
Silty gravels	GM	Unsuitable	Average	Good	Average	Average
Clayey gravels	GC	Suitable	Average	Good	Average	Excellent
Well graded sands	SW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded sands	SP	Unsuitable	Average	Good	Average	Unsuitable
Silty sands	SM	Suitable [2]	Average	Average	Average	Poor
Clayey sands	SC	Suitable	Average	Average	Average	Good
Inorganic silts	ML	Unsuitable	Poor	Average	Poor	Unsuitable
Inorganic clays	CL	Suitable [2]	Good	Average	Good	Poor
Organic silts	OL	Unsuitable	Unsuitable	Poor	Unsuitable	Unsuitable
Inorganic silts	MH	Unsuitable	Poor	Poor	Poor	Unsuitable
Inorganic clays	CH	Suitable [2]	Average	Unsuitable	Average	Unsuitable
Organic clays	OH	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable
Highly organic soils	Pt	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable

Notes: [1] Modified from Hazelton & Murphy (1992)
[2] Suitable only after modifications to soil such as compaction and/or erosion protection

[3] If the soils have not been tested for Emerson Class, then adopt a score of 4.

REQUIREMENTS:
Works proposed on sites containing Emerson Class 1 or 2 soils have a very high pollution potential and must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

WARNINGS:
Class 3 and 5 soils disturbed by cut and fill operations or construction traffic are highly likely to discolour stormwater (i.e. cause turbid runoff). Chemical stabilisation will likely be required if these soils are placed immediately adjacent to a retaining wall. Any disturbed Class 1, 2, 3 and 5 soils that are to be revegetated must be covered with a non-dispersive topsoil as soon as possible (unless otherwise agreed by the regulatory authority).

Class 1 and 2 soils are highly likely to discolour (pollute) stormwater if exposed to rainfall or flowing water. Treatment of these soils with gypsum (or other suitable substance) will most likely be required. These soils should not be placed directly behind a retaining wall unless it has been adequately treated (stabilised) or covered with a non-dispersible soil.

[4] The duration of disturbance refers to the total duration of soil exposure to rainfall up until a time when there is at least 70% coverage of all areas of soil.

REQUIREMENTS:
All land developments with an expected soil disturbance period greater than 6 months must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

COMMENTS:
Construction periods greater than 3 months will generally experience at least some significant storm events, independent of the time of year that the construction (soil disturbance) occurs.

[5] **REQUIREMENTS:**
Development proposals with an expected soil disturbance in excess of 1ha must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

The area of disturbance refers to the total area of soil exposed to rainfall or dust-producing winds either as a result of:

(a) the removal of ground cover vegetation, mulch or sealed surfaces;
(b) past land management practices;
(c) natural conditions.

WARNINGS:
A *Sediment Basin* will usually be required if the disturbed area exceeds 0.25ha (2500m^2) within any sub-catchment (i.e. land flowing to one outlet point).

COMMENTS:
For soil disturbances greater than 0.25ha, the revegetation phase should be staged to minimise the duration for which soils are exposed to wind, rain and concentrated runoff.

[6] **REQUIREMENTS:**
All developments that involve earthworks or construction within a natural watercourse (whether that watercourse is in a natural or modified condition) must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

Permits and/or licences may be required from the State Government, including possible submission of the ESCP to the relevant Government department.

[7] **REQUIREMENTS:**
No areas of soil disturbance shall be left exposed to rainfall or dust-producing winds at the end of a development without an adequate degree of protection and/or an appropriate action plan for the establishment of at least 70% cover.

COMMENTS:
Grass seeding without the application of a light mulch cover is considered the least favourable revegetation technique. A light mulch cover is required to protect the soil from raindrop impact, excessive temperature fluctuations, and the loss of essential soil moisture.

[8] **COMMENTS:**
All receiving waters can be adversely affected by unnatural quantities of sediment-laden runoff. Freshwater ecosystems are generally more susceptible to ecological harm resulting from the inflow of fine or dispersible clays than saline water bodies. The further inland a land disturbance is, the greater the potential for the released sediment to cause environmental harm as this sediment travels towards the coast.

For the purpose of this clause it is assumed that all sediment-laden runoff will eventually flow into saline waters. Thus, sediment-laden discharges that flow first into freshwater are likely to adversely affect both fresh and saline water bodies and are therefore considered potentially more damaging to the environment.

This clause does **not** imply that sediment-laden runoff will not cause harm to saline waters.

[9] **COMMENTS:**
This clause refers to subsoils exposed during the construction phase either as a result of past land practices or proposed construction activities. The exposure of subsoils resulting from the excavation of minor service trenches should not be considered.

[10] **WARNINGS:**
The greater the extent of external catchment, the greater the need to divert up-slope stormwater runoff around any soil disturbance.

COMMENTS:
The ability to separate “clean” (i.e. external catchment) stormwater runoff from “dirty” site runoff can have a significant effect on the size, efficiency and cost of the temporary drainage, erosion, and sediment control measures.

[11] **REQUIREMENTS:**
Permission must be obtained from the owner of a road reserve before placing any erosion and sediment control measures within the road reserve.

WARNINGS:
Few sediment control techniques work efficiently when placed on a road and/or around roadside stormwater inlets. Great care must be taken if sediment control measures are located on a public roadway, specifically:

- safety issues relating to road users;
- the risk of causing flooding on the road or within private property.

The construction of roads (whether temporary or permanent) will usually modify the flow path of stormwater runoff. This can affect how "dirty" site runoff is directed to the sediment control measures.

COMMENTS:
"On-road" sediment control devices are at best viewed as secondary or supplementary sediment control measures. Only in special cases and/or on very small projects (e.g. kerb and channel replacement) might these controls be considered as the "primary" sediment control measure.

[12] **WARNINGS:**
Soils with a pH less than 5.5 or greater than 8 will usually require treatment in order to achieve satisfactory revegetation. Soils with a pH of less than 5 (whether naturally acidic or in acid sulfate soil areas) may also limit the choice of chemical flocculants (e.g. Alum) for use in the flocculation of *Sediment Basins*.

[13] **REQUIREMENTS:**
A preliminary ESCP must be submitted to the local government for approval during the planning phase for any development that obtains a total point score of 17 or greater or when any trigger value is scored or exceeded.

Erosion Hazard Assessment Form – Phosphate Hill

Condition	Points	Score	Trigger value
AVERAGE SLOPE OF DISTURBANCE AREA [1]			
• not more than 3% [3% . 33H:1V]	0		
• more than 3% but not more than 5% [5% = 20H:1V]	1	**0**	**4**
• more than 5% but not more than 10% [10% = 10H:1V]	2		
• more than 10% but not more than 15% [15% . 6.7H:1V]	4		
• more than 15%	6		
SOIL CLASSIFICATION GROUP (AS1726) [2]			
• GW, GP, GM, GC	0		
• SW, SP, OL, OH	1	**-**	
• SM, SC, MH, CH	2		
• ML, CL, or if *imported fill* is used, or if soils are untested	3		
EMERSON (DISPERSION) CLASS NUMBER [3]			
• Class 4, 6, 7, or 8	0		
• Class 5	2	**4**	**6**
• Class 3, (default value if soils are untested)	4		
• Class 1 or 2	6		
DURATION OF SOIL DISTURBANCE [4]			
• not more than 1 month	0		
• more than 1 month but not more than 4 months	2	**6**	**6**
• more than 4 months but not more than 6 months	4		
• more than 6 months	6		
AREA OF DISTURBANCE [5]			
• not more than 1000 m^2	0		
• more than 1000 m^2 but not more than 5000 m^2	1	**6**	**4**
• more than 5000 m^2 but not more than 1 ha	2		
• more than 1 ha but not more than 4 ha	4		
• more than 4 ha	6		
WATERWAY DISTURBANCE [6]			
• No disturbance to a watercourse, open drain or channel	0	**2**	**2**
• Involves disturbance to a constructed open drain or channel	1		
• Involves disturbance to a natural watercourse	2		
REHABILITATION METHOD [7]			
Percentage of area (relative to total disturbance) revegetated by seeding without light mulching (i.e. worst-case revegetation method).			
• not more than 1%	0	**-**	
• more than 1% but not more than 5%	1		
• more than 5% but not more than 10%	2		
• more than 10%	4		
RECEIVING WATERS [8]			
• Saline waters only	0	**2**	
• Freshwater body (e.g. creek or freshwater lake or river)	2		
SUBSOIL EXPOSURE [9]			
• No subsoil exposure except of service trenches	0	**0**	
• Subsoils are likely to be exposed	2		
EXTERNAL CATCHMENTS [10]			
• No external catchment	0	**1**	
• External catchment diverted around the soil disturbance	1		
• External catchment not diverted around the soil disturbance	2		
ROAD CONSTRUCTION [11]			
• No road construction	0	**2**	
• Involves road construction works	2		
pH OF SOILS TO BE REVEGETATED [12]			
• more than pH 5.5 but less than pH 8	0	**1**	
• other pH values, or if soils are untested	1		
Total Score [13]		**24**	

Explanatory notes

Requirements: Specific issues or actions required by the proponent.

Warnings: Issues that should be considered by the proponent.

Comments: General information relating to the topic.

[1] **REQUIREMENTS:**
For sites with an average slope of proposed land disturbance greater than 10%, a preliminary ESCP must be submitted to the regulatory authority for approval during planning negotiations.

Proponents must demonstrate that adequate erosion and sediment control measures can be implemented on-site to effectively protect downstream environmental values.

If site or financial constraints suggest that it is not reasonable or practicable for the prescribed water quality objectives to be achieved for the proposal, then the proponent must demonstrate that alternative designs or construction techniques (e.g. pole homes, suspended slab) cannot reasonably be implemented on the site.

WARNINGS:
Steep sites usually require more stringent drainage and erosion controls than flatter grade sites.

COMMENTS:
The steeper the land, the greater the need for adequate drainage controls to prevent soil and mulch from being washed from the site.

[2] **REQUIREMENTS:**
If the actual soil K-factor is known from soil testing, then the Score shall be determined from Table 1.

If a preliminary ESCP is required during planning negotiations, then it must be demonstrated that adequate space is available for the construction and operation of any major sediment traps, including the provision for any sediment basins and their associated embankments and spillways. It must also be demonstrated that all reasonable and practicable measures can be taken to divert the maximum quantity of sediment-laden runoff (up to the specified design storm) to these sediment traps throughout the construction phase and until the contributing catchment is adequately stabilised against erosion.

WARNINGS:
The higher the point score, the greater the need to protect the soil from raindrop impact and thus the greater the need for effective erosion control measures. A point score of 2 or greater will require a greater emphasis to be placed on revegetation techniques that do not expose the soil to direct rainfall contact during vegetation establishment, e.g. turfing and *Hydromulching*.

COMMENTS:
Table 2 provides an *indication* of soil conditions likely to be associated with a particular Soil group based on a statistical analysis of soil testing across NSW. This table provides only an initial estimate of the likely soil conditions.

The left-hand-side of the table provides an indication of the type of sediment basin that will be required (Type C, F or D). The right-hand-side of the table provides an indication of the likely erodibility of the soil based on the Revised Universal Soil Loss Equation (RUSLE) K-factor.

Table 3 provides some general comments on the erosion potential of the various soil groups.

Table 1 – Score if soil K-factor is known

	RUSLE soil erodibility K-factor			
	K < 0.02	**0.02<K<0.04**	**0.04<K<0.06**	**K > 0.06**
Score	0	1	2	3

Table 2 – Statistical analysis of NSW soil data [1]

Unified Soil Class System	Likely sediment basin classification (%)			Probable soil erodibility K-factor (%) [2]			
	Dry	Wet		Low	Moderate	High	Very High
	Type C	Type F	Type D	K < 0.02	0.02<K<0.04	0.04<K<0.06	K > 0.06
GM	30	**58**	12	12	**51**	26	12
GC	**42**	33	25	13	**71**	17	0
SW	40	**48**	12	**49**	39	12	0
SP	**53**	32	15	**76**	18	5	1
SM	21	**67**	12	26	**48**	25	1
SC	26	**50**	24	16	**64**	18	2
ML	5	**63**	32	4	35	**45**	16
CL	9	**51**	39	12	**56**	19	13
OL	2	**80**	18	34	**61**	5	1
MH	12	41	**48**	15	19	**41**	25
CH	5	44	**51**	39	**43**	11	7

Notes: [1] Analysis of soil data presented in Landcom (2004).
[2] Soil erodibility based on Revised Universal Soil Loss Equation (RUSLE) K-factor.

Unified Soil Classification System (USCS)

GW Well graded gravels, gravel-sand mixtures, little or no fines
GP Poorly graded gravels, gravel-sand mixture, little or no fines
GM Silty gravels, poorly graded gravel-sand-silt mixtures
GC Clayey gravels, poorly graded gravel-sand-clay mixtures
SW Well graded sands, gravelly sands, little or no fines
SP Poorly graded sands, gravelly sands, little or no fines
SM Silty sands, poorly graded sand-silt mixtures
SC Clayey sands, poorly graded sand-clay mixtures
ML Inorganic silts & very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL Inorganic clays, low–medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL Organic silts and organic silt-clays of low plasticity
MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH Inorganic clays of high plasticity, fat clays
OH Organic clays of medium to high plasticity

Table 3 – Typical properties of various soil groups [1]

Soil Groups	Typical properties [2]
GW, GP	• Low erodibility potential.
GM, GC	• Low to medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
SW, SP	• Low to medium erodibility potential.
SM, SC	• Medium erodibility potential. • May create turbid runoff if disturbed as a result of the release of silt and clay particles.
MH, CH	• Highly variable (low to high) erodibility potential. • Will generally create turbid runoff if disturbed.
ML, CL	• High erodibility potential. • Tendency to be dispersive. • May create some turbidity in runoff if disturbed.

Note: [1] After Soil Services & NSW DLWC (1998).
[2] Any soil can represent a high erosion risk if the binding clays or silts are unstable.

Table 4 provides **general** guidelines on the suitability of various soil groups to various engineering applications.

Table 4 – Engineering suitability based on Unified Soil Classification [1]

Unified Soil Class	USC Group	Embankments		Fill	Slope stability	Untreated roads
		Water retaining	Non water retaining			
Well graded gravels	GW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded gravel	GP	Unsuitable	Average	Excellent	Average	Unsuitable
Silty gravels	GM	Unsuitable	Average	Good	Average	Average
Clayey gravels	GC	Suitable	Average	Good	Average	Excellent
Well graded sands	SW	Unsuitable	Excellent	Excellent	Excellent	Average
Poorly graded sands	SP	Unsuitable	Average	Good	Average	Unsuitable
Silty sands	SM	Suitable [2]	Average	Average	Average	Poor
Clayey sands	SC	Suitable	Average	Average	Average	Good
Inorganic silts	ML	Unsuitable	Poor	Average	Poor	Unsuitable
Inorganic clays	CL	Suitable [2]	Good	Average	Good	Poor
Organic silts	OL	Unsuitable	Unsuitable	Poor	Unsuitable	Unsuitable
Inorganic silts	MH	Unsuitable	Poor	Poor	Poor	Unsuitable
Inorganic clays	CH	Suitable [2]	Average	Unsuitable	Average	Unsuitable
Organic clays	OH	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable
Highly organic soils	Pt	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable

Notes: [1] Modified from Hazelton & Murphy (1992)
[2] Suitable only after modifications to soil such as compaction and/or erosion protection

[3] If the soils have not been tested for Emerson Class, then adopt a score of 4.

REQUIREMENTS:
Works proposed on sites containing Emerson Class 1 or 2 soils have a very high pollution potential and must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

WARNINGS:
Class 3 and 5 soils disturbed by cut and fill operations or construction traffic are highly likely to discolour stormwater (i.e. cause turbid runoff). Chemical stabilisation will likely be required if these soils are placed immediately adjacent to a retaining wall. Any disturbed Class 1, 2, 3 and 5 soils that are to be revegetated must be covered with a non-dispersive topsoil as soon as possible (unless otherwise agreed by the regulatory authority).

Class 1 and 2 soils are highly likely to discolour (pollute) stormwater if exposed to rainfall or flowing water. Treatment of these soils with gypsum (or other suitable substance) will most likely be required. These soils should not be placed directly behind a retaining wall unless it has been adequately treated (stabilised) or covered with a non-dispersible soil.

[4] The duration of disturbance refers to the total duration of soil exposure to rainfall up until a time when there is at least 70% coverage of all areas of soil.

REQUIREMENTS:
All land developments with an expected soil disturbance period greater than 6 months must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

COMMENTS:
Construction periods greater than 3 months will generally experience at least some significant storm events, independent of the time of year that the construction (soil disturbance) occurs.

[5] **REQUIREMENTS:**
Development proposals with an expected soil disturbance in excess of 1ha must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

The area of disturbance refers to the total area of soil exposed to rainfall or dust-producing winds either as a result of:

(a) the removal of ground cover vegetation, mulch or sealed surfaces;
(b) past land management practices;
(c) natural conditions.

WARNINGS:
A *Sediment Basin* will usually be required if the disturbed area exceeds 0.25ha (2500m^2) within any sub-catchment (i.e. land flowing to one outlet point).

COMMENTS:
For soil disturbances greater than 0.25ha, the revegetation phase should be staged to minimise the duration for which soils are exposed to wind, rain and concentrated runoff.

[6] **REQUIREMENTS:**
All developments that involve earthworks or construction within a natural watercourse (whether that watercourse is in a natural or modified condition) must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

Permits and/or licences may be required from the State Government, including possible submission of the ESCP to the relevant Government department.

[7] **REQUIREMENTS:**
No areas of soil disturbance shall be left exposed to rainfall or dust-producing winds at the end of a development without an adequate degree of protection and/or an appropriate action plan for the establishment of at least 70% cover.

COMMENTS:
Grass seeding without the application of a light mulch cover is considered the least favourable revegetation technique. A light mulch cover is required to protect the soil from raindrop impact, excessive temperature fluctuations, and the loss of essential soil moisture.

[8] **COMMENTS:**
All receiving waters can be adversely affected by unnatural quantities of sediment-laden runoff. Freshwater ecosystems are generally more susceptible to ecological harm resulting from the inflow of fine or dispersible clays than saline water bodies. The further inland a land disturbance is, the greater the potential for the released sediment to cause environmental harm as this sediment travels towards the coast.

For the purpose of this clause it is assumed that all sediment-laden runoff will eventually flow into saline waters. Thus, sediment-laden discharges that flow first into freshwater are likely to adversely affect both fresh and saline water bodies and are therefore considered potentially more damaging to the environment.

This clause does **not** imply that sediment-laden runoff will not cause harm to saline waters.

[9] **COMMENTS:**
This clause refers to subsoils exposed during the construction phase either as a result of past land practices or proposed construction activities. The exposure of subsoils resulting from the excavation of minor service trenches should not be considered.

[10] **WARNINGS:**
The greater the extent of external catchment, the greater the need to divert up-slope stormwater runoff around any soil disturbance.

COMMENTS:
The ability to separate “clean” (i.e. external catchment) stormwater runoff from “dirty” site runoff can have a significant effect on the size, efficiency and cost of the temporary drainage, erosion, and sediment control measures.

[11] **REQUIREMENTS:**
Permission must be obtained from the owner of a road reserve before placing any erosion and sediment control measures within the road reserve.

WARNINGS:
Few sediment control techniques work efficiently when placed on a road and/or around roadside stormwater inlets. Great care must be taken if sediment control measures are located on a public roadway, specifically:

- safety issues relating to road users;
- the risk of causing flooding on the road or within private property.

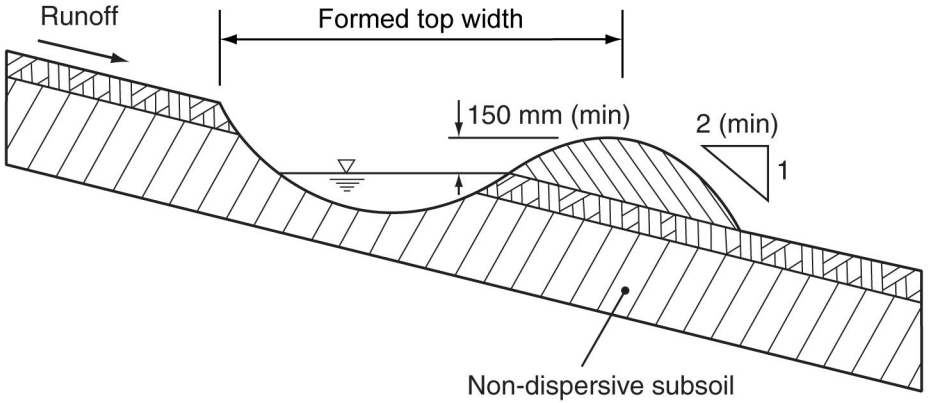
The construction of roads (whether temporary or permanent) will usually modify the flow path of stormwater runoff. This can affect how "dirty" site runoff is directed to the sediment control measures.

COMMENTS:
"On-road" sediment control devices are at best viewed as secondary or supplementary sediment control measures. Only in special cases and/or on very small projects (e.g. kerb and channel replacement) might these controls be considered as the "primary" sediment control measure.

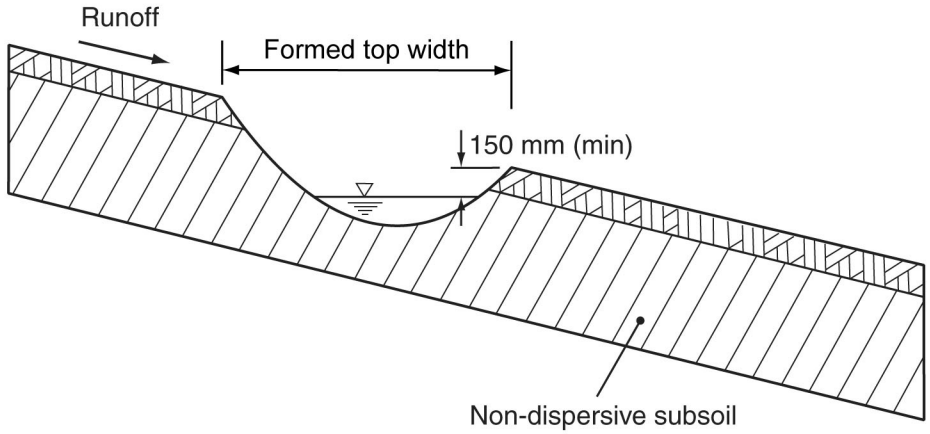
[12] **WARNINGS:**
Soils with a pH less than 5.5 or greater than 8 will usually require treatment in order to achieve satisfactory revegetation. Soils with a pH of less than 5 (whether naturally acidic or in acid sulfate soil areas) may also limit the choice of chemical flocculants (e.g. Alum) for use in the flocculation of *Sediment Basins*.

[13] **REQUIREMENTS:**
A preliminary ESCP must be submitted to the local government for approval during the planning phase for any development that obtains a total point score of 17 or greater or when any trigger value is scored or exceeded.

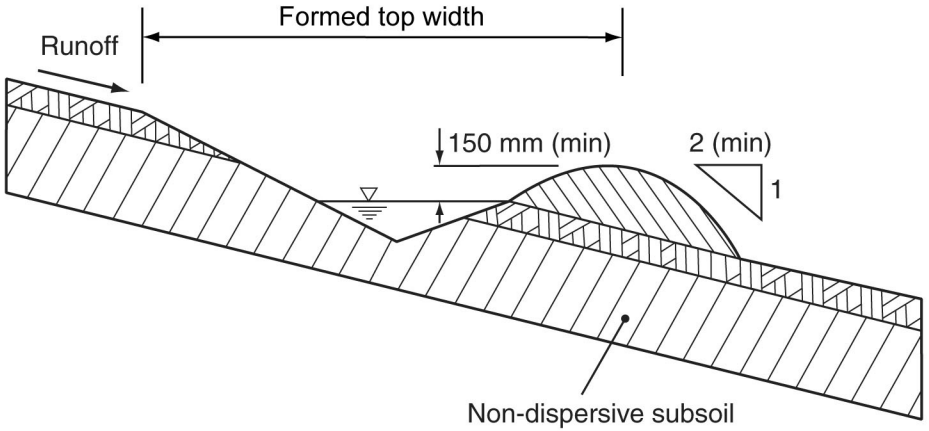
Appendix B – Standard drawings



(a) Parabolic catch drain with down-slope bank



(c) Parabolic catch drain without bank



(b) Triangular V-drain with down-slope bank

Constructed dimensions of parabolic catch drains		
Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-A	1.6 m	0.30 m
Type-B	2.4 m	0.45 m
Type-C	3.6 m	0.65 m

Constructed dimensions of triangular V-drains		
Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-AV	2.0 m	0.30 m
Type-BV	2.7 m	0.45 m
Type-CV	3.9 m	0.65 m

NOT TO SCALE

Drawn:	Date:		
GMW	Dec-09	Catch Drains	CD-01

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INSTALLATION (EARTH-LINED)

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION FOR THE CATCH DRAIN, CLEARING ONLY WHAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND EQUIPMENT FOR INSTALLATION.

3. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD THE BANK.

4. GRADE THE DRAIN TO THE SPECIFIED SLOPE AND FORM THE ASSOCIATED EMBANKMENT WITH COMPACTED FILL. NOTE THAT THE DRAIN INVERT MUST FALL 10cm EVERY 10m FOR EACH 1% OF REQUIRED CHANNEL GRADIENT.

5. ENSURE THE SIDES OF THE CUT DRAIN ARE NO STEEPER THAN A 1.5:1 (H:V) SLOPE AND THE EMBANKMENT FILL SLOPES NO STEEPER THAN 2:1.

6. ENSURE THE COMPLETED DRAIN HAS SUFFICIENT DEEP (AS SPECIFIED FOR THE TYPE OF DRAIN) MEASURED FROM THE DRAIN INVERT TO THE TOP OF THE EMBANKMENT.

7. ENSURE THE DRAIN HAS A CONSTANT FALL IN THE DESIRED DIRECTION FREE OF OBSTRUCTIONS.

8. ENSURE THE DRAIN DISCHARGES TO A STABLE OUTLET SUCH THAT SOIL EROSION WILL BE PREVENTED FROM OCCURRING. SPECIFICALLY, ENSURE THE DRAIN DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

MAINTENANCE

1. INSPECT ALL CATCH DRAINS AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING STORM EVENTS AND REPAIR ANY SLUMPS, BANK DAMAGE, OR LOSS OF FREEBOARD.

2. ENSURE FILL MATERIAL OR SEDIMENT IS NOT PARTIALLY BLOCKING THE DRAIN. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

3. DISPOSE OF ANY SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN THE SOIL DISTURBANCE ABOVE THE CATCH DRAIN IS FINISHED AND THE AREA IS STABILISED, THE TEMPORARY DRAIN AND ANY ASSOCIATED BANKS SHOULD BE REMOVED, UNLESS IT IS TO REMAIN AS A PERMANENT DRAINAGE FEATURE.

2. DISPOSE OF ANY SEDIMENT OR EARTH IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

4. STABILISE THE AREA BY GRASSING OR AS SPECIFIED WITHIN THE APPROVED SITE REHABILITATION PLAN.

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Drawn:	Date:		
GMW	Dec-09	Catch Drains - Earth Lined	CD-02

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. ENSURE ALL NECESSARY SOIL TESTING (e.g. SOIL pH, NUTRIENT LEVELS) AND ANALYSIS HAS BEEN COMPLETED, AND REQUIRED SOIL ADJUSTMENTS PERFORMED PRIOR TO PLANTING.

3. CLEAR THE LOCATION FOR THE CATCH DRAIN, CLEARING ONLY WHAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND EQUIPMENT FOR INSTALLATION.

4. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD THE BANK.

5. GRADE THE DRAIN TO THE SPECIFIED SLOPE AND FORM THE ASSOCIATED EMBANKMENT WITH COMPACTED FILL. NOTE THAT THE DRAIN INVERT MUST FALL 10cm EVERY 10m FOR EACH 1% OF CHANNEL GRADIENT.

6. ENSURE THE SIDES OF THE CUT DRAIN ARE NO STEEPER THAN A 1.5:1 (H:V) SLOPE AND THE EMBANKMENT FILL SLOPES NO STEEPER THAN 2:1.

7. ENSURE THE COMPLETED DRAIN HAS SUFFICIENT DEEP (AS SPECIFIED FOR THE TYPE OF DRAIN) MEASURED FROM THE DRAIN INVERT TO THE TOP OF THE EMBANKMENT. WHERE NECESSARY, CUT THE DRAIN SLIGHTLY DEEPER THAN THAT SPECIFIED ON THE PLANS SUCH THAT THE CORRECT CHANNEL DIMENSIONS ARE ACHIEVED FOLLOWING PLACEMENT OF THE TURF.

8. ENSURE THE DRAIN HAS A CONSTANT FALL IN THE DESIRED DIRECTION FREE OF OBSTRUCTIONS.

9. TURF SHOULD BE USED WITHIN 12-HOURS OF DELIVERY, OTHERWISE ENSURE THE TURF IS STORED IN CONDITIONS APPROPRIATE FOR THE WEATHER CONDITIONS (e.g. A SHADED AREA).

10. MOISTENING THE TURF AFTER IT IS UNROLLED WILL HELP MAINTAIN ITS VIABILITY.

11. TURF SHOULD BE LAID ON A MINIMUM 75mm BED OF ADEQUATELY FERTILISED TOPSOIL. RAKE THE SOIL SURFACE TO BREAK THE CRUST JUST BEFORE LAYING THE TURF.

12. DURING THE WARMER MONTHS, LIGHTLY IRRIGATE THE SOIL IMMEDIATELY BEFORE LAYING THE TURF.

13. ENSURE THE TURF IS NOT LAID ON GRAVEL, HEAVILY COMPACTED SOILS, OR SOILS THAT HAVE BEEN RECENTLY TREATED WITH HERBICIDES.

14. FOR WIDE DRAINS AND HIGH VELOCITY CHUTES, LAY THE FIRST ROW OF TURF IN A STRAIGHT LINE DIAGONAL TO THE DIRECTION OF FLOW. STAGGER SUBSEQUENT ROWS IN A BRICK-LIKE (STRETCHER BOND) PATTERN. THE TURF SHOULD NOT BE STRETCHED OR OVERLAPPED. USE A KNIFE OR SHARP SPADE TO TRIM AND FIT IRREGULARLY SHAPED AREAS.

15. FOR NARROW DRAINS, LAY THE TURF ALONG THE DIRECTION OF THE DRAIN, ENSURING, WHEREVER PRACTICABLE, THAT A LONGITUDINAL JOINT BETWEEN TWO STRIPS OF TURF IS NOT POSITIONED ALONG THE INVERT OF THE DRAIN.

16. ENSURE THE TURF EXTENDS UP THE SIDES OF THE DRAIN AT LEAST 100mm ABOVE THE ELEVATION OF THE CHANNEL INVERT, OR AT LEAST TO A SUFFICIENT ELEVATION TO FULLY CONTAIN EXPECTED CHANNEL FLOW.

17. ON CHANNEL GRADIENTS OF 3:1(H:V) OR STEEPER, OR IN SITUATIONS WHERE HIGH FLOW VELOCITIES (i.e. VELOCITY >1.5m/s) ARE LIKELY WITHIN THE FIRST 2-WEEKS FOLLOWING PLACEMENT, SECURE THE INDIVIDUAL TURF STRIPS WITH WOODEN OR PLASTIC PEGS.

18. ENSURE THAT INTIMATE CONTACT IS ACHIEVED AND MAINTAINED BETWEEN THE TURF AND THE SOIL SUCH THAT SEEPAGE FLOW BENEATH THE TURF IS AVOIDED.

19. WATER UNTIL THE SOIL IS WET 100mm BELOW THE TURF. THEREAFTER, WATERING SHOULD BE SUFFICIENT TO MAINTAIN AND PROMOTE HEALTHY GROWTH.

20. ENSURE THE DRAIN DISCHARGES TO A STABLE OUTLET SUCH THAT DOWN-SLOPE SOIL EROSION WILL BE PREVENTED FROM OCCURRING. ENSURE THE DRAIN DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

MAINTENANCE

1. INSPECT ALL CATCH DRAINS AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING STORM EVENTS AND REPAIR ANY SLUMPS, BANK DAMAGE, OR LOSS OF FREEBOARD.

2. ENSURE FILL MATERIAL OR SEDIMENT IS NOT PARTIALLY BLOCKING THE DRAIN. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

3. DISPOSE OF ANY SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN THE SOIL DISTURBANCE ABOVE THE CATCH DRAIN IS FINISHED AND THE AREA IS STABILISED, THE DRAIN AND ANY ASSOCIATED BANKS SHOULD BE REMOVED, UNLESS IT IS TO REMAIN AS A PERMANENT DRAINAGE FEATURE.

2. DISPOSE OF ANY SEDIMENT OR EARTH IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

4. STABILISE THE AREA BY GRASSING OR AS SPECIFIED WITHIN THE APPROVED PLAN.

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Dec-09	Catch Drains - Grass Lined	CD-03

INSTALLATION (DRAIN FORMATION)

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION FOR THE CATCH DRAIN, CLEARING ONLY WHAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND EQUIPMENT FOR INSTALLATION.

3. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD THE BANK.

4. GRADE THE DRAIN TO THE SPECIFIED SLOPE AND FORM THE ASSOCIATED EMBANKMENT WITH COMPACTED FILL. NOTE THAT THE DRAIN INVERT MUST FALL 10cm EVERY 10m FOR EACH 1% OF CHANNEL GRADIENT.

5. ENSURE THE SIDES OF THE CUT DRAIN ARE NO STEEPER THAN A 1.5:1 (H:V) SLOPE AND THE EMBANKMENT FILL SLOPES NO STEEPER THAN 2:1.

6. ENSURE THE COMPLETED DRAIN HAS SUFFICIENT DEEP (AS SPECIFIED FOR THE TYPE OF DRAIN) MEASURED FROM THE DRAIN INVERT TO THE TOP OF THE EMBANKMENT.

7. ENSURE THE DRAIN HAS A CONSTANT FALL IN THE DESIRED DIRECTION FREE OF OBSTRUCTIONS.

8. ENSURE THE DRAIN DISCHARGES TO A STABLE OUTLET SUCH THAT SOIL EROSION WILL BE PREVENTED FROM OCCURRING. ENSURE THE DRAIN DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

INSTALLATION (MAT PLACEMENT)

THE METHOD OF MAT INSTALLATION VARIES WITH THE TYPE OF MAT. INSTALLATION PROCEDURES SHOULD BE PROVIDED BY THE MANUFACTURER OR DISTRIBUTOR OF THE PRODUCT. A TYPICAL INSTALLATION PROCEDURE IS DESCRIBED BELOW, BUT SHOULD BE CONFIRMED WITH THE PRODUCT MANUFACTURER OR DISTRIBUTOR.

1. EROSION CONTROL MATS MUST BE STORED AWAY FROM DIRECT SUNLIGHT OR COVERED WITH ULTRAVIOLET LIGHT PROTECTIVE SHEETING UNTIL THE SITE IS READY FOR THEIR INSTALLATION.

2. VEHICLES AND CONSTRUCTION EQUIPMENT MUST NOT BE PERMITTED TO MANOEUVRE OVER THE GEOTEXTILE UNLESS IT HAS BEEN COVERED WITH A LAYER OF SOIL OR GRAVEL AT LEAST 150mm THICK. FILL MATERIAL SHALL NOT BE MIXED OVER THE GEOTEXTILE.

3. IF THE CHANNEL IS TO BE GRASSED, PREPARE A SMOOTH SEED BED OF APPROXIMATELY 75mm OF TOPSOIL, SEED, FERTILISE, WATER AND RAKE TO REMOVE ANY REMAINING SURFACE IRREGULARITIES.

4. EXCAVATE A 300mm DEEP BY 150mm WIDE ANCHOR TRENCH ALONG THE FULL WIDTH OF THE UPSTREAM END OF THE AREA TO BE TREATED.

5. AT LEAST 300mm OF THE MAT MUST BE ANCHORED INTO THE TRENCH WITH THE ROLL OF MATTING RESTING ON THE GROUND UP-SLOPE OF THE TRENCH.

6. STAPLE THE FABRIC WITHIN THE TRENCH AT 200 TO 250mm SPACING USING 100mm WIDE BY 150mm PENETRATION LENGTH U-SHAPED, 8 TO 11 GAUGE WIRE STAPLES. NARROWER U-SECTIONS MAY EASILY TEAR THE MATTING WHEN PLACED UNDER STRESS.

7. WHEN ALL MATS HAVE BEEN ANCHORED WITHIN THE TRENCH ACROSS THE FULL WIDTH OF THE TREATED AREA, THEN THE TRENCH IS BACKFILLED AND COMPACTED. THE MATS ARE THEN UNROLLED DOWN THE SLOPE SUCH THAT EACH MAT COVERS AND PROTECTS THE BACKFILLED TRENCH.

8. WHEN SPREADING THE MATS, AVOID STRETCHING THE FABRIC. THE MATS SHOULD REMAIN IN GOOD CONTACT WITH THE SOIL.

9. IF THE CHANNEL CURVES, THEN SUITABLY FOLD (IN A DOWNSTREAM DIRECTION) AND STAPLE THE FABRIC TO MAINTAIN THE FABRIC PARALLEL TO THE DIRECTION OF CHANNEL FLOW.

10. STAPLE THE SURFACE OF THE MATTING AT 1m CENTRES. ON IRREGULAR GROUND, ADDITIONAL STAPLES WILL BE REQUIRED WHEREVER THE MAT DOES NOT INITIALLY CONTACT THE GROUND SURFACE.

11. AT THE END OF EACH LENGTH OF MAT, A NEW TRENCH IS FORMED AT LEAST 300mm UP-SLOPE OF THE END OF THE MAT SUCH THAT THE END OF THE MAT WILL BE ABLE TO FULLY COVER THE TRENCH. A NEW ROLL OF MATTING IS THEN ANCHORED WITHIN THIS TRENCH AS PER THE FIRST MAT. AFTER THIS NEW MAT HAS BEEN UNROLLED DOWN THE SLOPE, THE UP-SLOPE MAT CAN BE PINNED IN PLACE FULLY COVERING THE NEW TRENCH AND AT LEAST 300mm OF THE DOWN-SLOPE MAT. THE PROCESS IS CONTINUED DOWN THE SLOPE UNTIL THE DESIRED AREA IS FULLY COVERED.

12. IN HIGH-VELOCITY CHANNELS, INTERMEDIATE ANCHOR SLOTS ARE USUALLY REQUIRED AT 10M INTERVALS DOWN THE CHANNEL.

13. ANCHOR THE OUTER MOST EDGES (TOP AND UPPER MOST SIDES) OF THE TREATED AREA IN A 300mm DEEP TRENCH AND STAPLE AT 200 TO 250mm CENTRES.

14. IF THE CHANNEL WAS GRASS SEEDED PRIOR TO PLACEMENT OF THE MATS, THEN THE MATS SHOULD BE ROLLED WITH A SUITABLE ROLLER WEIGHING 60 TO 90kg/m, THEN WATERED.

15. THE INSTALLATION PROCEDURE MUST ENSURE THAT THE MAT ACHIEVES AND RETAINS GOOD CONTACT WITH THE SOIL.

16. DAMAGED MATTING MUST BE REPAIRED OR REPLACED.

ADDITIONAL INSTRUCTIONS FOR THE INSTALLATION OF JUTE MESH (NOT JUTE BLANKETS):

1. ENSURE THE JUTE MESH IS LAID ON A FIRM EARTH SURFACE THAT HAS BEEN TRIMMED, TOPSOILED, WATERED, SOWN WITH SEED AND FERTILISER.

2. THE JUTE MESH IS THEN EITHER TAMPED OR ROLLED FIRMLY ONTO THE PREPARED SURFACE, AVOIDING STRETCHING, WATERED TO ENCOURAGE THE PENETRATION OF THE BITUMEN EMULSION, AND FINALLY SPRAYED WITH A TOP LAYER OF BITUMEN AT 1 TO 3 LITRES PER SQUARE METRE.

3. THE RATE OF EMULSION APPLICATION SHOULD BE ADJUSTED SUCH THAT THE EMULSION JUST STARTS TO POND IN THE MESH SQUARES.

MAINTENANCE

1. INSPECT ALL CATCH DRAINS AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING STORM EVENTS AND REPAIR ANY SLUMPS, BANK DAMAGE, OR LOSS OF FREEBOARD.

2. ENSURE FILL MATERIAL OR SEDIMENT IS NOT PARTIALLY BLOCKING THE DRAIN. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

3. DISPOSE OF ANY SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN THE SOIL DISTURBANCE ABOVE THE CATCH DRAIN IS FINISHED AND THE AREA IS STABILISED, THE DRAIN AND ANY ASSOCIATED BANKS SHOULD BE REMOVED, UNLESS IT IS TO REMAIN AS A PERMANENT DRAINAGE FEATURE.

2. DISPOSE OF ANY SEDIMENT OR EARTH IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

4. STABILISE THE AREA BY GRASSING OR AS SPECIFIED WITHIN THE APPROVED PLAN.

Drawn:	Date:		
GMW	May-10	Catch Drains - Geotextile Lined	CD-04

Catchments & Creeks Pty Ltd

MATERIALS

ROCK:
(i) ALL ROCK MUST BE HARD, WEATHER RESISTANT, AND DURABLE AGAINST DISINTEGRATION UNDER CONDITIONS TO BE MET IN HANDLING, PLACEMENT AND OPERATION.

(ii) ALL ROCK MUST HAVE ITS GREATEST DIMENSION NOT GREATER THAN 3 TIMES ITS LEAST DIMENSIONS.

(iii) THE ROCK USED IN FORMATION OF THE DRAIN MUST BE EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE AND HAVE SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. DIRT, FINES, AND SMALLER ROCK MUST NOT EXCEED 5% BY WEIGHT.

(iv) THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE. SPECIFIC GRAVITY TO BE AT LEAST 2.5.

(v) THE COLOUR OF THE RIPRAP SHALL BE [INSERT] AND MUST BE APPROVED BY THE ENGINEER. ONCE APPROVED, THE COLOUR SHALL BE KEPT CONSISTENT THROUGH THE PROJECT.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM BIDIM A24 OR EQUIVALENT.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. PRIOR TO PLACEMENT, ALL ROCKS MUST BE VISUALLY CHECKED FOR SIZE, ELONGATION, CRACKS, DETERIORATION AND OTHER VISIBLE. THE DEGREE AND THOROUGHNESS OF SUCH CHECKING MUST BE APPROPRIATE FOR THE POTENTIAL CONSEQUENCES ASSOCIATED WITH FAILURE OF THE STRUCTURE OR PURPOSE FOR WHICH THE MATERIAL WILL BE USED.

3. CLEAR THE LOCATION FOR THE CATCH DRAIN, CLEARING ONLY WHAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND EQUIPMENT FOR INSTALLATION.

4. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD THE BANK.

5. REMOVE ALL SOFT, YIELDING MATERIAL; REPLACE WITH SUITABLE ON-SITE MATERIAL; COMPACT TO SMOOTH FIRM SURFACE.

6. EXCAVATE THE DRAIN TO THE LINES AND GRADES SHOWN ON THE APPROVED PLANS. OVER-CUT THE DRAIN TO A DEPTH EQUAL TO THE SPECIFIED DEPTH OF ROCK PLACEMENT SUCH THAT THE FINISHED TOP SURFACE WILL BE AT THE ELEVATION OF THE SURROUNDING LAND. PLACEMENT OF THE ROCK LINING MUST NOT REDUCE THE DRAIN'S TOP WIDTH AND DEPTH AS SPECIFIED WITHIN THE APPROVED PLANS.

7. GRADE THE DRAIN TO THE SPECIFIED SLOPE AND FORM THE ASSOCIATED EMBANKMENT WITH COMPACTED FILL. NOTE THAT THE DRAIN INVERT MUST FALL 10CM EVERY 10m FOR EACH 1% OF CHANNEL GRADIENT.

8. ENSURE THE SIDES OF THE CUT DRAIN ARE NO STEEPER THAN A 1.5:1 (H:V) SLOPE AND THE EMBANKMENT FILL SLOPES NO STEEPER THAN 2:1.

9. IF THE DRAIN IS CUT INTO A DISPERSIVE (SODIC) SOIL, THEN PRIOR TO PLACING FILTER CLOTH, THE EXPOSED DISPERSIVE SOIL MUST BE COVERED WITH A MINIMUM 200mm THICK LAYER OF NON-DISPERSIVE SOIL PRIOR TO PLACEMENT OF FILTER CLOTH OR ROCKS.

10. IF A FILTER CLOTH UNDERLAY IS SPECIFIED, PLACE THE FILTER FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN ONE SHEET OF FILTER CLOTH IS REQUIRED TO OVER THE AREA, OVERLAP THE EDGE OF EACH SHEET AT LEAST 300mm, AND SECURE ANCHOR PINS AT MINIMUM 1M SPACING ALONG THE OVERLAP.

11. ENSURE THE FILTER CLOTH IS PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION OF THE FABRIC AND THE ROCK. REPAIR ANY DAMAGE BY REMOVING THE ROCK AND PLACING WITH ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA OVERLAPPING THE EXISTING FABRIC A MINIMUM OF 300mm.

12. PLACEMENT OF ROCK SHOULD FOLLOW IMMEDIATELY AFTER PLACEMENT OF THE FILTER LAYER. PLACE ROCK SO THAT IT FORMS A DENSE, WELL-GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS.

13. PLACE ROCK LINING TO THE EXTENT AND DEPTH INDICATED WITHIN THE APPROVED PLANS.

14. ENSURE THE ROCK IS PLACED IN AN APPROPRIATE MANNER TO AVOID DISPLACING UNDERLYING MATERIALS OR PLACING UNDUE IMPACT FORCE ON THE BEDDING MATERIALS.

15. ENSURE THE ROCK IS PLACED WITH A MINIMUM THICKNESS OF 1.5 TIMES THE NOMINAL ROCK SIZE (D50).

16. ENSURE MATERIALS THAT ARE D50 AND LARGER ARE POSITIONED FLUSH WITH THE TOP SURFACE WITH FACES AND SHAPES MATCHED TO MINIMISE VOIDS.

17. ENSURE PROJECTIONS ABOVE OR DEPRESSIONS UNDER THE SPECIFIED TOP SURFACE ARE LESS THAN 20% OF THE ROCK LAYER THICKNESS. THE AVERAGE SURFACE PLANE OF THE FINISHED ROCK IS DEFINED AS THE PLANE WHERE 50% OF THE TOPS OF ROCKS WOULD CONTACT.

18. ENSURE THE COMPLETED DRAIN HAS SUFFICIENT DEEP (AS SPECIFIED FOR THE TYPE OF DRAIN) MEASURED FROM THE DRAIN INVERT (AVERAGE SURFACE PLANE ALONG CHANNEL INVERT) TO THE TOP OF THE EMBANKMENT. THE AVERAGE SURFACE PLANE OF THE FINISHED ROCK IS DEFINED AS THE PLANE WHERE 50% OF THE TOPS OF ROCKS WOULD CONTACT.

19. TO THE MAXIMUM DEGREE PRACTICABLE, THE MATERIAL BETWEEN LARGER ROCK MUST NOT BE LOOSE OR EASILY DISPLACED BY THE EXPECTED FLOW.

20. AFTER PLACEMENT OF THE ROCK LINING, ENSURE THE DRAIN HAS A CONSTANT FALL IN THE DESIRED DIRECTION FREE OF OBSTRUCTIONS.

21. ENSURE THE DRAIN DISCHARGES TO A STABLE OUTLET SUCH THAT SOIL EROSION WILL BE PREVENTED FROM OCCURRING. ENSURE THE DRAIN DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

MAINTENANCE

1. INSPECT ALL CATCH DRAINS AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING STORM EVENTS AND REPAIR ANY SLUMPS, BANK DAMAGE, OR LOSS OF FREEBOARD.

2. CLOSELY INSPECT THE OUTER EDGES OF THE ROCK PROTECTION. ENSURE WATER ENTRY INTO THE ROCK-LINED AREA IS NOT CAUSING EROSION ALONG THE EDGE OF THE ROCK PROTECTION.

3. CAREFULLY CHECK THE STABILITY OF THE ROCK LOOKING FOR INDICATIONS OF PIPING, SCOUR HOLES, OR BANK FAILURES.

4. REPLACE OR REPOSITION THE SURFACE ROCK SUCH THAT THE DRAIN FUNCTIONS AS REQUIRED AND THE DRAIN'S REQUIRED HYDRAULIC CAPACITY IS NOT REDUCED.

5. REPLACE ANY DISPLACED ROCK WITH ROCK OF A SIGNIFICANTLY (MINIMUM 110%) LARGER SIZE THAN THE DISPLACED ROCK.

6. ENSURE SEDIMENT IS NOT PARTIALLY BLOCKING THE DRAIN. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

7. DISPOSE OF ANY SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

Drawn:	Date:		
GMW	Dec-09	Catch Drains - Rock Lined	CD-05

Catchments & Creeks Pty Ltd

MATERIAL

CELLULAR CONFINEMENT MATRIX: HIGH-DENSITY POLYETHYLENE (HDPE) (STIFF CELL WALL).

TENDONS: STEEL CABLE, OR BRIGHT, HIGH-TENACITY, INDUSTRIAL- CONTINUOUS-FILAMENT POLYESTER YARN WOVEN INTO ROUND BRAIDED CORD.

ANCHORS: WOODEN STAKES, OR 500mm STEEL J-PINS. WOODEN TAKES USED ONLY AS A TEMPORARY ANCHOR DURING THE PLACEMENT OF THE INFILL MATERIAL.

INFILL: TOPSOIL, EARTH, AGGREGATE OR CONCRETE. MAXIMUM AGGREGATE SIZE NO GREATER THAN 75% OF THE SIDEWALL DEPTH OF THE CCS MATRIX.

INSTALLATION

THE FOLLOWING SPECIFICATION APPLIES TO THE SURFACE PLACEMENT OF A CELLULAR CONFINEMENT SYSTEM WITHIN A DRAINAGE CHANNEL, SPILLWAY OR CHUTE FOR TEMPORARY PURPOSES ONLY. FOR THE PLACEMENT OF PERMANENT INSTALLATION, OR EARTH REINFORCEMENT APPLICATIONS, REFER TO MANUFACTURER'S ADVICE.

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE TREATMENT AREA OF ANY DEBRIS THAT MAY INTERFERE WITH PLACEMENT OF THE CELLULAR CONFINEMENT SYSTEM (CCS), OR PREVENT GOOD CONTACT BETWEEN THE CCS MATRIX AND THE SUBGRADE.

3. ENSURE THE SURFACE IS FREE OF DEEP TRACK MARKS OF OTHER FEATURES THAT MAY RESULT IN STORMWATER OR GROUNDWATER PASSING IN A CONCENTRATED FORM UNDER THE CCS MATRIX.

4. SHAPE AND COMPACT THE SUBGRADE SURFACES TO THE SHAPE AND ELEVATION SHOWN ON THE CONSTRUCTION DRAWINGS. WHEN DETERMINING THE ELEVATION OF THE SUBGRADE, ENSURE ALLOWANCE IS MADE FOR THE THICKNESS OF THE CCS MATRIX SUCH THAT THE TOP OF THE MATRIX WILL BE FLUSH WITH, OR SLIGHTLY BELOW, THE ADJACENT TERRAIN.

5. WHERE NECESSARY, EXCAVATE THE SUBGRADE SUCH THAT WHEN PLACED, THE UPPER SURFACE OF THE CCS MATRIX WILL BE FLUSH WITH, OR SLIGHTLY LOWER, THAN THE ADJACENT TERRAIN.

6. REMOVE ANY UNSTABLE SUBGRADE, REPLACE WITH SUITABLE MATERIAL AND COMPACT TO ACHIEVE A STABLE SURFACE.

7. IF THE MATERIAL IS TO BE PLACED ON A SLOPE STEEPER THAN 10%, THEN EXCAVATE AN ANCHORING TRENCH ALONG THE TOP OF THE TREATMENT AREA 200mm DEEP AND 500mm WIDE.

8. WHERE PRACTICAL, ROUGHEN ANY EXCESSIVELY SMOOTH, COMPACTED SUBGRADE TO IMPROVE THE EVENTUAL BONDING BETWEEN THE SUBGRADE AND APPLIED CCS MATRIX.

9. IF SPECIFIED, INSTALL THE REQUIRED GEOTEXTILE UNDERLAY ON THE PREPARED SURFACE, ENSURING THAT REQUIRED OVERLAPS ARE MAINTAINED AND THAT THE UPPER EDGE OF THE GEOTEXTILE IS ANCHORED (PINNED) WITHIN THE FORMED ANCHORING TRENCH.

10. SPREAD OUT (EXPAND) INDIVIDUAL PANELS UNIFORMLY ACROSS THE TREATMENT AREA AS SPECIFIED BY THE MANUFACTURER. EXPAND AND STRETCH THE PANELS DOWN THE SLOPE INSTEAD OF ACROSS THE SLOPE.

11. ALONG THE TOP EDGE OF THE TREATMENT AREA, ANCHOR EVERY OTHER CELL INTO THE FORMED ANCHOR TRENCH USING STEEL U-SHAPED OR J-PINS.

12. ON SLOPES STEEPER THAN 10%, ANCHOR EVERY OTHER CELL USING STEEL J-PINS AT 2m INTERVALS DOWN THE SLOPE.

13. ON SLOPES NOT STEEPER THAN 10%, ANCHOR THE INDIVIDUAL PANELS ALONG ALL FOUR SIDES WITH WOODEN STAKES, OR STEEL J-PINS TO PREVENT MOVEMENT WHILE PLACING INFILL.

14. INTERLEAF OR OVERLAP THE EDGES OF ADJACENT PANELS ACCORDING TO WHICH SIDEWALL PROFILE ABUTS. IN ALL CASES, ENSURE THAT THE UPPER SURFACES OF ADJOINING PANEL SECTIONS ARE FLUSH AT THE JOINT AND THAT ADJOINING CELLS ARE FULLY ANCHORED (STAPLED).

15. FILL AND COMPACT (IF NECESSARY) THE ANCHORING TRENCH.

16. FILL THE HONEYCOMB PANELS MECHANICALLY OR MANUALLY. ENSURE EARTH FILL AND SMALL AGGREGATE (<75mm) IS PLACED FROM A DROP HEIGHT NOT EXCEEDING 1m, AND LARGE AGGREGATE (>75mm) FROM A DROP HEIGHT NOT EXCEEDING 0.15m.

17. PLACE THE FILL EVENLY AND SLIGHTLY OVERFILL SUCH THAT WHEN COMPACTED, THE FILL WILL BE LEVEL WITH THE UPPER SURFACE OF THE PANEL.

18. LIGHTLY TAMP OR ROLL TOPSOIL OR EARTH FILL, LEVEL AGGREGATE FILL WITH A PLATE TAMPER OR MECHANICAL (BACKHOE) BUCKET.

ADDITIONAL SPECIFICATION FOR ATTACHMENT OF TENDONS FOR ANCHORAGE:

1. FEED PRE-CUT LENGTHS OF TENDON MATERIAL THROUGH THE ALIGNED HOLES IN THE CELL WALLS OF THE MATRIX AT 800mm INTERVALS PRIOR TO EXPANDING INDIVIDUAL PANELS INTO POSITION.

2. TIE OFF THE ENDS OF THE TENDONS SO THAT THE KNOT CANNOT PASS THROUGH THE HOLE IN THE CELL WALLS. ENSURE THE KNOTS ARE TIED TO PROVIDE FULL TENDON STRENGTH AND WILL NOT SLIP WHEN TENSIONED.

3. ATTACH RESTRAINING CLIPS TO THE TENDONS AT REGULAR INTERVALS TO ACHIEVE THE NECESSARY LOAD TRANSFER.

4. ANCHOR THE TENDONS AND RESTRAINING CLIPS WITH 500mm STEEL J-PINS AT 1m INTERVALS. AT EACH INTERNAL ANCHOR LOCATION, FORM A LOOP IN THE TENDON, INSERT THE ANCHOR, AND DRIVE INTO THE SUBGRADE.

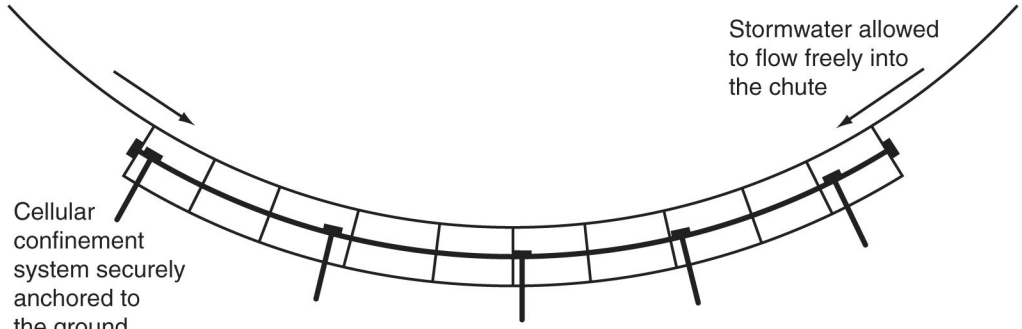

Figure 1 - Anchorage of cellular confinement matrix within channel

Drawn:	Date:		
GMW	May-10	Cellular Confinement System - used as chute/channel lining	CCS-01

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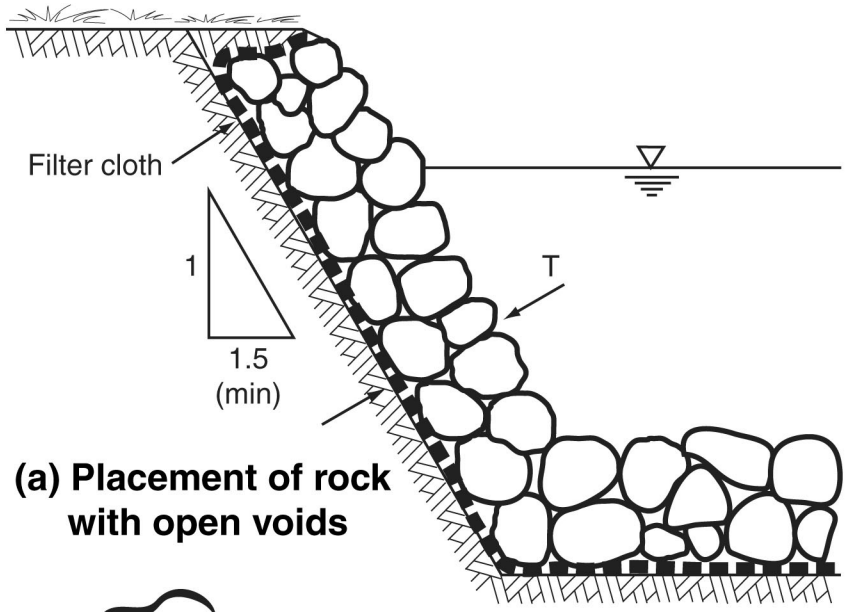
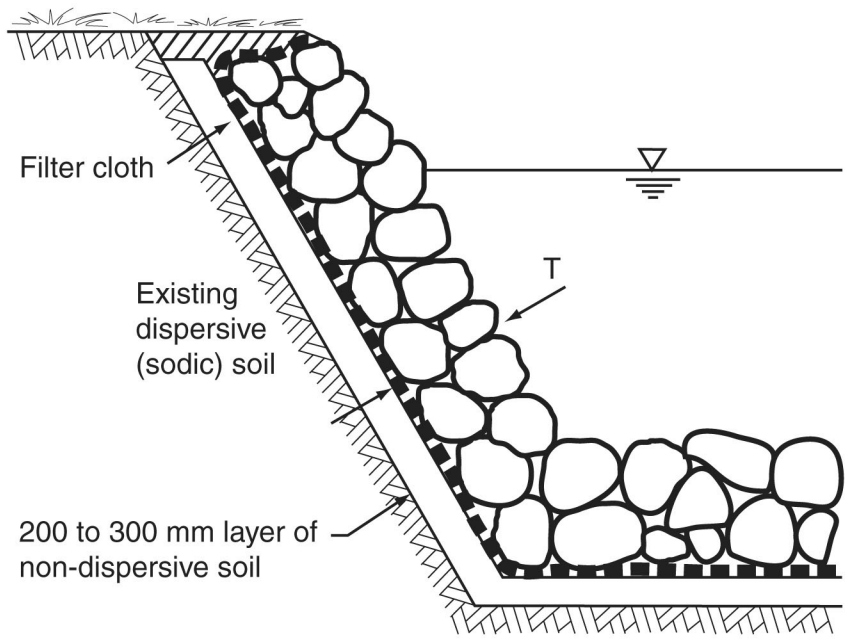
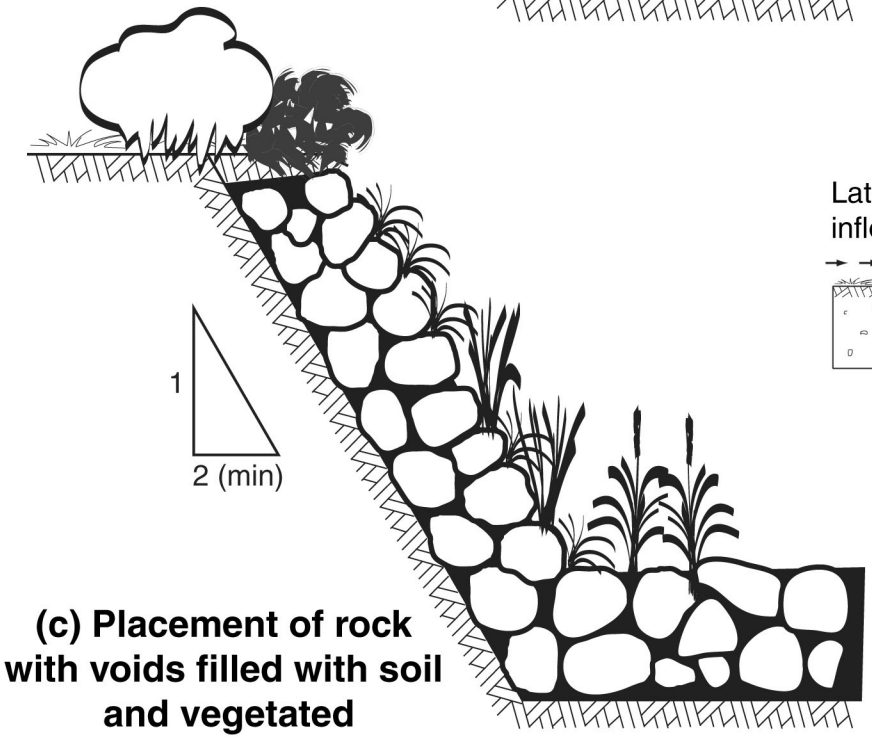


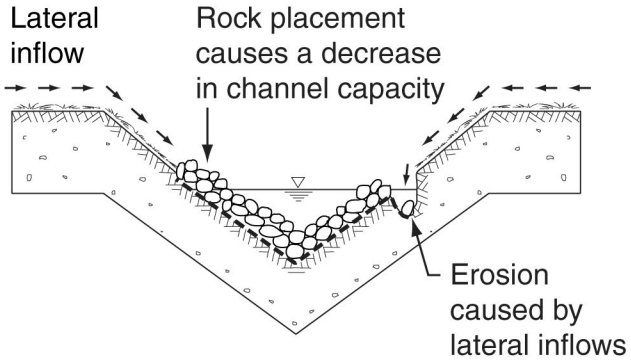
(a) Placement of rock with open voids



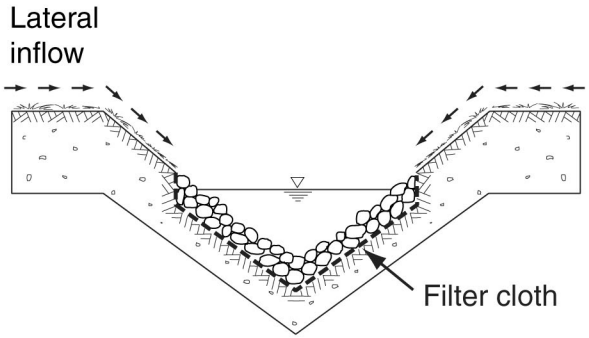
(b) Placement of rock within a channel cut into dispersive soils



(c) Placement of rock with voids filled with soil and vegetated



(d) Poor placement of rock along channel invert



(e) Good placement of rock along channel invert

Drawn:	Date:		
GMW	Dec-09	Rock Linings	RR-01

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MATERIALS

ROCK: HARD, ANGULAR, DURABLE, WEATHER RESISTANT AND EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE AND SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE. SPECIFIC GRAVITY TO BE AT LEAST 2.5.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM BIDIM A24 OR EQUIVALENT.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE PROPOSED CHANNEL AREA OF TREES, STUMPS, ROOTS, LOOSE ROCK, AND OTHER OBJECTIONABLE MATERIALS.

3. EXCAVATE THE CHANNEL TO THE LINES AND GRADES AS SHOWN ON THE PLANS. OVER-CUT THE CHANNEL TO A DEPTH EQUAL TO THE SPECIFIED DEPTH OF ROCK PLACEMENT SUCH THAT THE FINISHED ROCK SURFACE WILL BE AT THE ELEVATION OF THE SURROUNDING LAND.

4. ROCK MUST BE PLACED WITHIN THE CHANNEL AS SPECIFIED WITHIN THE APPROVED PLANS, INCLUDING THE PLACEMENT OF ANY SPECIFIED FILTER LAYER.

5. IF DETAILS ARE NOT PROVIDED ON THE ROCK PLACEMENT, THEN THE PRIMARY ARMOUR ROCK MUST BE EITHER PLACED ON:

(i) A FILTER BED FORMED FROM A LAYER OF SPECIFIED SMALLER ROCK (ROCK FILTER LAYER);

(ii) AN EARTH BED LINED WITH FILTER CLOTH;

(iii) AN EARTH BED NOT LINED IN FILTER CLOTH, BUT ONLY IF ALL VOIDS BETWEEN THE ARMOUR ROCK ARE TO BE FILLED WITH SOIL AND POCKET PLANTED IMMEDIATELY AFTER PLACEMENT OF THE ROCK.

6. IF A ROCK/AGGREGATE FILTER LAYER IS SPECIFIED, THEN PLACE THE FILTER LAYER IMMEDIATELY AFTER THE FOUNDATIONS ARE PREPARED. SPREAD THE FILTER ROCK IN A UNIFORM LAYER TO THE SPECIFIED DEPTH BUT A MINIMUM OF 150mm. WHERE MORE THAN ONE LAYER OF FILTER MATERIAL HAS BEEN SPECIFIED, SPREAD EACH LAYER SUCH THAT MINIMAL MIXING OCCURS BETWEEN EACH LAYER OF ROCK.

7. IF A GEOTEXTILE (FILTER CLOTH) UNDERLAY IS SPECIFIED, PLACE THE FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN ONE SHEET OF FABRIC IS REQUIRED TO OVER THE AREA, OVERLAP THE EDGE OF EACH SHEET AT LEAST 300mm AND PLACE ANCHOR PINS AT MINIMUM 1m SPACING ALONG THE OVERLAP.

8. ENSURE THE GEOTEXTILE FABRIC IS PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION OF THE FABRIC AND THE ROCK. REPAIR ANY DAMAGE BY REMOVING THE ROCK AND PLACING WITH ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA OVERLAPPING THE EXISTING FABRIC A MINIMUM OF 300mm.

9. WHERE NECESSARY, A MINIMUM 100mm LAYER OF FINE GRAVEL, AGGREGATE OR SAND SHOULD BE PLACED OVER THE FABRIC TO PROTECT IT FROM DAMAGE.

10. PLACEMENT OF ROCK SHOULD FOLLOW IMMEDIATELY AFTER PLACEMENT OF THE FILTER LAYER. PLACE ROCK SO THAT IT FORMS A DENSE, WELL-GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS.

11. PLACE ROCK TO ITS FULL THICKNESS IN ONE OPERATION. DO NOT PLACE ROCK BY DUMPING THROUGH CHUTES OR OTHER METHODS THAT CAUSE SEGREGATION OF ROCK SIZES.

12. THE FINISHED SURFACE SHOULD BE FREE OF POCKETS OF SMALL ROCK OR CLUSTERS OF LARGE ROCKS. HAND PLACING MAY BE NECESSARY TO ACHIEVE THE PROPER DISTRIBUTION OF ROCK SIZES TO PRODUCE A RELATIVELY SMOOTH, UNIFORM SURFACE. THE FINISHED GRADE OF THE ROCK SHOULD BLEND WITH THE SURROUNDING AREA. NO OVERFALL OR PROTRUSION OF ROCK SHOULD BE APPARENT.

13. IMMEDIATELY UPON COMPLETION OF THE CHANNEL, VEGETATE ALL DISTURBED AREAS OR OTHERWISE PROTECT THEM AGAINST SOIL EROSION.

14. WHERE SPECIFIED, FILL ALL VOIDS WITH SOIL AND VEGETATE THE ROCK SURFACE IN ACCORDANCE WITH THE APPROVED PLAN.

MAINTENANCE

1. ROCK-LINED CHANNELS SHOULD BE INSPECTED PERIODICALLY AND AFTER SIGNIFICANT STORM EVENTS. CHECK FOR SCOUR OR DISLODGED ROCK. REPAIR DAMAGED AREAS IMMEDIATELY.

2. CLOSELY INSPECT THE OUTER EDGES OF THE ROCK PROTECTION. ENSURE WATER ENTRY INTO THE CHANNEL OR CHUTE IS NOT CAUSING EROSION ALONG THE EDGE OF THE ROCK PROTECTION.

3. CAREFULLY CHECK THE STABILITY OF THE ROCK LOOKING FOR INDICATIONS OF PIPING, SCOUR HOLES, OR BANK FAILURES.

4. REPLACE ANY DISPLACED ROCK WITH ROCK OF A SIGNIFICANTLY (MINIMUM 110%) LARGER SIZE THAN THE DISPLACED ROCK.

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Drawn:	Date:		
GMW	May-10	Rock Linings	RR-02

MATERIALS

ROCK INFILL: HARD, ANGULAR, DURABLE, WEATHER RESISTANT AND EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM BIDIM A24 OR EQUIVALENT.

INSTALLATION

INSTALLATION PROCEDURES SHOULD BE PROVIDED BY THE MANUFACTURER OR DISTRIBUTOR OF THE PRODUCT. A TYPICAL INSTALLATION PROCEDURE IS DESCRIBED BELOW, BUT SHOULD BE CONFIRMED WITH THE PRODUCT MANUFACTURER OR DISTRIBUTOR.

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. MATTRESSES OF DIFFERENT THICKNESSES SHOULD BE STORED ON-SITE IN SEPARATE PILES AND CLEARLY LABELLED.

3. CLEAR THE PROPOSED CHANNEL AREA OF TREES, STUMPS, ROOTS, LOOSE ROCK, AND OTHER OBJECTIONABLE MATERIALS.

4. EXCAVATE THE TREATMENT AREA TO THE LINES AND GRADES AS SHOWN ON THE PLANS. OVER-CUT THE AREA TO A DEPTH EQUAL TO THE SPECIFIED MATTRESS THICKNESS SUCH THAT THE FINISHED SURFACE WILL BE AT THE ELEVATION OF THE SURROUNDING LAND.

5. PLACE FILTER FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN ONE SHEET OF FILTER CLOTH IS REQUIRED TO OVER THE AREA, OVERLAP THE EDGE OF EACH SHEET AT LEAST 300mm AND PLACE ANCHOR PINS AT MINIMUM 1m SPACING ALONG THE OVERLAP.

6. ENSURE THE FILTER CLOTH IS PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION OF THE MATTRESSES. REPAIR ANY DAMAGE BY REMOVING THE ROCK AND PLACING WITH ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA OVERLAPPING THE EXISTING FABRIC A MINIMUM OF 300mm.

7. FLATTEN OUT EACH MATTRESS ON A HARD, FLAT SURFACE, AND STAMP OUT ANY UNNECESSARY CREASES. EDGE CREASES WILL NEED TO BE STAMPED INTO THE BOTTOM OF THE 2ND AND 4TH INTERNAL DIAPHRAGMS.

8. ENSURE THAT EACH DIAPHRAGM IS VERTICAL AND THE CORRECT HEIGHT. FOLD THE SIDES AND ENDS OF THE MATTRESS TO MEET THE TOP OF THE DIAPHRAGMS. FOLD THE SIDE PANEL FLAPS TO LIE ADJACENT TO THE DIAPHRAGMS. TACK TEMPORARILY EITHER BY USING SHORT LENGTHS OF BINDING WIRE, OR ALTERNATIVELY BY TWISTING THE TOP DIAPHRAGM WIRE OVER THE FLAP SELVEDGE WIRE.

9. THE ENDS OF THE DIAPHRAGMS MUST NOW BE PERMANENTLY LACED TO THE SIDES OF THE MATTRESS. AT THE FOUR CORNERS, BEND THE PROJECTED LENGTHS OF THE END PANELS TO OVERLAP THE SIDES, AND LACE UP WITH BINDING WIRE.

10. WHEN THE MATTRESS IS PLACED OVER A GEOTEXTILE, CARE MUST BE TAKEN TO ENSURE THAT PROJECTING ENDS OF WIRE ARE BENT UPWARDS TO AVOID PUNCTURING OR TEARING THE CLOTH. GEOTEXTILE SHOULD BE PLACED ACCORDING TO SPECIFICATIONS.

11. CARRY THE WIRED-UP MATTRESS TO ITS FINAL POSITION, AND WIRE IT SECURELY TO THE ADJACENT MATTRESSES. MATTRESSES SHOULD BE PLACED AND WIRED TOGETHER EMPTY AS IT IS DIFFICULT TO WIRE MATTRESSES TOGETHER WHEN BOTH ARE FULL OF STONE.

12. ON SLOPES, THE MATTRESS SHOULD GENERALLY BE LAID WITH THE DIAPHRAGM ACROSS THE SLOPE RATHER THAN UP AND DOWN THE SLOPE. ON CHUTE AND STREAM BEDS, THE MATTRESS SHOULD GENERALLY BE LAID WITH THE DIAPHRAGM AT RIGHT ANGLES TO THE MAIN DIRECTION OF WATER FLOW.

13. ALL HAND WIRING MUST BE DONE AS A CONTINUOUS LACING OPERATION. BEGIN WIRING BY SECURING THE BINDING WIRE TO THE CORNER OF THE PANELS TO BE JOINED BY LOOPING IT THROUGH AND TWISTING IT TOGETHER. THEN LACE WITH SINGLE LOOPS AND DOUBLE LOOPS IN TURN AT 100mm INTERVALS. FINALLY POKE THE LOOSE END INSIDE THE MATTRESS. TIGHTNESS OF THE MESH AND WIRING IS ESSENTIAL AT ALL TIMES.

14. PLACE THE FILL MATERIAL, BY HAND OR MECHANICALLY, IN THE COMPARTMENTS, STARTING AT THE BOTTOM IF ON A SLOPE. THE FILL SHOULD BE A HARD, DURABLE STONE, IN SIZE BETWEEN 80mm AND 2/3 THE THICKNESS OF THE MATTRESS, BUT GENERALLY NO GREATER THAN 200mm.

15. FILLING CAN BE DONE UNIT BY UNIT, BUT SEVERAL UNITS SHOULD BE READY FOR FILLING AT ANY ONE TIME.

16. FOR UNITS WITH PVC COATED WIRE MESH, PARTICULAR CARE SHALL BE TAKEN TO ENSURE THAT SHARP EDGES OF QUARRY STONE ARE NOT PLACED AGAINST THE MESH IN ORDER TO AVOID CAUSING UNNECESSARY ABRASION.

17. SLIGHTLY OVERFILL EACH MATTRESS TO ALLOW FOR SETTLEMENT. TACK THE LID TO THE CORNERS OF THE MATTRESS, AND THEN SECURELY WIRE IT TO THE TOPS OF THE SIDES, ENDS AND DIAPHRAGMS, USING ALTERNATE SINGLE AND DOUBLE LOOPS AS SPECIFIED ABOVE.

18. WITH MORE THAN ONE MATTRESS FILLED, THE EDGES OF ADJACENT LIDS CAN BE WIRED DOWN IN THE SAME OPERATION, SAVING BOTH TIME AND BINDING WIRE.

19. WHEN THE MATTRESS IS LAID ON A SLOPE STEEPER THAN 1.5:1(H:V), IT SHOULD BE SECURED BY STAR PICKETS OR HARDWOOD PEGS DRIVEN INTO THE GROUND JUST INSIDE THE UPPER END PANEL AT 2m CENTRES OR AS NECESSARY.

20. ON SOFT OR SANDY SLOPES, PEGS CAN BE USED TO HOLD THE MATTRESS IN POSITION DURING FILLING.

21. MATTRESSES CAN BE SHORTENED WHERE NECESSARY, BY CUTTING ALONG THE FOLD AT THE TOP OF A DIAPHRAGM AND REMOVING THE BOTTOM SPIRAL CONNECTIONS.

22. ALWAYS CONSULT MANUFACTURER'S SPECIFICATIONS AND ASSEMBLY INSTRUCTIONS BEFORE MODIFYING THE SHAPE OF THE MATTRESS OR WIRING DEFORMED MATTRESS SHAPES.

23. IMMEDIATELY UPON COMPLETION OF THE CHANNEL, VEGETATE ALL DISTURBED AREAS OR OTHERWISE PROTECT THEM AGAINST SOIL EROSION.

24. WHERE SPECIFIED, FILL ALL VOIDS WITH SOIL AND VEGETATE IN ACCORDANCE WITH THE APPROVED PLAN.

MAINTENANCE

1. ROCK MATTRESS CHANNELS SHOULD BE INSPECTED PERIODICALLY AND AFTER SIGNIFICANT STORM EVENTS. REPAIR DAMAGED AREAS IMMEDIATELY.

2. CLOSELY INSPECT THE OUTER EDGES OF THE TREATED AREA. ENSURE WATER ENTRY INTO THE CHANNEL OR CHUTE IS NOT CAUSING EROSION ALONG THE EDGE OF THE MATTRESSES.

3. CHECK FOR PIPING FAILURE, SCOUR HOLES, OR BANK FAILURES.

Drawn:	Date:		
GMW	May-10	Rock Mattress Linings	RM-01

Catchments & Creeks Pty Ltd

INSTALLATION

THE METHOD OF INSTALLATION VARIES WITH THE TYPE OF MAT. INSTALLATION PROCEDURES SHOULD BE PROVIDED BY THE MANUFACTURER OR DISTRIBUTOR OF THE PRODUCT. A TYPICAL INSTALLATION PROCEDURE IS DESCRIBED BELOW, BUT SHOULD BE CONFIRMED WITH THE PRODUCT MANUFACTURER OR DISTRIBUTOR.

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. EROSION CONTROL MATS SHALL BE STORED AWAY FROM DIRECT SUNLIGHT OR COVERED WITH ULTRAVIOLET LIGHT PROTECTIVE SHEETING UNTIL THE SITE IS READY FOR THEIR INSTALLATION.

3. VEHICLES AND CONSTRUCTION EQUIPMENT SHALL NOT BE PERMITTED TO MANOEUVRE OVER THE GEOTEXTILE UNLESS IT HAS BEEN COVERED WITH A LAYER OF SOIL OR GRAVEL AT LEAST 150mm THICK. FILL MATERIAL SHALL NOT BE MIXED OVER THE GEOTEXTILE.

4. CLEAR AWAY TRASH AND LARGE STONES, AND GRADE THE SURFACE SMOOTHLY TO ELIMINATE FOOTPRINTS, TRACKS AND RUTS.

5. IF THE CHANNEL IS TO BE GRASSED, PREPARE A SMOOTH SEED BED OF APPROXIMATELY 75mm OF TOPSOIL, SEED, FERTILISE, WATER AND RAKE TO REMOVE ANY REMAINING SURFACE IRREGULARITIES.

6. EXCAVATE A 300mm DEEP BY 150mm WIDE ANCHOR TRENCH ALONG THE FULL WIDTH OF THE UPSTREAM END OF THE AREA TO BE TREATED.

7. AT LEAST 300mm OF THE MAT IS ANCHORED INTO THE TRENCH WITH THE ROLL OF MATTING RESTING ON THE GROUND UP-SLOPE OF THE TRENCH.

8. STAPLE THE FABRIC WITHIN THE TRENCH AT 200 TO 250mm SPACING USING 100mm WIDE BY 150mm PENETRATION LENGTH U-SHAPED, 8 TO 11 GAUGE WIRE STAPLES. NARROWER U-SECTIONS MAY EASILY TEAR THE MATTING WHEN PLACED UNDER STRESS.

9. IN LARGE DRAINAGE CHANNEL WHERE THE WIDTH OF THE CHANNEL IS MORE THAN THE WIDTH OF ONE MAT, INSTALL EACH PARALLEL MAT SUCH THAT MAT HIGHER UP THE CHANNEL BANK ALWAYS OVERLAPS THE MAT LOWER DOWN THE BANK BY AT LEAST 300mm. THIS USUALLY REQUIRES THE MATS LOCATED ALONG THE CHANNEL BED TO BE UNROLLED FIRST, FOLLOWED BY EACH CONSECUTIVE PARALLEL MAT LOCATED HIGHER UP THE CHANNEL BANK.

10. WHEN ALL MATS HAVE BEEN ANCHORED WITHIN THE TRENCH ACROSS THE FULL WIDTH OF THE TREATED AREA, THEN THE TRENCH IS BACKFILLED AND COMPACTED. THE MATS ARE THEN UNROLLED DOWN THE SLOPE SUCH THAT EACH MAT COVERS AND PROTECTS THE BACKFILLED TRENCH.

11. WHEN SPREADING THE MATS, AVOID STRETCHING THE FABRIC. THE MATS SHOULD REMAIN IN GOOD CONTACT WITH THE SOIL.

12. IF THE CHANNEL CURVES, THEN SUITABLY FOLD (IN A DOWNSTREAM DIRECTION) AND STAPLE THE FABRIC TO MAINTAIN THE FABRIC PARALLEL TO THE DIRECTION OF CHANNEL FLOW.

13. STAPLE THE SURFACE OF THE MATTING AT 1m CENTRES. ON IRREGULAR GROUND, ADDITIONAL STAPLES WILL BE REQUIRED WHEREVER THE MAT DOES NOT INITIALLY CONTACT THE GROUND SURFACE.

14. AT THE END OF EACH LENGTH OF MAT, A NEW TRENCH IS FORMED AT LEAST 300mm UP-SLOPE OF THE END OF THE MAT SUCH THAT THE END OF THE MAT WILL BE ABLE TO FULLY COVER THE TRENCH. A NEW ROLL OF MATTING IS THEN ANCHORED WITHIN THIS TRENCH AS PER THE FIRST MAT. AFTER THIS NEW MAT HAS BEEN UNROLLED DOWN THE SLOPE, THE UP-SLOPE MAT CAN BE PINNED IN PLACE FULLY COVERING THE NEW TRENCH AND AT LEAST 300mm OF THE DOWN-SLOPE MAT. THE PROCESS IS CONTINUED DOWN THE SLOPE UNTIL THE DESIRED AREA IS FULLY COVERED.

15. IN HIGH-VELOCITY CHANNELS, INTERMEDIATE ANCHOR SLOTS MAY BE REQUIRED AT 10m INTERVALS DOWN THE CHANNEL.

16. ANCHOR THE OUTER MOST EDGES (TOP AND UPPER MOST SIDES) OF THE TREATED AREA IN A 300mm DEEP TRENCH AND STAPLE AT 200 TO 250mm CENTRES.

17. IF THE CHANNEL WAS GRASS SEEDED PRIOR TO PLACEMENT OF THE MATS, THEN THE MATS MAY NEED TO BE ROLLED WITH A SUITABLE ROLLER WEIGHING 60 TO 90kg/m, THEN WATERED.

18. THE INSTALLATION PROCEDURE MUST ENSURE THAT THE BLANKET ACHIEVES AND RETAINS GOOD CONTACT WITH THE SOIL.

19. DAMAGED MATTING SHALL BE REPAIRED OR REPLACED.

ADDITIONAL INSTRUCTIONS FOR THE INSTALLATION OF JUTE MESH (NOT JUTE BLANKETS):

1. ENSURE THE JUTE MESH IS LAID ON A FIRM EARTH SURFACE THAT HAS BEEN TRIMMED, TOPSOILED, WATERED, SOWN WITH SEED AND FERTILISER.

2. THE JUTE MESH IS THEN EITHER TAMPED OR ROLLED FIRMLY ONTO THE PREPARED SURFACE, AVOIDING STRETCHING, WATERED TO ENCOURAGE THE PENETRATION OF THE BITUMEN EMULSION, AND FINALLY SPRAYED WITH A TOP LAYER OF BITUMEN AT 1 TO 3 LITRES PER SQUARE METRE.

3. THE RATE OF EMULSION APPLICATION SHOULD BE ADJUSTED SUCH THAT THE EMULSION JUST STARTS TO POND IN THE MESH SQUARES.

ADDITIONAL REQUIREMENTS ASSOCIATED WITH USE NEAR AIRPORT PAVEMENTS:

1. ONLY EROSION MATS THAT ARE DOUBLE NETTED SHALL BE ALLOWED WITHIN 3.0m OF ANY AIRPORT PAVEMENT USED BY AIRCRAFT WITH THE EXCEPTION OF AIRPORTS CLASSIFIED AS AIR CARRIER OR CORPORATE/TRANSPORT. IF THE AIRPORT IS CLASSIFIED AS AN AIR CARRIER OR CORPORATE/TRANSPORT, THERE WILL BE NO EROSION MATS ALLOWED WITHIN 9.0m OF PAVEMENT USED BY AIRCRAFT.

2. ONLY BIODEGRADABLE ANCHORING DEVICES SHALL BE ALLOWED IN THE INSTALLATION OF ANY EROSION MAT FOR AIRPORT APPLICATIONS. NO METAL STAPLES WILL BE ALLOWED.

MAINTENANCE

1. ALL SURFACE-LAID FABRICS SHOULD BE INSPECTED FORTNIGHTLY DURING THE CONSTRUCTION PHASE AND AFTER SIGNIFICANT RAINFALL.

2. BIODEGRADABLE MATS SHOULD BE INSPECTED AFTER THE FIRST FEW RUNOFF-PRODUCING RAINFALL EVENTS.

3. INSPECT THE MATS TO SEE IF:
(i) CONSTRUCTION ACTIVITY OR FALLING DEBRIS HAVE DAMAGED THE MATS;
(ii) RUNOFF IS UNDERMINING THE MATS;
(iii) THE MATS ARE NOT IN GOOD CONTACT WITH THE SOIL;
(iv) THE MATS DO NOT HAVE ADEQUATE OVERLAP; AND
(v) UP-SLOPE MATS DO NOT OVERLAP DOWN-SLOPE MATS.

4. IF THE MATTING IS DAMAGED, REPAIR OR REPLACE THE DAMAGED SECTION. IF WATER IS UNDERMINING THE FABRIC, REPAIR ANY HOLES OR JOINTS OR RE-BURY THE UPPER ENDS OF THE DAMAGED SECTIONS.

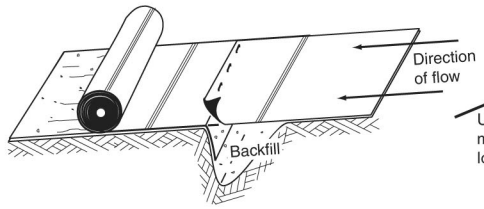
5. MAKE NECESSARY REPAIRS WITHIN 48 HOURS BUT AT LEAST BEFORE THE NEXT EXPECTED RAINFALL EVENT.

REMOVAL

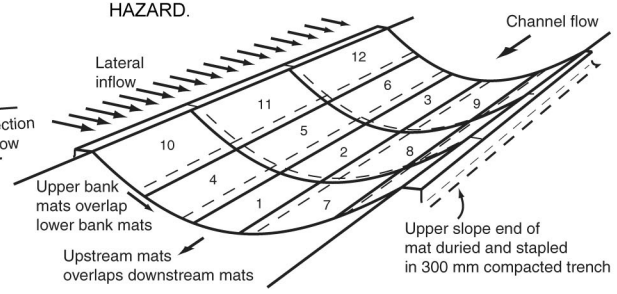
1. IF THE MATTING IS TEMPORARY, IT MUST BE REPLACED/SUPPLEMENTED WITH PERMANENT STABILISATION MEASURES AS SPECIFIED IN THE APPROVED PLAN.

2. TEMPORARY STABILISATION WORKS MUST BE MAINTAINED UNTIL ARRANGEMENTS HAVE BEEN MADE TO INSTALL THE PERMANENT STABILISATION MEASURES.

3. DISPOSE OF THE REMOVED FABRIC IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.



(a) Typical anchorage of mats in high velocity channels



(b) Typical order of placement of mats

Drawn:	Date:		
GMW	May-10	Erosion Control Mats	ECM-01

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MATERIALS

ROCK: 150 TO 300mm NOMINAL DIAMETER, HARD, EROSION RESISTANT ROCK. SMALLER ROCK MAY BE USED IF SUITABLE LARGE ROCK IS NOT AVAILABLE.

SANDBAGS: GEOTEXTILE BAGS (WOVEN SYNTHETIC, OR NON-WOVEN BIODEGRADABLE) FILLED WITH CLEAN COARSE SAND, CLEAN AGGREGATE, STRAW OR COMPOST.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. PRIOR TO PLACEMENT OF THE CHECK DAMS, ENSURE THE TYPE AND SIZE OF EACH CHECK DAMS WILL NOT CAUSE A SAFETY HAZARD OR CAUSE WATER TO SPILL OUT OF THE DRAIN.

3. LOCATE THE FIRST CHECK DAM AT THE DOWNSTREAM END OF THE SECTION OF CHANNEL BEING PROTECTED. LOCATE EACH SUCCESSIVE CHECK DAM SUCH THAT THE CREST OF THE IMMEDIATE DOWNSTREAM DAM IS LEVEL WITH THE TOE OF THE CHECK DAM BEING INSTALLED.

4. ENSURE THE CHANNEL SLOPE IS NO STEEPER THAN 10:1 (H:V). OTHERWISE CONSIDER THE USE OF A SUITABLE CHANNEL LINER INSTEAD OF THE CHECK DAMS.

5. CONSTRUCT THE CHECK DAM TO THE DIMENSIONS AND PROFILE SHOWN WITHIN THE APPROVED PLAN.

6. WHERE SPECIFIED, THE CHECK DAMS SHALL BE CONSTRUCTED ON A SHEET OF GEOTEXTILE FABRIC USED AS A DOWNSTREAM SPLASH PAD.

7. EACH CHECK DAM SHALL BE EXTENDED UP THE CHANNEL BANK (WHERE PRACTICABLE) TO AN ELEVATION AT LEAST 150mm ABOVE THE CREST LEVEL OF THE DAM.

MAINTENANCE

1. INSPECT EACH CHECK DAM AND THE DRAINAGE CHANNEL AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. CORRECT ALL DAMAGE IMMEDIATELY. IF SIGNIFICANT EROSION OCCURS BETWEEN ANY OF THE CHECK DAMS, THEN CHECK THE SPACING OF DAMS AND WHERE NECESSARY INSTALL INTERMEDIATE CHECK DAMS OR A SUITABLE CHANNEL LINER.

3. CHECK FOR DISPLACEMENT OF THE CHECK DAMS

4. CHECK FOR SOIL SCOUR AROUND THE ENDS OF EACH CHECK DAM. IF SUCH EROSION IS OCCURRING, CONSIDER EXTENDING THE WIDTH OF THE CHECK DAM TO AVOID SUCH PROBLEMS.

5. IF SEVERE SOIL EROSION OCCURS EITHER UNDER OR AROUND THE CHECK DAMS, THEN SEEK EXPERT ADVICE ON AN ALTERNATIVE TREATMENT MEASURE.

6. REMOVE ANY SEDIMENT ACCUMULATED BY THE CHECK DAMS, UNLESS IT IS INTENDED THAT THIS SEDIMENT WILL REMAIN WITHIN THE CHANNEL.

7. DISPOSE OF COLLECTED SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN CONSTRUCTION WORK WITHIN THE DRAINAGE AREA ABOVE THE CHECK DAMS HAS BEEN COMPLETED, AND THE DISTURBED AREAS AND THE DRAINAGE CHANNEL ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, ALL TEMPORARY CHECK DAMS MUST BE REMOVED.

2. REMOVE THE CHECK DAMS AND ASSOCIATED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

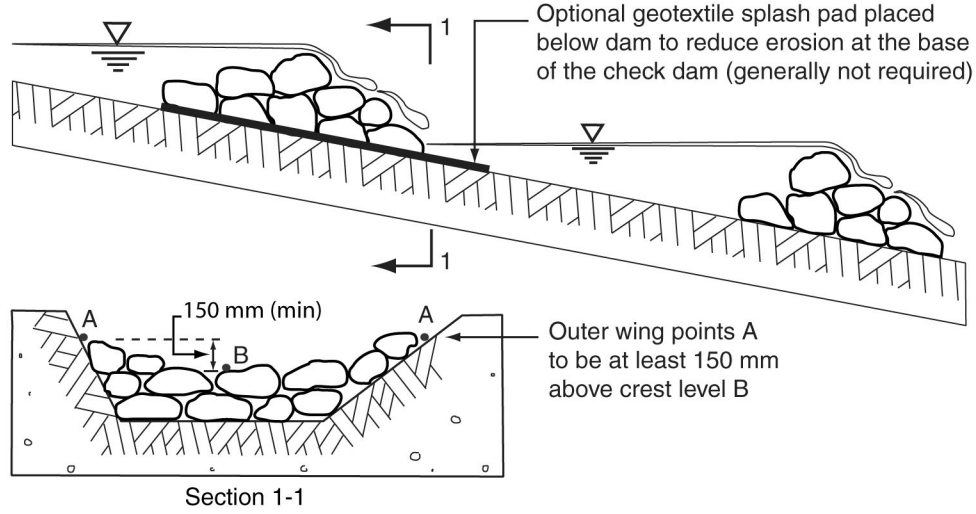

Figure 1 - Layout and profile of check dams (rock check dams shown)

Drawn:	Date:		
GMW	Dec-09	Check Dams	RCD-01

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INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. ENSURE ALL NECESSARY SOIL TESTING (e.g. SOIL pH, NUTRIENT LEVELS) AND ANALYSIS HAS BEEN COMPLETED, AND REQUIRED SOIL ADJUSTMENTS PERFORMED PRIOR TO PLANTING.

3. CLEAR THE LOCATION FOR THE CHANNEL, CLEARING ONLY WHAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND CONSTRUCTION EQUIPMENT.

4. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD ANY ASSOCIATED EMBANKMENTS.

5. EXCAVATE THE DIVERSION CHANNEL TO THE SPECIFIED SHAPE, ELEVATION AND GRADIENT. THE SIDES OF THE CHANNEL SHOULD BE NO STEEPER THAN A 2:1 (H:V) IF CONSTRUCTED IN EARTH, UNLESS SPECIFICALLY DIRECTED WITHIN THE APPROVED PLANS.

6. STABILISE THE CHANNEL AND BANKS IMMEDIATELY UNLESS IT WILL OPERATE FOR LESS THAN 30 DAYS. IN EITHER CASE, TEMPORARY EROSION PROTECTION (MATTING, ROCK, ETC.) WILL BE REQUIRED AS SPECIFIED WITHIN THE APPROVED PLANS OR AS DIRECTED.

7. ENSURE THE CHANNEL DISCHARGES TO A STABLE AREA.

ADDITIONAL REQUIREMENTS FOR TURF PLACEMENT:

1. TURF SHOULD BE USED WITHIN 12 HOURS OF DELIVERY, OTHERWISE ENSURE THE TURF IS STORED IN CONDITIONS APPROPRIATE FOR THE WEATHER CONDITIONS (e.g. A SHADED AREA).

2. MOISTENING THE TURF AFTER IT IS UNROLLED WILL HELP MAINTAIN ITS VIABILITY.

3. TURF SHOULD BE LAID ON A MINIMUM 75mm BED OF ADEQUATELY FERTILISED TOPSOIL. RAKE THE SOIL SURFACE TO BREAK THE CRUST JUST BEFORE LAYING THE TURF.

4. DURING THE WARMER MONTHS, LIGHTLY IRRIGATE THE SOIL IMMEDIATELY BEFORE LAYING THE TURF.

5. ENSURE THE TURF IS NOT LAID ON GRAVEL, HEAVILY COMPACTED SOILS, OR SOILS THAT HAVE BEEN RECENTLY TREATED WITH HERBICIDES.

6. ENSURE THE TURF EXTENDS UP THE SIDES OF THE DRAIN AT LEAST 100mm ABOVE THE ELEVATION OF THE CHANNEL INVERT, OR AT LEAST TO A SUFFICIENT ELEVATION TO FULLY CONTAIN EXPECTED CHANNEL FLOW.

7. ON CHANNEL GRADIENTS OF 3:1(H:V) OR STEEPER, OR IN SITUATIONS WHERE HIGH FLOW VELOCITIES (i.e. VELOCITY >1.5m/s) ARE LIKELY WITHIN THE FIRST TWO WEEK FOLLOWING PLACEMENT, SECURE THE INDIVIDUAL TURF STRIPS WITH WOODEN OR PLASTIC PEGS.

8. ENSURE THAT INTIMATE CONTACT IS ACHIEVED AND MAINTAINED BETWEEN THE TURF AND THE SOIL SUCH THAT SEEPAGE FLOW BENEATH THE TURF IS AVOIDED.

9. WATER UNTIL THE SOIL IS WET 100mm BELOW THE TURF. THEREAFTER, WATERING SHOULD BE SUFFICIENT TO MAINTAIN AND PROMOTE HEALTHY GROWTH

MAINTENANCE

1. DURING THE SITE'S CONSTRUCTION PERIOD, INSPECT THE DIVERSION CHANNEL WEEKLY AND AFTER ANY INCREASE IN FLOWS WITHIN THE CHANNEL. REPAIR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD.

2. ENSURE FILL MATERIAL OR SEDIMENT IS NOT PARTIALLY BLOCKING THE CHANNEL. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

3. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN THE CONSTRUCTION WORK ABOVE A TEMPORARY DIVERSION CHANNEL IS FINISHED AND THE AREA IS STABILISED, THE AREA SHOULD BE APPROPRIATELY REHABILITATED.

2. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

4. STABILISE THE AREA AS SPECIFIED IN THE APPROVED PLAN.

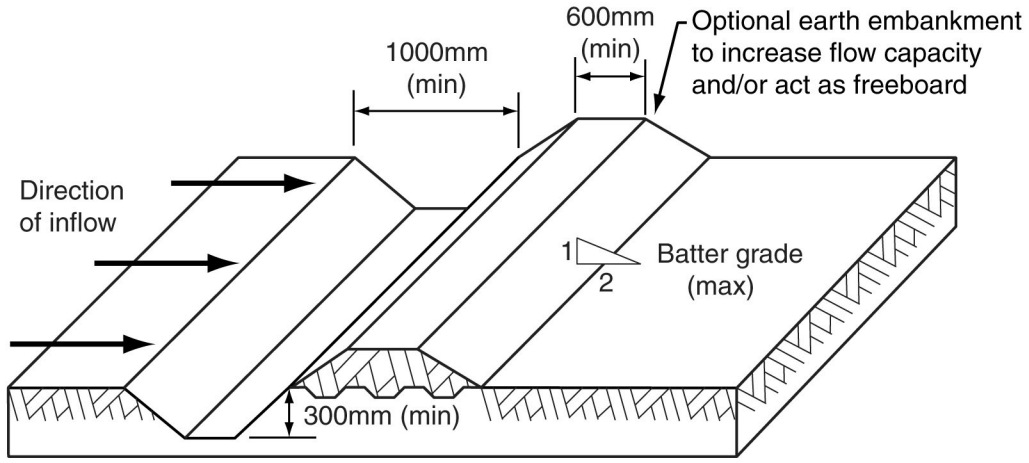

Figure 1 - Typical profile of diversion channel with bank

Drawn:	Date:		
GMW	Dec-09	Diversion Channels	DC-01

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INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION FOR THE BANK, CLEARING ONLY THE AREA THAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND EQUIPMENT.

3. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD THE BANK.

4. FORM THE BANK FROM THE MATERIAL, AND TO THE DIMENSION SPECIFIED IN THE APPROVED PLANS.

5. IF EARTH IS USED, THEN ENSURE THE SIDES OF THE BANK ARE NO STEEPER THAN A 2:1 (H:V) SLOPE, AND THE COMPLETED BANK MUST BE AT LEAST 500mm HIGH.

6. IF FORMED FROM SANDBAGS, THEN ENSURE THE BAGS ARE TIGHTLY PACKED SUCH THAT WATER LEAKAGE THROUGH THE BAGS IS MINIMISED.

7. CHECK THE BANK ALIGNMENT TO ENSURE POSITIVE DRAINAGE IN THE DESIRED DIRECTION.

8. THE BANK SHOULD BE VEGETATED (TURFED, SEEDED AND MULCHED), OR OTHERWISE STABILISED IMMEDIATELY, UNLESS IT WILL OPERATE FOR LESS THAN 30 DAYS OR IF SIGNIFICANT RAINFALL IS NOT EXPECTED DURING THE LIFE OF THE BANK.

9. ENSURE THE EMBANKMENT DRAINS TO A STABLE OUTLET, AND DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

MAINTENANCE

1. INSPECT FLOW DIVERSION BANKS AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. INSPECT THE BANK FOR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD. MAKE REPAIRS AS NECESSARY.

3. CHECK THAT FILL MATERIAL OR SEDIMENT HAS NOT PARTIALLY BLOCKED THE DRAINAGE PATH UP-SLOPE OF THE EMBANKMENT. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

4. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

5. REPAIR ANY PLACES IN THE BANK THAT ARE WEAKENED OR IN RISK OF FAILURE.

REMOVAL

1. WHEN THE SOIL DISTURBANCE ABOVE THE BANK IS FINISHED AND THE AREA IS STABILISED, THE FLOW DIVERSION BANK SHOULD BE REMOVED, UNLESS IT IS TO REMAIN AS A PERMANENT DRAINAGE FEATURE.

2. DISPOSE OF ANY SEDIMENT OR EARTH IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

4. STABILISE THE AREA BY GRASSING OR AS SPECIFIED IN THE APPROVED PLAN.

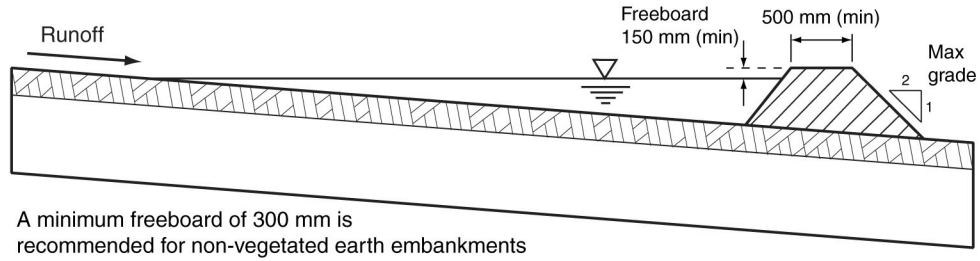

Figure 1 - Typical profile of flow diversion bank formed from earth

Table 1 - Recommended dimensions of flow diversion banks

Parameter	Earth banks	Vegetated banks	Compost berms	Sandbag berms
Height (min)	500 mm	500 mm	300 mm	N/A
Top width (min)	500 mm	500 mm	100 mm	N/A
Base width (min)	2500 mm	2500 mm	600 mm	N/A
Side slope (max)	2:1 (H:V)	2:1 (H:V)	1:1 (H:V)	N/A
Freeboard	300 mm	150 mm	100 mm	50 mm

Drawn:	Date:		
GMW	Dec-09	Flow Diversion Banks	DB-01

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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

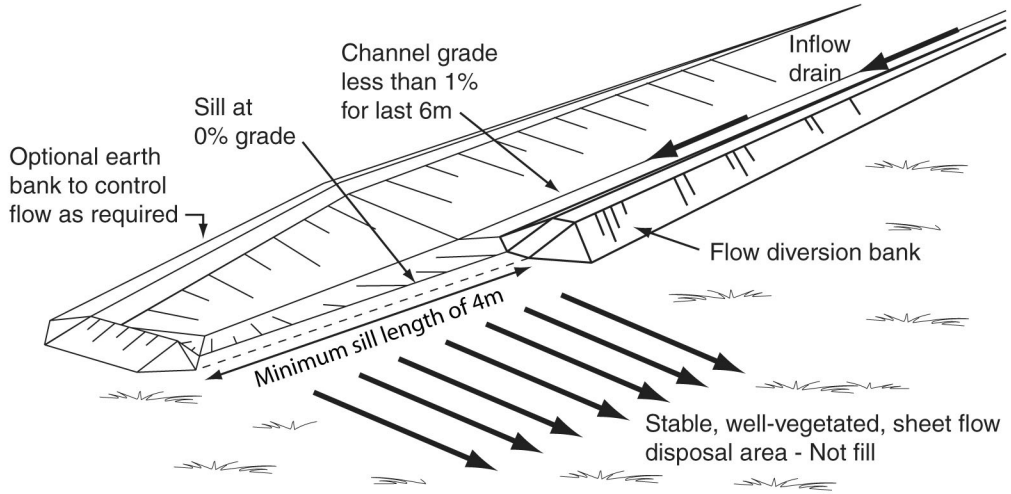
1. TEMPORARY LEVEL SPREADERS SHOULD BE DECOMMISSIONED ONLY AFTER AN ALTERNATIVE STABLE OUTLET IS OPERATIONAL, OR WHEN THE INFLOW CHANNEL IS DECOMMISSIONED.

2. REMOVE COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

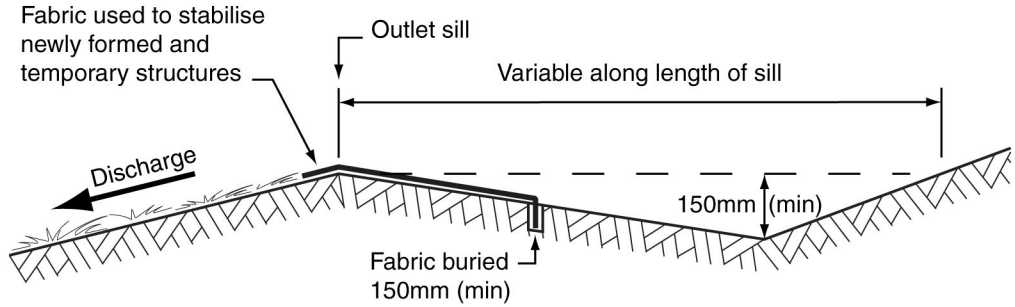
3. REMOVE AND APPROPRIATELY DISPOSE OF ANY EXPOSED GEOTEXTILE.

4. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

5. STABILISE THE AREA AS SPECIFIED ON THE APPROVED PLAN.



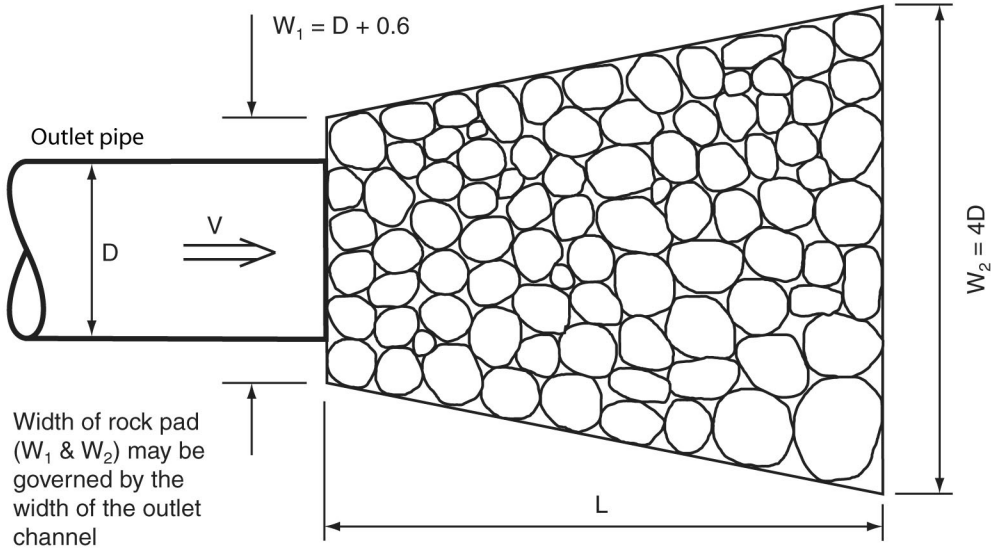
(a) Typical layout of level spreader



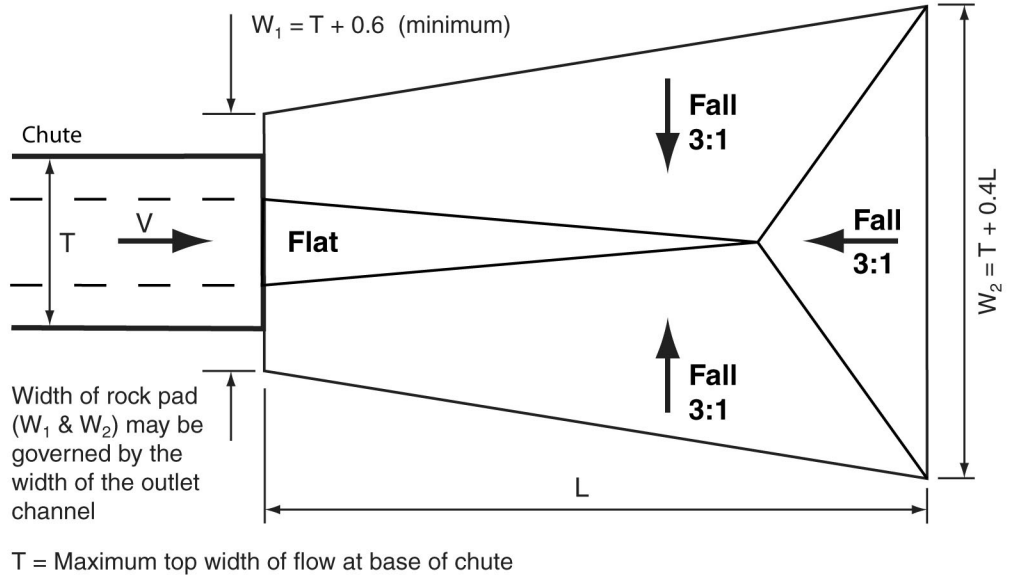
(b) Typical profile of the the outlet weir

Drawn:	Date:		
GMW	Dec-09	Level Spreaders	LS-01

Catchments & Creeks Pty Ltd

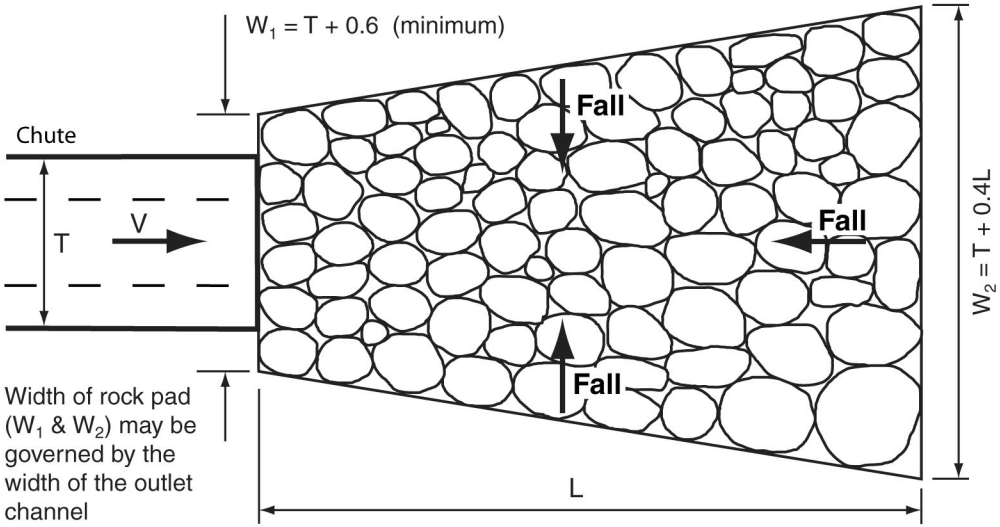


(a) Typical layout of a rock pad outlet structure for a pipe outlet

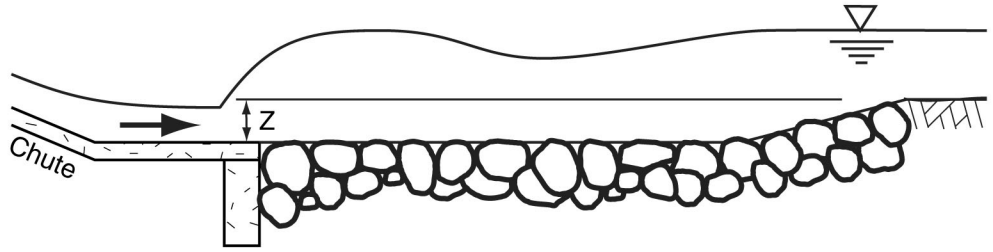


T = Maximum top width of flow at base of chute

(b) Typical form of a rock pad outlet structure for a drainage chute



(c) Typical layout of a rock pad outlet structure for a drainage chute



(d) Typical profile of a rock pad outlet structure for a drainage chute

Notes:

1. Drawings applicable to temporary drainage chutes and slope drains.
2. Rock pad outlet structures for slope drains usually are not required to be recessed below natural ground level as is the case for chute outlets (see Figure B).

Drawn:	Date:		
GMW	Dec-09	Outlet Structures	OS-01

Catchments & Creeks Pty Ltd

MATERIALS (ROCK PADS)

ROCK: HARD, ANGULAR, DURABLE, WEATHER RESISTANT AND EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE AND SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE. SPECIFIC GRAVITY TO BE AT LEAST 2.5.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM BIDIM A24 OR EQUIVALENT.

INSTALLATION (ROCK PADS)

1. REFER TO APPROVED PLANS FOR LOCATION 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. THE DIMENSIONS OF THE OUTLET STRUCTURE MUST ALIGN WITH THE DOMINANT FLOW DIRECTION.

3. EXCAVATE THE OUTLET PAD FOOTPRINT TO THE SPECIFIED DIMENSION SUCH THE WHEN THE ROCK IS PLACED IN THE EXCAVATED PIT THE TOP OF THE ROCKS WILL BE LEVEL WITH THE SURROUNDING GROUND, UNLESS OTHERWISE DIRECTED.

4. IF THE EXCAVATED SOILS ARE DISPERSIVE, OVER-EXCAVATED THE ROCK PAD BY AT LEAST 300mm AND BACKFILL WITH STABLE, NON-DISPERSIVE MATERIAL.

5. LINE THE EXCAVATED PIT WITH GEOTEXTILE FILTER CLOTH, PREFERABLY USING A SINGLE SHEET. IF JOINTS ARE REQUIRED, OVERLAP THE FABRIC AT LEAST 300mm.

6. ENSURE THE FILTER CLOTH IS PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION OF THE FABRIC AND THE ROCK. REPAIR ANY DAMAGE BY REMOVING THE ROCK AND PLACING WITH ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA OVERLAPPING THE EXISTING FABRIC A MINIMUM OF 300mm.

7. ENSURE THERE ARE AT LEAST TWO LAYERS OF ROCKS. WHERE NECESSARY, REPOSITION THE LARGER ROCKS TO ENSURE TWO LAYERS OF ROCKS ARE ACHIEVED WITHOUT ELEVATING THE UPPER SURFACE ABOVE THE PIPE INVERT.

8. ENSURE THE ROCK IS PLACED IN A MANNER THAT WILL ALLOW WATER TO DISCHARGE FREELY FROM THE PIPE.

9. ENSURE THE UPPER SURFACE OF THE ROCK PAD DOES NOT CAUSE WATER TO BE DEFLECTED AROUND THE EDGE OF THE ROCK PAD.

10. IMMEDIATELY AFTER CONSTRUCTION, APPROPRIATELY STABILISE ALL DISTURBED AREAS.

MAINTENANCE

1. WHILE CONSTRUCTION WORKS CONTINUE ON THE SITE, INSPECT THE OUTLET STRUCTURE PRIOR TO FORECAST RAINFALL, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER SIGNIFICANT RUNOFF PRODUCING RAINFALL, AND ON AT LEAST A WEEKLY BASIS.

2. REPLACE ANY DISPLACED ROCK WITH ROCK OF A SIGNIFICANTLY (MINIMUM 110%) LARGER SIZE THAN THE DISPLACED ROCK.

REMOVAL

1. TEMPORARY OUTLET STRUCTURES SHOULD BE COMPLETELY REMOVED, OR WHERE APPROPRIATE, REHABILITATED SO AS NOT TO CAUSE ONGOING ENVIRONMENTAL NUISANCE OR HARM.

2. FOLLOWING REMOVAL OF THE DEVICE, THE DISTURBED AREA MUST BE APPROPRIATELY REHABILITATED SO AS NOT TO CAUSE ONGOING ENVIRONMENTAL NUISANCE OR HARM.

3. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Dec-09	Outlet Structure - Rock Pad	OS-02

MATERIALS

FIBRE ROLLS: TYPICALLY 200 TO 250mm JUTE, COIR OR STRAW ROLL TIED WITH SYNTHETIC OR BIODEGRADABLE MESH.

STAKES: MINIMUM 25 x 25mm TIMBER STAKES.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION 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. WHEN PLACED ACROSS NON-VEGETATED OR NEWLY SEEDED SLOPES, THE ROLLS MUST BE PLACED ALONG THE CONTOUR.

3. IF PLACED ON OPEN OR LOOSE SOIL, ENSURE THE FIBRE ROLLS ARE TRENCHED 75 TO 125mm IN SANDY SOILS AND 50 TO 75mm IN CLAYEY SOILS.

4. ENSURE THE OUTER MOST ENDS OF THE FIBRE ROLL ARE TURNED UP THE SLOPE TO ALLOW WATER TO ADEQUATELY POND UP-SLOPE OF THE ROLL, AND TO MINIMISE FLOW BYPASSING.

5. WHEN PLACED ACROSS THE INVERT OF MINOR DRAINS, ENSURE THE SOCKS ARE PLACED SUCH THAT:

(i) THE CREST OF THE DOWNSTREAM ROLL IS LEVEL WITH THE CHANNEL INVERT AT THE IMMEDIATE UPSTREAM SOCK (IF ANY);

(ii) EACH ROLL EXTENDS UP THE CHANNEL BANKS SUCH THAT THE CREST OF THE FIBRE ROLL AT ITS LOWEST POINT IS LOWER THAN THE GROUND LEVEL AT EITHER END OF THE ROLL.

6. ENSURE THE ANCHORING STAKES ARE DRIVEN INTO THE END OF EACH ROLL AND ALONG THE LENGTH OF EACH ROLL AT A SPACING NOT EXCEEDING 1.2m OR SIX TIMES THE ROLL DIAMETER, WHICHEVER IS THE LESSER. A MAXIMUM STAKE SPACING OF 0.3m APPLIES WHEN USED TO FORM CHECK DAMS.

7. ADJOINING ROLL MUST BE OVERLAP AT LEAST 450mm, NOT ABUTTED.

MAINTENANCE

1. INSPECT ALL FIBRE ROLLS PRIOR TO FORECAST RAIN, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER SIGNIFICANT RUNOFF PRODUCING STORMS OR OTHERWISE AT WEEKLY INTERVALS.

2. REPAIR OR REPLACE DAMAGED FIBRE ROLLS.

3. REMOVE COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. ALL EXCESSIVE SEDIMENT TRAPPED BY THE ROLLS MUST BE REMOVED FROM THE DRAIN OR SLOPE IF SUCH SEDIMENT IS LIKELY TO BE WASHED AWAY BY EXPECTED FLOWS.

2. DISPOSE OF COLLECTED SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. THE BIODEGRADABLE CONTENT OF THE STRAW ROLLS MAY NOT NECESSARILY NEED TO BE REMOVED FROM THE SITE.

4. ALL SYNTHETIC (PLASTIC) MESH OR OTHER NON READILY BIODEGRADABLE MATERIAL MUST BE REMOVED FROM THE SITE ONCE THE SLOPE OR DRAIN IS STABILISED, OR THE ROLLS HAVE DETERIORATED TO A POINT WHERE THEY ARE NO LONGER PROVIDING THEIR INTENDED DRAINAGE OR SEDIMENT CONTROL FUNCTION.

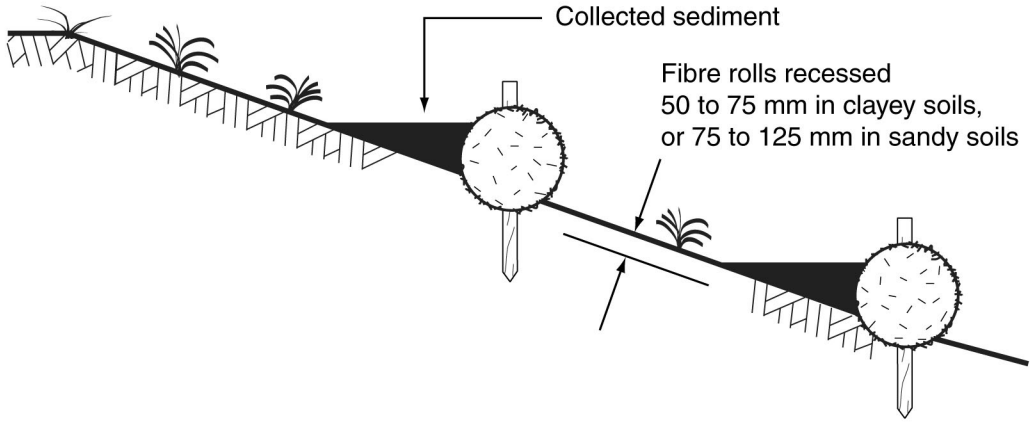


Figure 1 - Typical installation of fibre rolls

Drawn:	Date:		
GMW	Apr-10	Fibre Rolls	FR-01

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MATERIALS

GEOTEXTILE FABRIC: NON-WOVEN FILTER CLOTH (MINIMUM 'BIDIM' A34 OR THE EQUIVALENT), WIDE STRIP TENSILE STRENGTH (AS3706.2) MINIMUM 15kN/m IN BOTH DIRECTIONS, PORE SIZE (EOS, O95, AS 3706.7) LESS THAN 110mm, MASS PER UNIT AREA (AS3706.1) MINIMUM 200GSM.

SUPPORT POSTS/STAKES: 1500mm^2 (MIN) HARDWOOD, 2500mm^2 (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

BACKING MESH: PLASTIC OR STEEL MESH WITH A MAXIMUM MESH OPENING OF 200mm.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. UNLESS OTHERWISE DIRECTED BY THE RESPONSIBLE ON-SITE OFFICER, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE PROPOSED ALIGNMENT OF THE FILTER FENCE, PLACING THE EXCAVATED MATERIAL UP-SLOPE OF THE FENCE.

3. IF THE FILTER FENCE IS TO BE STAKED WITHOUT A MESH BACKING, THEN SECURE THE SUPPORT POSTS INTO THE GROUND AT A SPACING NO GREATER THAN 1.5m.

4. IF THE FILTER FENCE IS TO BE STAKED WITH A MESH BACKING, SECURE THE SUPPORT POSTS INTO THE GROUND AT A SPACING NO GREATER THAN 2.0m, THEN SECURELY ATTACH THE BACKING MESH TO THE UP-SLOPE SIDE OF THE SUPPORT POSTS FROM A CONTINUOUS LENGTH OF MESH. EXTEND THE MESH INTO THE EXCAVATED TRENCH.

5. IF THE FILTER FENCE IS THE BE SUPPORTED BY STRAW BALES, THEN AFTER SUITABLE ANCHORING THE BOTTOM 300mm OF FABRIC, PLACE A CONTINUOUS ROW OF STRAW BALES IMMEDIATELY DOWN-SLOPE OF THE FABRIC AND WRAP THE FABRIC OVER THE TOP OF THE STRAW BALES. SECURELY ANCHOR THE FILTER FENCE WITH A SINGLE STAKE DRIVEN THROUGH THE FABRIC AND CENTRE OF EACH BALE.

6. USING A CONTINUOUS LENGTH OF NON-WOVEN GEOTEXTILE, SECURELY ATTACH THE FABRIC TO THE UP-SLOPE SIDE OF THE SUPPORT POSTS OR BACKING MESH, WITH THE FABRIC EXTENDED AT LEAST 200mm INTO THE TRENCH.

7. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC TO PREVENT DISPLACEMENT OF THE FABRIC AND TO PREVENT THE FREE MOVEMENT OF WATER UNDER THE FABRIC.

8. IN ALL CASES, INSTALL THE FILTER FENCE IN A MANNER THAT WILL MINIMISE THE RISK OF SEDIMENT-LADEN WATER FLOWING AROUND THE FENCE.

MAINTENANCE

1. INSPECT THE FILTER FENCE REGULARLY AND AT LEAST DAILY DURING DE-WATERING OPERATIONS. MAKE REPAIRS AS NEEDED TO THE FABRIC AND SUPPORT FRAME.

2. INSPECT THE FABRIC FOR OBVIOUS LEAKS RESULTING FROM HOLES, TEARS OR JOINT FAILURE IN THE FABRIC.

3. CHECK THAT WATER HAS NOT OVERTOPPED THE FENCE AT LOW POINTS.

4. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC PLACED INSIDE THE OLD FABRIC, EXTENDING AT LEAST FROM SUPPORT POST TO SUPPORT POST.

5. CHECK FOR MATERIALS LEANING UP AGAINST THE FILTER FENCE. MAKE REPAIRS AS NEEDED TO THE FABRIC AND SUPPORT FRAME.

REMOVAL

1. REMOVE ALL ACCUMULATED SEDIMENT AND DISPOSE OF IT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

2. REMOVE ALL MATERIALS AND REPAIR DAMAGE TO THE GROUND SURFACE AS NECESSARY.

3. APPROPRIATELY REHABILITATE (E.G. REVEGETATE) THE GROUND AS NECESSARY TO MINIMISE THE RISK OF AN ONGOING EROSION HAZARD.

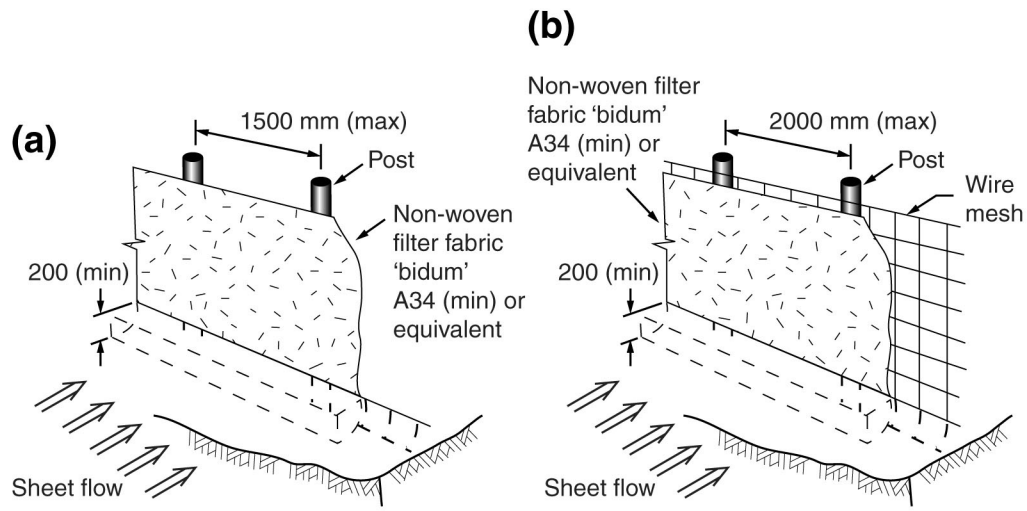

Figure 1 - Various installation methods

Drawn:	Date:		
GMW	Apr-10	Filter Fence	FF-01

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PREPARATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND DIMENSIONAL DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, OR EXTENT, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. TAKE ALL NECESSARY STEPS TO ENSURE DISTURBANCE TO THE BUFFER ZONE IS MINIMISED THROUGHOUT THE TIME IT IS USED AS A SEDIMENT TRAP.

3. TO THE MAXIMUM DEGREE PRACTICABLE, ENSURE FLOW PASSING THROUGH THE BUFFER ZONE IS NOT ALLOWED TO CONCENTRATE WITHIN DRAINAGE DEPRESSIONS, SWALES, RILLS OR WHEEL TRACKS.

4. WHERE NECESSARY, INSTALL APPROPRIATE DRAINAGE CONTROLS UP-SLOPE OF THE BUFFER ZONE TO DISTRIBUTE THE INFLOW ALONG THE FULLY LENGTH OF THE BUFFER ZONE AS 'SHEET FLOW'.

5. WHERE NECESSARY, INSTALL A COARSE SEDIMENT TRAP, SUCH AS A SEDIMENT FENCE, UP-SLOPE OF THE BUFFER ZONE TO REDUCE THE QUANTITY OF SEDIMENT PASSING ONTO THE GRASS. GENERALLY THIS IS REQUIRED IF LARGE QUANTITIES OF COARSE SEDIMENT ARE EXPECTED.

6. IF REQUIRED, INSTALL A LIGHT BARRIER FENCE TO CLEARLY IDENTIFY THE BUFFER ZONE AND HELP EXCLUDE CONSTRUCTION TRAFFIC.

MAINTENANCE

1. INSPECT THE BUFFER ZONE ON A REGULAR BASIS AND AFTER RUNOFF-PRODUCING RAINFALL.

2. ENSURE THAT THERE IS NO SOIL EROSION AND THAT SEDIMENT DEPOSITION IS NOT CAUSING THE CONCENTRATION OF FLOW THROUGH THE BUFFER ZONE, OR FLOW BYPASSING.

3. IF THE BUFFER ZONE HAS BEEN DISTURBED, TAKE NECESSARY STEPS TO RE-ESTABLISH SUITABLE SHEET FLOW CONDITIONS.

4. REMOVE EXCESSIVE ACCUMULATIONS OF SEDIMENT THAT MAY CAUSE THE CONCENTRATION OF FLOW. EXCESSIVE SEDIMENT SHOULD BE REMOVED AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT, OR WHERE APPROPRIATE, EVENLY RAKED INTO THE SOIL. SEDIMENT SHOULD BE REMOVED IN A MANNER THAT AVOIDS DAMAGE TO THE BUFFER ZONE OR THE CREATION OF WHEEL TRACKS DOWN THE SLOPE.

5. EXCESSIVE SEDIMENT MAY BE DEFINED AS:

(i) ANY SEDIMENT THAT COVERS A PORTION OF THE GRASSED SURFACE; OR

(ii) SEDIMENT DEPOSITION SUCH THAT THE GRASS STRAND HEIGHT ABOVE THE SEDIMENT IS LESS THAN 50mm; OR

(iii) A DEPOSITION OF SEDIMENT IN EXCESS OF 750g/m^2 (APPROXIMATELY THE EQUIVALENT OF THREE 70mm DIAMETER BALLS OF DRY SOIL).

6. THE SOURCE OF ANY EXCESSIVE SEDIMENT SHOULD BE INVESTIGATED AND CONTROLLED WHERE PRACTICAL.

7. TAKE APPROPRIATE STEPS TO MAINTAIN AT LEAST 75% GRASS COVER OVER THE BUFFER ZONE.

8. WHERE PRACTICAL, MAINTAIN ANY GROUNDCOVER VEGETATION AT A HEIGHT GREATER THAN THE EXPECTED DEPTH OF WATER FLOW AND AT LEAST 50mm.

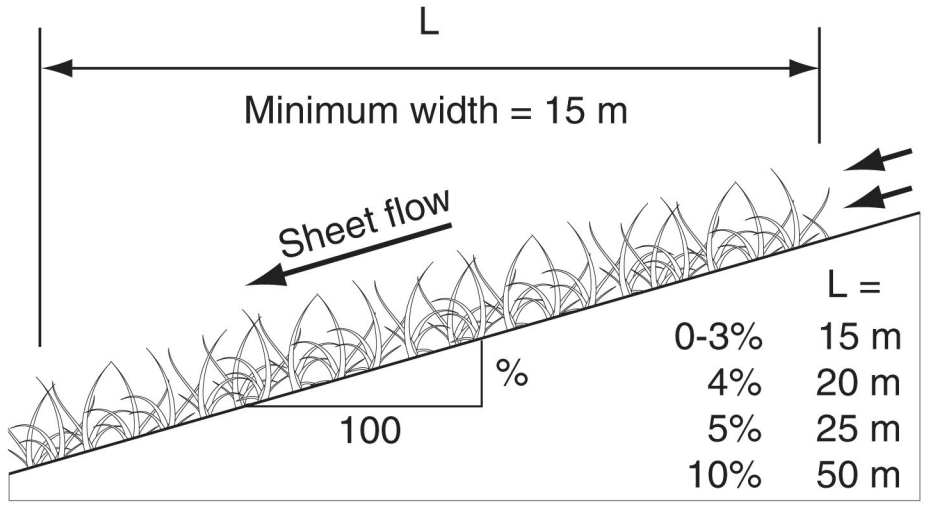

Figure 1 - Minimum dimensional requirements of a grassed buffer zone

Drawn:	Date:		
GMW	Apr-10	Buffer Zones (grassed)	BZ-01

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MATERIALS

(i) MULCH MUST COMPLY WITH THE REQUIREMENTS OF AS4454.

(ii) MAXIMUM SOLUBLE SALT CONCENTRATION OF 5dS/m.

(iii) MOISTURE CONTENT OF 30 TO 50% PRIOR TO APPLICATION.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND EXTENT. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, MATERIAL TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEN SELECTING THE LOCATION OF A MULCH FILTER BERM, TO THE MAXIMUM DEGREE PRACTICAL, ENSURE THE BERM IS LOCATED:

(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;

(ii) ALONG A LINE OF CONSTANT ELEVATION (PREFERRED, BUT NOT ALWAYS PRACTICAL);

(iii) AT LEAST 1m, IDEALLY 3m, FROM THE TOE OF A FILL EMBANKMENT;

(iv) AWAY FROM AREAS OF CONCENTRATED FLOW.

3. ENSURE THE BERM IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE BERM, OR THE UNDESIRABLE DISCHARGE OF WATER AROUND THE END OF THE BERM.

4. ENSURE THE BERM HAS BEEN PLACED SUCH THAT PONDING UP-SLOPE OF THE BERM IS MAXIMISED.

5. ENSURE BOTH ENDS OF THE BERM ARE ADEQUATELY TURNED UP THE SLOPE TO PREVENT FLOW BYPASSING PRIOR TO WATER PASSING OVER THE BERM.

6. ENSURE 100% CONTACT WITH THE SOIL SURFACE.

7. WHERE SPECIFIED, TAKE APPROPRIATE STEPS TO VEGETATE THE BERM.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL BERMS AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR OR REPLACE ANY DAMAGED SECTIONS.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 100mm OR 1/3 THE HEIGHT OF THE BERM.

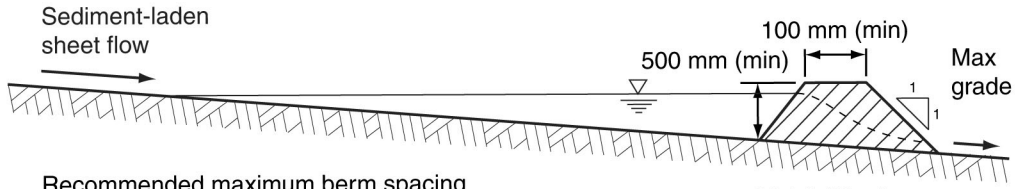
5. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL (IF REQUIRED)

1. WHEN DISTURBED AREAS UP-SLOPE OF THE BERM ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE BERM MAYBE REMOVED.

2. REMOVE ANY 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.



Recommended maximum berm spacing

Land slope	Max spacing
< 2%	30 m
5%	25 m
10%	15 m
20%	8 m

Figure 1 - Typical placement of mulch filter berm

Drawn:	Date:		
GMW	Apr-10	Mulch Filter Berms	MB-01

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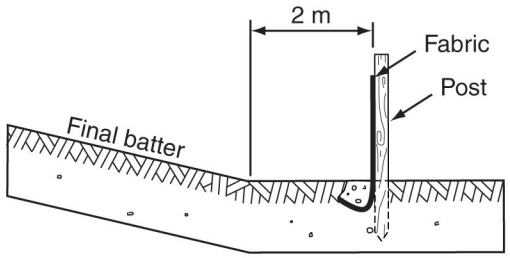
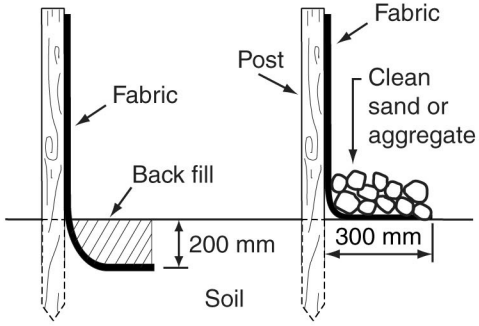
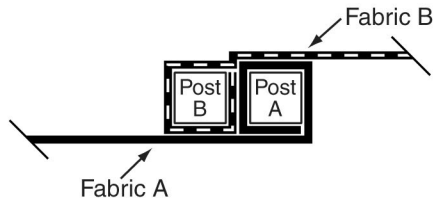


(a) Location of fence relative to base of slope

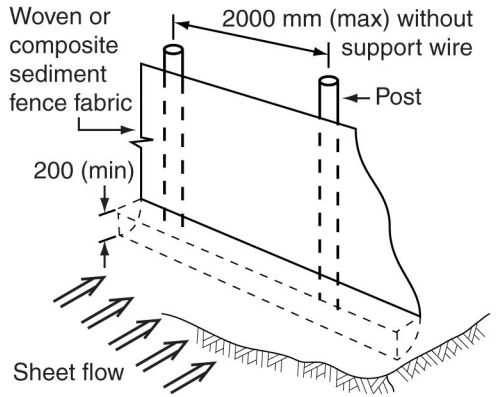


(b) Anchoring base of fabric

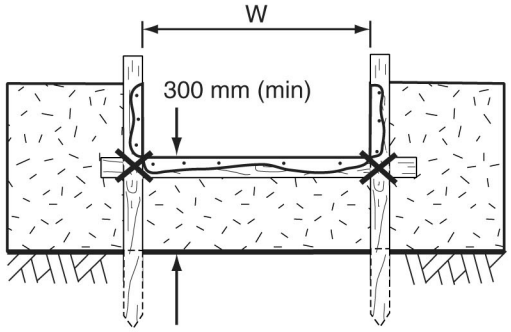


Fabric to fold around each stake one full turn.
Stake B to be drive tightly against Stake A.
The tops of both stakes to be secured with wire.

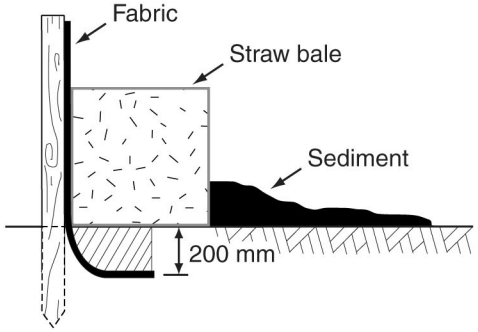
(c) Joining fabric - Method 1



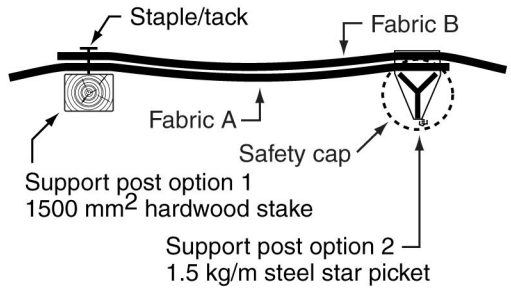
(d) Installation without backing support



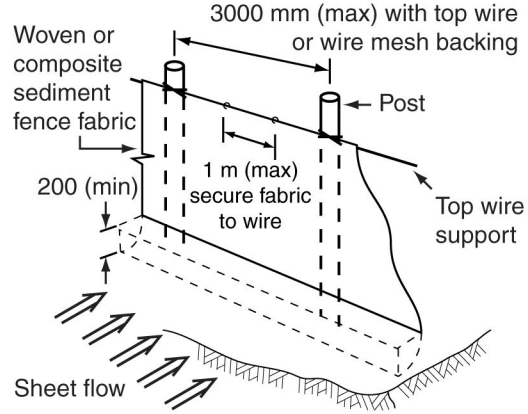
(e) Spill-through weir



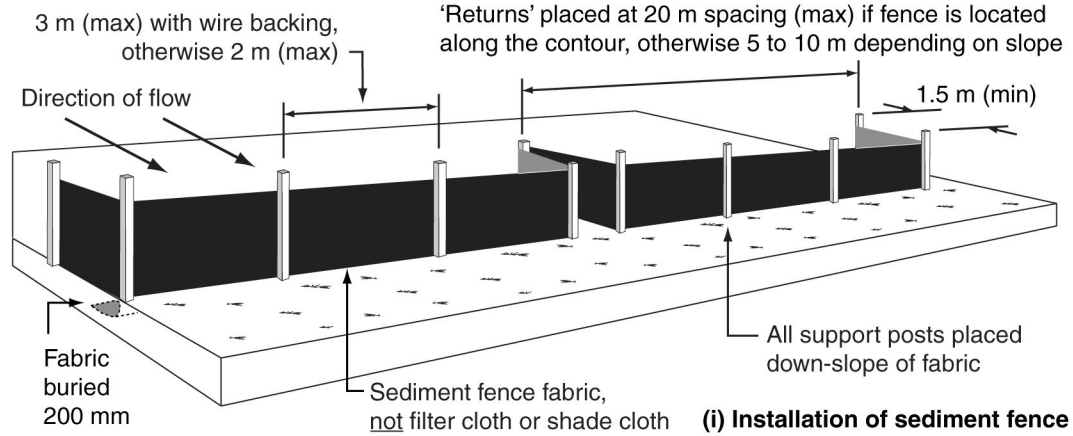
(f) Placement of up-slope straw bale



(g) Joining fabric - Method 2



(h) Installation with top wire support



(i) Installation of sediment fence

Notes:

1. Sediment fence to be installed along a line of constant ground elevation wherever practical.
2. Both end of the sediment fence to extend up the slope at least 1m.
3. Support post to be spaced a maximum 2m unless the fence is supported by a top wire or wire mesh backing, in which case 3m maximum spacing.
4. Fence 'returns' shall be installed at maximum 20m spacing if fence is installed along the contour, otherwise 5 to 10m maximum spacing.
5. Minimum 4 staples or tie wires per stake.

Drawn:	Date:		
GMW	Dec-09	Sediment Fence	SF-01

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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; OR
(ii) OVERLAP THE FABRIC TO THE NEXT ADJACENT SUPPORT POST.

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.

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.

Drawn:	Date:		
GMW	Apr-10	Sediment Fence	SF-02

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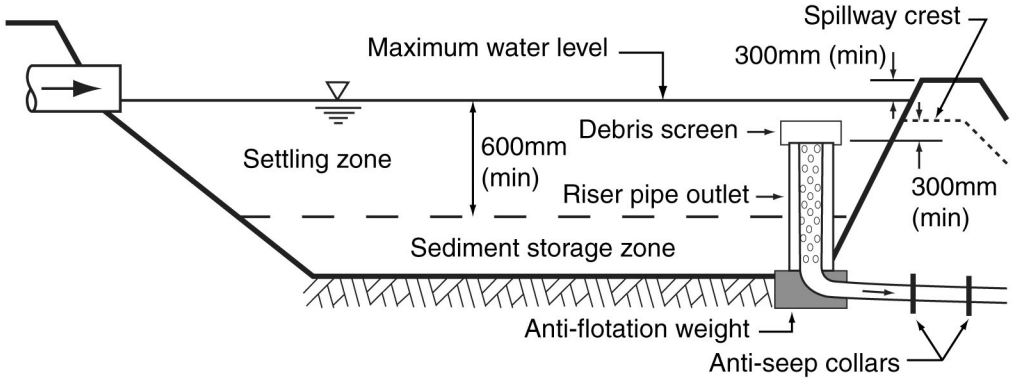
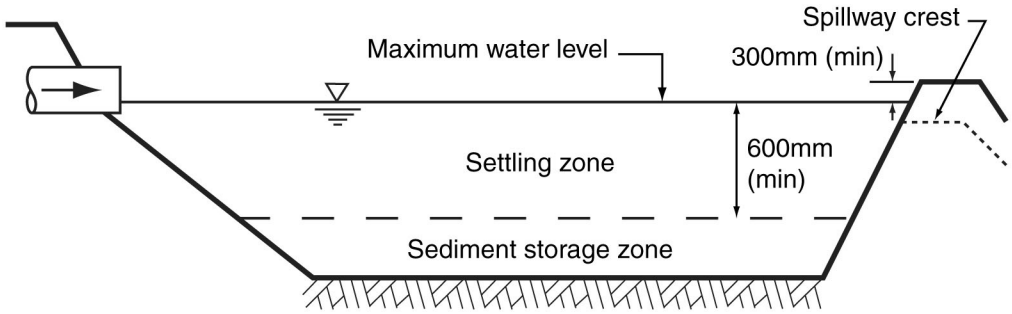
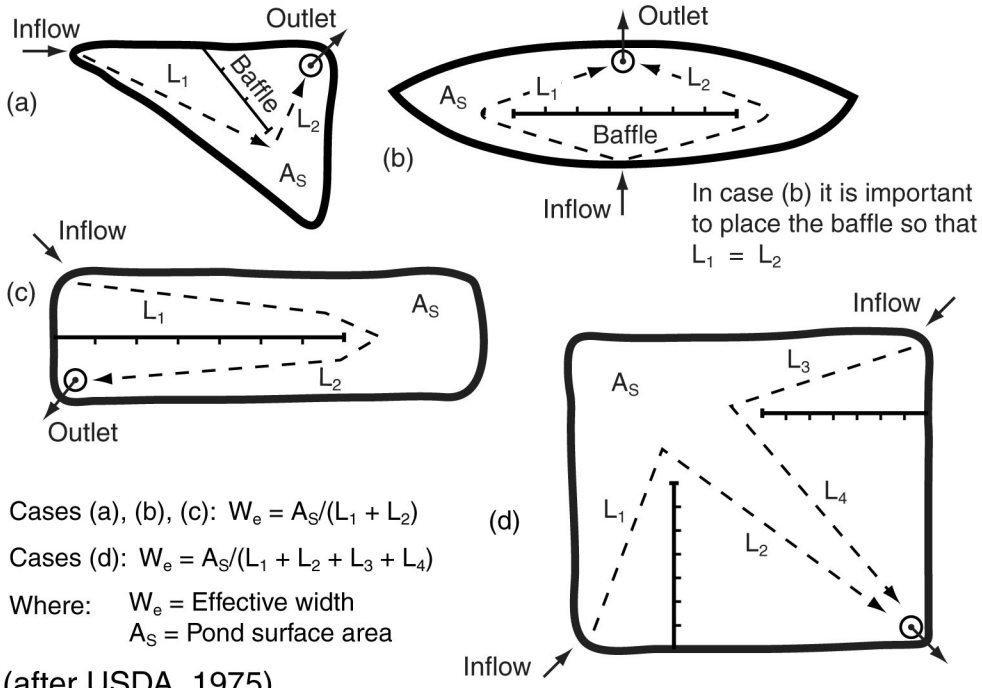


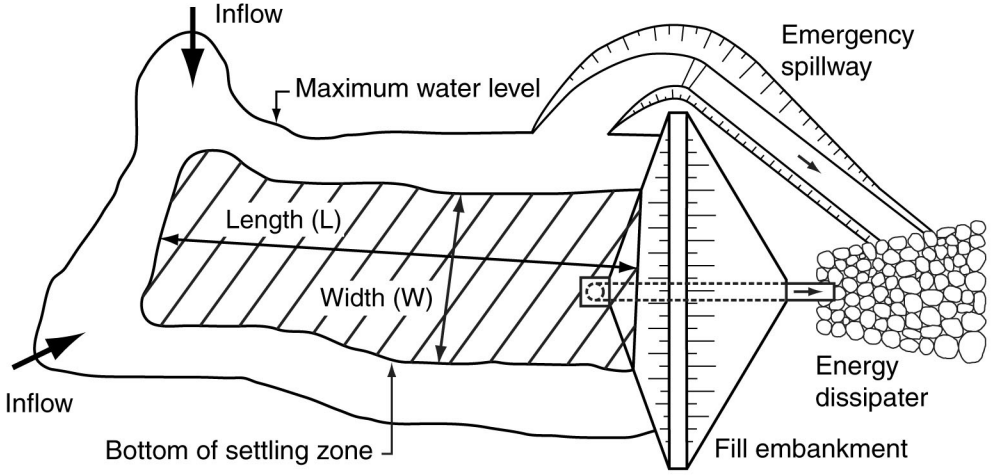
(a) Type C (dry) basin with riser pipe outlet system



(b) Typical profile of Type F/D (wet) basin



(c) Typical arrangement of internal flow control baffles



(d) Type C (dry) basin with riser pipe outlet system (plan view)

Drawn:	Date:		
GMW	Feb-10	Sediment Basins	SB-01

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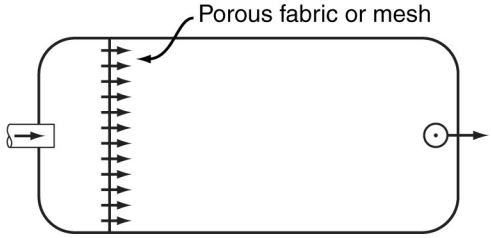
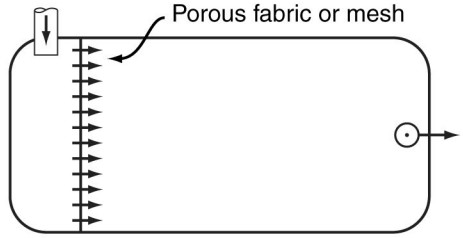
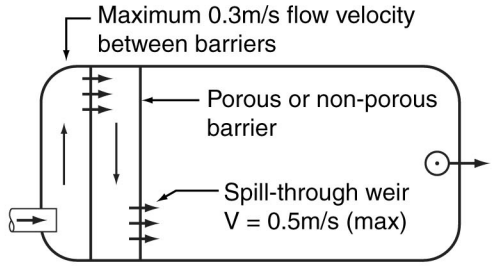


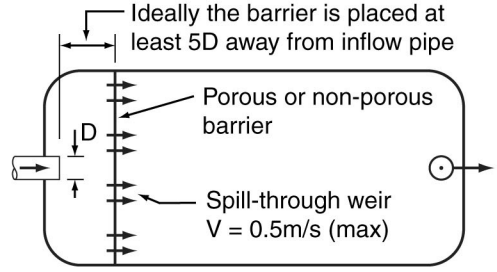
(a1) Porous barrier inlet chamber (plan view)



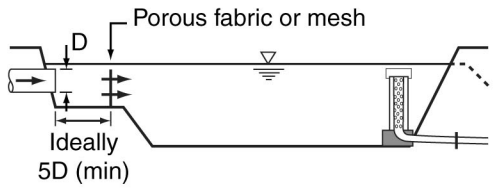
(b1) Porous barrier inlet chamber (plan view)



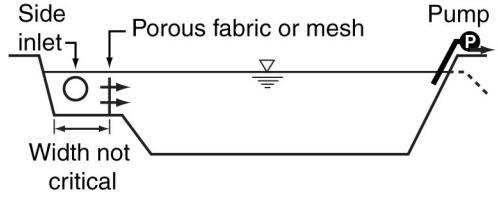
(c1) Alternative inlet chamber (plan view)



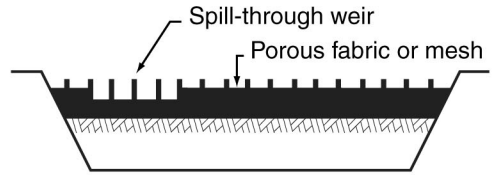
(d1) Alternative inlet chamber (plan view)



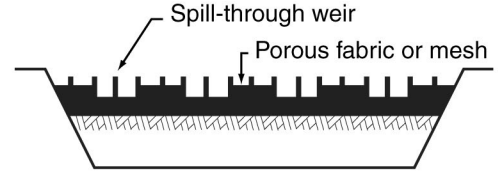
(a2) Typical layout of inlet chamber (long-section)



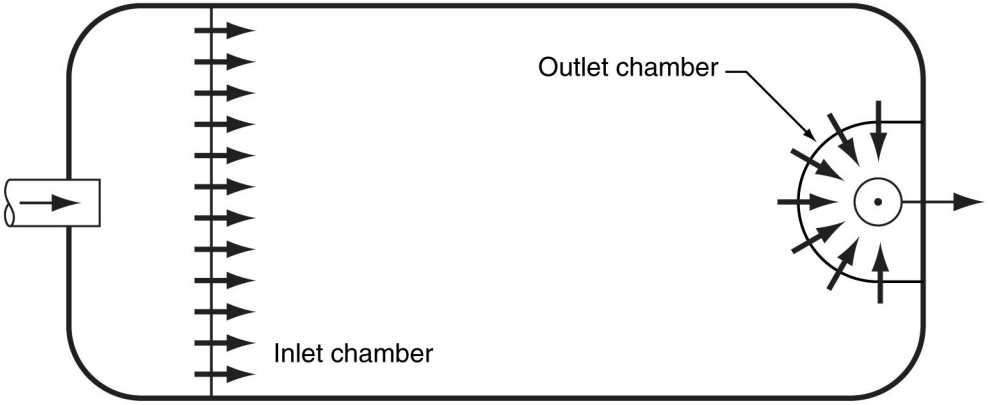
(b2) Typical layout of inlet chamber (long-section)



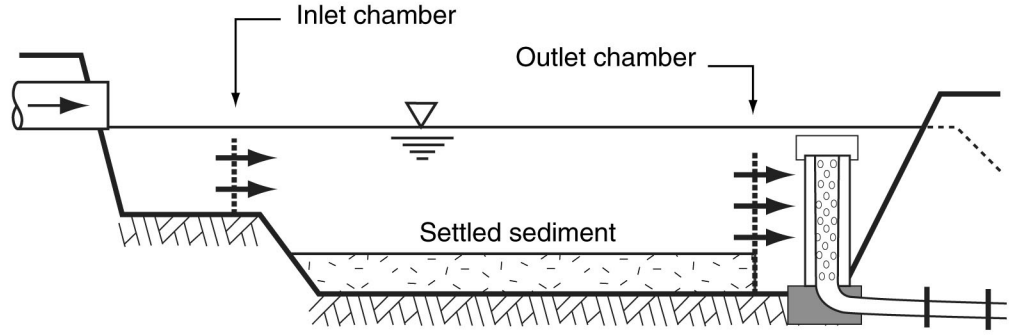
(c2) Single spill-through weir per barrier



(d2) Multiple spill-through weirs per barrier



(e) Typical arrangement of inlet and outlet chambers (plan view)



(f) Typical arrangement of inlet and outlet chambers (long-section)

Drawn:	Date:		
GMW	Feb-10	Sediment Basins - Inlet Chambers and Outlet Chambers	SB-02

Catchments & Creeks Pty Ltd

MATERIALS

EARTH FILL: CLEAN SOIL WITH EMERSON CLASS 2(1), 3, 4, OR 5, AND FREE OF ROOTS, WOODY VEGETATION, ROCKS AND OTHER UNSUITABLE MATERIAL. SOIL WITH EMERSON CLASS 4 AND 5 MAY NOT BE SUITABLE DEPENDING ON PARTICLE SIZE DISTRIBUTION AND DEGREE OF DISPERSION. CLASS 2(1) SHOULD ONLY BE USED UPON RECOMMENDATION FROM GEOTECHNICAL SPECIALIST. THIS SPECIFICATION MAYBE REPLACED BY AN EQUIVALENT STANDARD BASED ON THE EXCHANGEABLE SODIUM PERCENTAGE.

RISER PIPE: MINIMUM 250mm DIAMETER.

SPILLWAY ROCK: HARD, ANGULAR, DURABLE, WEATHER RESISTANT AND EVENLY GRADED ROCK WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL (d50) ROCK SIZE. LARGE ROCK SHOULD DOMINATE, WITH SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE. THE SPECIFIC GRAVITY SHOULD BE AT LEAST 2.5.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM 'BIDIM' A24 OR EQUIVALENT.

CONSTRUCTION

1. NOTWITHSTANDING ANY DESCRIPTION CONTAINED WITHIN THE APPROVED PLANS OR SPECIFICATIONS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR SATISFYING THEMSELVES AS TO THE NATURE AND EXTENT OF THE SPECIFIED WORKS AND THE PHYSICAL AND LEGAL CONDITIONS UNDER WHICH THE WORKS WILL BE CARRIED OUT. THIS SHALL INCLUDE MEANS OF ACCESS, EXTENT OF CLEARING, NATURE OF MATERIAL TO BE EXCAVATED, TYPE AND SIZE OF MECHANICAL PLANT REQUIRED, LOCATION AND SUITABILITY OF WATER SUPPLY FOR CONSTRUCTION AND TESTING PURPOSES, AND ANY OTHER LIKE MATTERS AFFECTING THE CONSTRUCTION OF THE WORKS.

2. 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.

3. BEFORE STARTING ANY CLEARING OR CONSTRUCTION, ENSURE ALL THE NECESSARY MATERIALS AND COMPONENTS ARE ON THE SITE TO AVOID DELAYS IN COMPLETING THE POND ONCE WORKS BEGIN.

4. INSTALL REQUIRED SHORT-TERM SEDIMENT CONTROL MEASURES DOWNSTREAM OF THE PROPOSED EARTHWORKS TO CONTROL SEDIMENT RUNOFF DURING CONSTRUCTION OF THE BASIN.

5. THE AREA TO BE COVERED BY THE EMBANKMENT, BORROW PITS AND INCIDENTAL WORKS, TOGETHER WITH AN AREA EXTENDING BEYOND THE LIMITS OF EACH FOR A DISTANCE NOT EXCEEDING FIVE (5) METRES ALL AROUND MUST BE CLEARED OF ALL TREES, SCRUB, STUMPS, ROOTS, DEAD TIMBER AND RUBBISH AND DISPOSED OF IN A SUITABLE MANNER. DELAY CLEARING THE MAIN POND AREA UNTIL THE EMBANKMENT IS COMPLETE.

6. ENSURE ALL HOLES MADE BY GRUBBING WITHIN THE EMBANKMENT FOOTPRINT ARE FILLED WITH SOUND MATERIAL, ADEQUATELY COMPACTED, AND FINISHED FLUSH WITH THE NATURAL SURFACE.
CUT-OFF TRENCH:

7. BEFORE CONSTRUCTION OF THE CUT-OFF TRENCH OR ANY ANCILLARY WORKS WITHIN THE EMBANKMENT FOOTPRINT, ALL GRASS GROWTH AND TOPSOIL MUST BE REMOVED FROM THE AREA TO BE OCCUPIED BY THE EMBANKMENT AND MUST BE DEPOSITED CLEAR OF THIS AREA AND RESERVED FOR TOPDRESSING THE COMPLETING THE EMBANKMENT.

8. EXCAVATE A CUT-OFF TRENCH ALONG THE CENTRE LINE OF THE EARTH FILL EMBANKMENT. CUT THE TRENCH TO STABLE SOIL MATERIAL, BUT IN NO CASE MAKE IT LESS THAN 600mm DEEP. THE CUT-OFF TRENCH MUST EXTEND INTO BOTH ABUTMENTS TO AT LEAST THE ELEVATION OF THE RISER PIPE CREST. MAKE THE MINIMUM BOTTOM WIDTH WIDE ENOUGH TO PERMIT OPERATION OF EXCAVATION AND COMPACTION EQUIPMENT, BUT IN NO CASE LESS THAN 600mm. MAKE THE SIDE SLOPES OF THE TRENCH NO STEEPER THAN 1:1 (H:V).

9. ENSURE ALL WATER, LOOSE SOIL, AND ROCK ARE REMOVED FROM THE TRENCH BEFORE BACKFILLING COMMENCES. THE CUT-OFF TRENCH MUST BE BACKFILLED WITH SELECTED EARTH-FILL OF THE TYPE SPECIFIED FOR THE EMBANKMENT, AND THIS SOIL MUST HAVE A MOISTURE CONTENT AND DEGREE OF COMPACTION THE SAME AS THAT SPECIFIED FOR THE SELECTED CORE ZONE.

10. MATERIAL EXCAVATED FROM THE CUT-OFF TRENCH MAY BE USED IN CONSTRUCTION OF THE EMBANKMENT PROVIDED IT IS SUITABLE AND IT IS PLACED IN THE CORRECT ZONE ACCORDING TO ITS CLASSIFICATION.

EMBANKMENT:

11. SCARIFY AREAS ON WHICH FILL IS TO BE PLACED BEFORE PLACING THE FILL.

12. ENSURE ALL FILL MATERIAL USED TO FORM THE EMBANKMENT MEETS THE SPECIFICATIONS CERTIFIED BY A SOIL SCIENTIST OR GEOTECHNICAL SPECIALIST.

13. THE FILL MATERIAL MUST CONTAIN SUFFICIENT MOISTURE SO IT CAN BE FORMED BY HAND INTO A BALL WITHOUT CRUMBLING. IF WATER CAN BE SQUEEZED OUT OF THE BALL, IT IS TOO WET FOR PROPER COMPACTION. PLACE FILL MATERIAL IN 150 TO 250mm CONTINUOUS LAYERS OVER THE ENTIRE LENGTH OF THE FILL AREA AND THEN COMPACT BEFORE PLACEMENT OF FURTHER FILL.

14. PLACE RISER PIPE OUTLET SYSTEM, IF SPECIFIED, IN APPROPRIATE SEQUENCE WITH THE EMBANKMENT FILLING. REFER TO SEPARATE INSTALLATION SPECIFICATIONS.

15. UNLESS OTHERWISE SPECIFIED ON THE APPROVED PLANS, COMPACT THE SOIL AT ABOUT 1% TO 2% WET OF OPTIMUM AND TO 95% MODIFIED OR 100% STANDARD COMPACTION.

16. WHERE BOTH DISPERSIVE AND NON-DISPERSIVE CLASSIFIED EARTH-FILL MATERIALS ARE AVAILABLE, NON-DISPERSIVE EARTH-FILL MUST BE USED IN THE CORE ZONE. THE REMAINING CLASSIFIED EARTH-FILL MATERIALS MUST ONLY BE USED AS DIRECTED BY [INSERT TITLE].

17. WHERE SPECIFIED, CONSTRUCT THE EMBANKMENT TO AN ELEVATION 10% HIGHER THAN THE DESIGN HEIGHT TO ALLOW FOR SETTLING; OTHERWISE FINISHED DIMENSIONS OF THE EMBANKMENT AFTER SPREADING OF TOPSOIL MUST CONFORM TO THE DRAWING WITH A TOLERANCE OF 75mm FROM THE SPECIFIED DIMENSIONS.

18. ENSURE DEBRIS AND OTHER UNSUITABLE BUILDING WASTE IS NOT PLACED WITHIN THE EARTH EMBANKMENT.

19. AFTER COMPLETION OF THE EMBANKMENT ALL LOOSE UNCOMPACTED EARTH-FILL MATERIAL ON THE UPSTREAM AND DOWNSTREAM BATTER MUST BE REMOVED PRIOR TO SPREADING OF TOPSOIL.

20. TOPSOIL AND REVEGETATE/STABILISED ALL EXPOSED EARTH AS DIRECTED WITHIN THE APPROVED PLANS.

(continued on SB-06)

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Feb-10	Sediment Basins	SB-05

SPILLWAY CONSTRUCTION:

21. THE SPILLWAY MUST BE EXCAVATED AS SHOWN ON THE PLANS, AND THE EXCAVATED MATERIAL IF CLASSIFIED AS SUITABLE, MUST BE USED IN THE EMBANKMENT, AND IF NOT SUITABLE IT MUST BE DISPOSED OF INTO SPOIL HEAPS.

22. ENSURE EXCAVATED DIMENSIONS ALLOW ADEQUATE BOXING-OUT SUCH THAT THE SPECIFIED ELEVATIONS, GRADES, CHUTE WIDTH, AND ENTRANCE AND EXIT SLOPES FOR THE EMERGENCY SPILLWAY WILL BE ACHIEVED AFTER PLACEMENT OF THE ROCK OR OTHER SCOUR PROTECTION MEASURES AS SPECIFIED IN THE PLANS.

23. PLACE SPECIFIED SCOUR PROTECTION MEASURES ON THE EMERGENCY SPILLWAY. ENSURE THE FINISHED GRADE BLENDS WITH THE SURROUNDING AREA TO ALLOW A SMOOTH FLOW TRANSITION FROM SPILLWAY TO DOWNSTREAM CHANNEL.

24. IF A SYNTHETIC FILTER FABRIC UNDERLAY IS SPECIFIED, PLACE THE FILTER FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN ONE SHEET OF FILTER FABRIC IS REQUIRED, OVERLAP THE EDGES BY AT LEAST 300mm AND PLACE ANCHOR PINS AT MINIMUM 1m SPACING ALONG THE OVERLAP. BURY THE UPSTREAM END OF THE FABRIC A MINIMUM 300mm BELOW GROUND AND WHERE NECESSARY, BURY THE LOWER END OF THE FABRIC OR OVERLAP A MINIMUM 300mm OVER THE NEXT DOWNSTREAM SECTION AS REQUIRED. ENSURE THE FILTER FABRIC EXTENDS AT LEAST 1000mm UPSTREAM OF THE SPILLWAY CREST.

25. TAKE CARE NOT TO DAMAGE THE FABRIC DURING OR AFTER PLACEMENT. IF DAMAGE OCCURS, REMOVE THE ROCK AND REPAIR THE SHEET BY ADDING ANOTHER LAYER OF FABRIC WITH A MINIMUM OVERLAP OF 300mm AROUND THE DAMAGED AREA. IF EXTENSIVE DAMAGE IS SUSPECTED, REMOVE AND REPLACE THE ENTIRE SHEET.

26. WHERE LARGE ROCK IS USED, OR MACHINE PLACEMENT IS DIFFICULT, A MINIMUM 100mm LAYER OF FINE GRAVEL, AGGREGATE, OR SAND MAY BE NEEDED TO PROTECT THE FABRIC.

27. PLACEMENT OF ROCK SHOULD FOLLOW IMMEDIATELY AFTER PLACEMENT OF THE FILTER FABRIC. PLACE ROCK SO THAT IT FORMS A DENSE, WELL-GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS. THE DESIRED DISTRIBUTION OF ROCK THROUGHOUT THE MASS MAY BE OBTAINED BY SELECTIVE LOADING AT THE QUARRY AND CONTROLLED DUMPING DURING FINAL PLACEMENT.

28. THE FINISHED SLOPE SHOULD BE FREE OF POCKETS OF SMALL ROCK OR CLUSTERS OF LARGE ROCKS. HAND PLACING MAY BE NECESSARY TO ACHIEVE THE PROPER DISTRIBUTION OF ROCK SIZES TO PRODUCE A RELATIVELY SMOOTH, UNIFORM SURFACE. THE FINISHED GRADE OF THE ROCK SHOULD BLEND WITH THE SURROUNDING AREA. NO OVERFALL OR PROTRUSION OF ROCK SHOULD BE APPARENT.

29. ENSURE THAT THE FINAL ARRANGEMENT OF THE SPILLWAY CREST WILL NOT PROMOTE EXCESSIVE FLOW THROUGH THE ROCK SUCH THAT THE WATER CAN BE RETAINED WITHIN THE SETTLING BASIN AN ELEVATION NO LESS THAN 50mm ABOVE OR BELOW THE NOMINATED SPILLWAY CREST ELEVATION. ESTABLISHMENT OF SETTLING POND:

30. THE AREA TO BE COVERED BY THE STORED WATER OUTSIDE THE LIMITS OF THE BORROW PITS MUST BE CLEARED OF ALL SCRUB AND RUBBISH. TREES MUST BE CUT DOWN STUMP HIGH AND REMOVED FROM THE IMMEDIATE VICINITY OF THE WORK.

31. ESTABLISH ALL REQUIRED INFLOW CHUTES AND INLET BAFFLES, IF SPECIFIED, TO ENABLE WATER TO DISCHARGE INTO THE BASIN IN A MANNER THAT WILL NOT CAUSE SOIL EROSION OR THE RE-SUSPENSION OF SETTLED SEDIMENT.

32. INSTALL A SEDIMENT STORAGE LEVEL MARKER POST WITH A CROSS MEMBER SET JUST BELOW THE TOP OF THE SEDIMENT STORAGE ZONE (AS SPECIFIED ON THE APPROVED PLANS). USE AT LEAST A 75mm WIDE POST FIRMLY SET INTO THE BASIN FLOOR.

33. IF SPECIFIED, INSTALL INTERNAL SETTLING POND BAFFLES. ENSURE THE CREST OF THESE BAFFLES IS SET LEVEL WITH, OR JUST BELOW, THE ELEVATION OF THE EMERGENCY SPILLWAY CREST.

34. INSTALL ALL APPROPRIATE MEASURES TO MINIMISE SAFETY RISK TO ON-SITE PERSONNEL AND THE PUBLIC CAUSED BY THE PRESENCE OF THE SETTLING POND. AVOID STEEP, SMOOTH INTERNAL SLOPES. APPROPRIATELY FENCE THE SETTLING POND AND POST WARNING SIGNS IF UNSUPERVISED PUBLIC ACCESS IS LIKELY OR THERE IS CONSIDERED TO BE AN UNACCEPTABLE RISK TO THE PUBLIC.

MAINTENANCE OF SEDIMENT BASIN

1. INSPECT THE SEDIMENT BASIN DURING THE FOLLOWING PERIODS:

(i) DURING CONSTRUCTION TO DETERMINE WHETHER MACHINERY, FALLING TREES, OR CONSTRUCTION ACTIVITY HAS DAMAGED ANY COMPONENTS OF THE SEDIMENT BASIN. IF DAMAGE HAS OCCURRED, REPAIR IT.

(ii) AFTER EACH RUNOFF EVENT. INSPECT THE EROSION DAMAGE AT FLOW ENTRY AND EXIT POINTS. IF DAMAGE HAS OCCURRED, MAKE THE NECESSARY REPAIRS.

(iii) AT LEAST WEEKLY DURING THE NOMINATED WET SEASON (IF ANY) OTHERWISE AT LEAST FORTNIGHTLY.

(iv) PRIOR TO, AND IMMEDIATELY AFTER, PERIODS OF 'STOP WORK' OR SITE SHUTDOWN.

2. CLEAN OUT ACCUMULATED SEDIMENT WHEN IT REACHES THE MARKER BOARD/POST, AND RESTORE THE ORIGINAL STORAGE VOLUME. PLACE SEDIMENT IN A DISPOSAL AREA OR, IF APPROPRIATE, MIX WITH DRY SOIL ON THE SITE.

3. DO NOT DISPOSE OF SEDIMENT IN A MANNER THAT WILL CREATE AN EROSION OR POLLUTION HAZARD.

4. CHECK ALL VISIBLE PIPE CONNECTIONS FOR LEAKS, AND REPAIR AS NECESSARY.

5. CHECK ALL EMBANKMENTS FOR EXCESSIVE SETTLEMENT, SLUMPING OF THE SLOPES OR PIPING BETWEEN THE CONDUIT AND THE EMBANKMENT; MAKE ALL NECESSARY REPAIRS.

6. REMOVE ALL TRASH AND OTHER DEBRIS FROM THE BASIN AND RISER.

7. SUBMERGED INFLOW PIPES MUST BE INSPECTED AND DE-SILTED (AS REQUIRED) AFTER EACH INFLOW EVENT.

REMOVAL OF SEDIMENT BASIN

1. WHEN GRADING AND CONSTRUCTION IN THE DRAINAGE AREA ABOVE A TEMPORARY SEDIMENT BASIN IS COMPLETED AND THE DISTURBED AREAS ARE ADEQUATELY STABILISED, THE BASIN MUST BE REMOVED OR OTHERWISE INCORPORATED INTO THE PERMANENT STORMWATER DRAINAGE SYSTEM. IN EITHER CASE, SEDIMENT SHOULD BE CLEARED AND PROPERLY DISPOSED OF AND THE BASIN AREA STABILISED.

2. BEFORE STARTING ANY MAINTENANCE WORK ON THE BASIN OR SPILLWAY, INSTALL ALL NECESSARY SHORT-TERM SEDIMENT CONTROL MEASURES DOWNSTREAM OF THE SEDIMENT BASIN.

3. ALL WATER AND SEDIMENT MUST BE REMOVED FROM THE BASIN PRIOR TO THE DAM'S REMOVAL. DISPOSE OF SEDIMENT AND WATER IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

4. BRING THE DISTURBED AREA TO A PROPER GRADE, THEN SMOOTH, COMPACT, AND STABILISE AND/OR REVEGETATE AS REQUIRED TO ESTABLISH A STABLE LAND SURFACE.

Drawn:	Date:		
GMW	Feb-10	Sediment Basins	SB-06

Catchments & Creeks Pty Ltd

CONSTRUCTION

1. THE SPILLWAY MUST BE EXCAVATED AS SHOWN ON THE PLANS, AND THE EXCAVATED MATERIAL IF CLASSIFIED AS SUITABLE, MUST BE USED IN THE EMBANKMENT, AND IF NOT SUITABLE IT MUST BE DISPOSED OF INTO SPOIL HEAPS.

2. ENSURE EXCAVATED DIMENSIONS ALLOW ADEQUATE BOXING-OUT SUCH THAT THE SPECIFIED ELEVATIONS, GRADES, CHUTE WIDTH, AND ENTRANCE AND EXIT SLOPES FOR THE EMERGENCY SPILLWAY WILL BE ACHIEVED AFTER PLACEMENT OF THE ROCK OR OTHER SCOUR PROTECTION MEASURES AS SPECIFIED IN THE PLANS.

3. PLACE SPECIFIED SCOUR PROTECTION MEASURES ON THE EMERGENCY SPILLWAY. ENSURE THE FINISHED GRADE BLENDS WITH THE SURROUNDING AREA TO ALLOW A SMOOTH FLOW TRANSITION FROM SPILLWAY TO DOWNSTREAM CHANNEL.

4. IF A SYNTHETIC FILTER FABRIC UNDERLAY IS SPECIFIED, PLACE THE FILTER FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN 1 SHEET OF FILTER FABRIC IS REQUIRED, OVERLAP THE EDGES BY AT LEAST 300mm AND PLACE ANCHOR PINS AT MINIMUM 1m SPACING ALONG THE OVERLAP. BURY THE UPSTREAM END OF THE FABRIC A MINIMUM 300mm BELOW GROUND AND WHERE NECESSARY, BURY THE LOWER END OF THE FABRIC OR OVERLAP A MINIMUM 300mm OVER THE NEXT DOWNSTREAM SECTION AS REQUIRED. ENSURE THE FILTER FABRIC EXTENDS AT LEAST 1000mm UPSTREAM OF THE SPILLWAY CREST.

5. TAKE CARE NOT TO DAMAGE THE FABRIC DURING OR AFTER PLACEMENT. IF DAMAGE OCCURS, REMOVE THE ROCK AND REPAIR THE SHEET BY ADDING ANOTHER LAYER OF FABRIC WITH A MINIMUM OVERLAP OF 300mm AROUND THE DAMAGED AREA. IF EXTENSIVE DAMAGE IS SUSPECTED, REMOVE AND REPLACE THE ENTIRE SHEET.

6. WHERE LARGE ROCK IS USED, OR MACHINE PLACEMENT IS DIFFICULT, A MINIMUM 100mm LAYER OF FINE GRAVEL, AGGREGATE, OR SAND MAY BE NEEDED TO PROTECT THE FABRIC.

7. PLACEMENT OF ROCK SHOULD FOLLOW IMMEDIATELY AFTER PLACEMENT OF THE FILTER FABRIC. PLACE ROCK SO THAT IT FORMS A DENSE, WELL-GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS. THE DESIRED DISTRIBUTION OF ROCK THROUGHOUT THE MASS MAY BE OBTAINED BY SELECTIVE LOADING AT THE QUARRY AND CONTROLLED DUMPING DURING FINAL PLACEMENT.

8. THE FINISHED SLOPE SHOULD BE FREE OF POCKETS OF SMALL ROCK OR CLUSTERS OF LARGE ROCKS. HAND PLACING MAY BE NECESSARY TO ACHIEVE THE PROPER DISTRIBUTION OF ROCK SIZES TO PRODUCE A RELATIVELY SMOOTH, UNIFORM SURFACE. THE FINISHED GRADE OF THE ROCK SHOULD BLEND WITH THE SURROUNDING AREA. NO OVERFALL OR PROTRUSION OF ROCK SHOULD BE APPARENT.

9. ENSURE THAT THE FINAL ARRANGEMENT OF THE SPILLWAY CREST WILL NOT PROMOTE EXCESSIVE FLOW THROUGH THE ROCK SUCH THAT THE WATER CAN BE RETAINED WITHIN THE SETTLING BASIN AN ELEVATION NO LESS THAN 50mm ABOVE OR BELOW THE NOMINATED SPILLWAY CREST ELEVATION.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT THE SPILLWAY PRIOR TO FORECAST RAINFALL, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER SIGNIFICANT RUNOFF PRODUCING STORM EVENTS, OR OTHERWISE ON A WEEKLY BASIS. MAKE REPAIRS AS NECESSARY.

2. CHECK FOR MOVEMENT OF, OR DAMAGE TO, THE SPILLWAY'S LINING, INCLUDING SURFACE CRACKING.

3. CHECK FOR SOIL SCOUR ADJACENT THE SPILLWAY. INVESTIGATE THE CAUSE OF ANY SCOUR, AND REPAIR AS NECESSARY.

4. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SPILLWAY TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED.

REMOVAL

1. TEMPORARY SPILLWAYS SHOULD BE REMOVED WHEN AN ALTERNATIVE, STABLE, DRAINAGE SYSTEM IS AVAILABLE.

2. REMOVE ALL MATERIALS AND DEPOSITED SEDIMENT, AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA IN PREPARATION FOR STABILISATION, THEN STABILISE THE AREA AS SPECIFIED IN THE APPROVED PLAN.

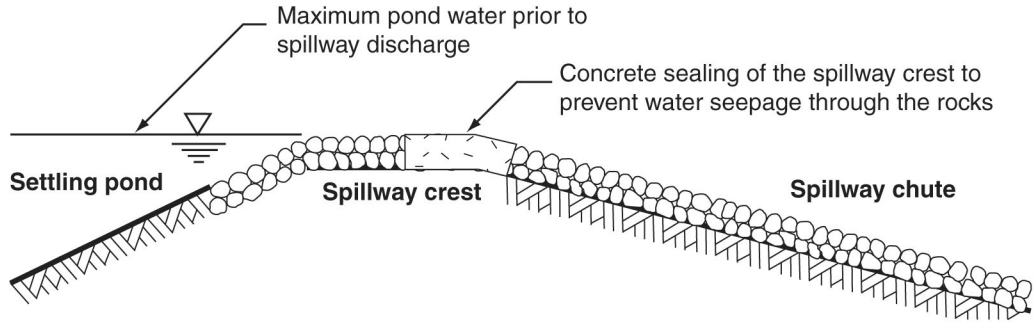


Figure 1 - Example of seepage control on the spillway crest

Drawn:	Date:		
GMW	Dec-09	Emergency Spillways	ES-1

Catchments & Creeks Pty Ltd

CONSTRUCTION

1. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE FOUNDATION AREA OF THE OUTLET STRUCTURE (IF ANY), AND INSTALL AS PER SEPARATE INSTRUCTIONS.

3. EXCAVATE THE SETTLING POND IN ACCORDANCE WITH THE APPROVED PLANS. UNLESS OTHERWISE SPECIFIED, THE EXCAVATED PIT SHOULD HAVE A SIDE SLOPE OF 2:1(H:V) OR FLATTER.

4. APPROPRIATELY STABILISE ANY BANK SUBJECT TO DIRECT INFLOW.

5. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT-LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.

6. TAKE ALL NECESSARY MEASURE TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE.

MAINTENANCE

1. CHECK EXCAVATED SEDIMENT TRAPS AFTER EACH RUNOFF EVENT AND MAKE REPAIRS IMMEDIATELY.

2. INSPECT THE BANKS FOR SLUMPING OR EXCESSIVE SCOUR.

3. IF FLOW THROUGH THE STRUCTURE IS REDUCED TO AN UNACCEPTABLE LEVEL DUE TO BLOCKAGE OF THE OUTLET STRUCTURE (IF ANY), THEN MAKE ALL NECESSARY REPAIRS AND MAINTENANCE TO RESTORE THE DESIRED FLOW CONDITIONS.

4. CHECK THE STRUCTURE AND SURROUNDING CHANNEL BANKS FOR DAMAGE FROM OVERTOPPING FLOWS AND MAKE REPAIRS AS NECESSARY.

5. REMOVE SEDIMENT AND RESTORE ORIGINAL SEDIMENT STORAGE VOLUME WHEN COLLECTED SEDIMENT EXCEEDS 30% OF THE PIT VOLUME.

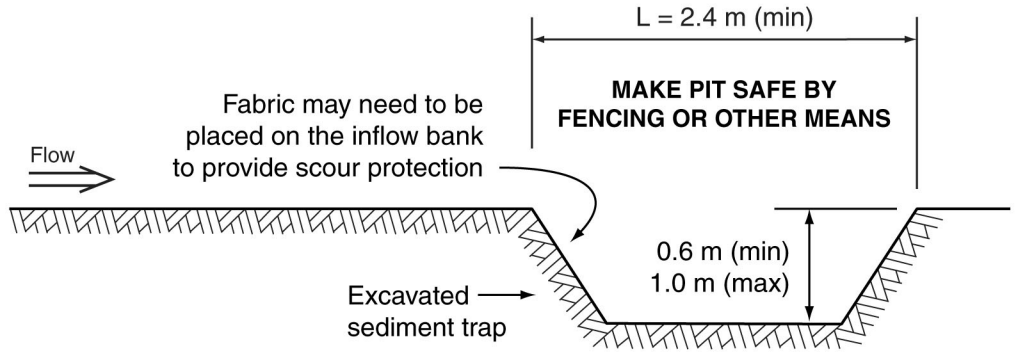
6. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

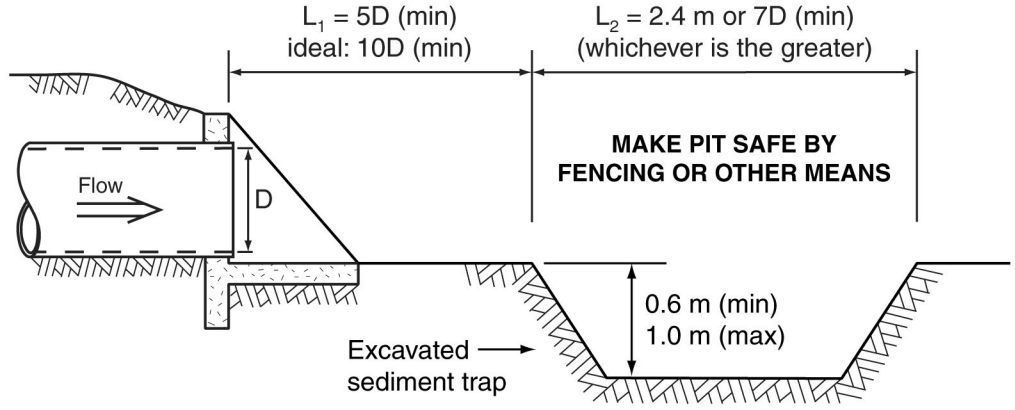
1. WHEN THE UP-SLOPE DRAINAGE AREA HAS BEEN STABILISED, REMOVE ALL MATERIALS INCLUDED DEPOSITED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

2. ALL WATER AND SEDIMENT SHOULD BE REMOVED FROM THE BASIN PRIOR TO THE DAM'S REMOVAL. DISPOSE OF SEDIMENT AND WATER IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. BRING THE DISTURBED AREA TO A PROPER GRADE, THEN SMOOTH, COMPACT AND STABILISE AND/OR REVEGETATE AS REQUIRED.



(a) Excavated sediment trap located within a minor drainage path



Where space is not available, make optimum use of the available space

(b) Excavated sediment trap located downstream of a stormwater outlet

Drawn:	Date:		
GMW	Apr-10	Excavated Sediment Trap	EST-01

Catchments & Creeks Pty Ltd

MATERIAL

GRAVEL: 20–50mm HARD, ANGULAR, DURABLE, WEATHER RESISTANT AND EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE AND SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. SPREAD ENOUGH GRAVEL TO COMPLETELY COVER THE SURFACE OF THE SOIL AT THE DENSITY OR THICKNESS SPECIFIED IN THE APPROVED PLANS. IF THE APPLICATION DENSITY IS NOT SUPPLIED, THEN APPLY AT A THICKNESS OF AT LEAST TWICE THE MEAN ROCK SIZE.

3. MAKE ALL NECESSARY ADJUSTMENTS TO ENSURE ANY RUN-ON STORMWATER FLOW IS ALLOWED TO PASS FREELY ACROSS THE TREATED AREA FOLLOWING ITS NATURAL DRAINAGE PATH.

MAINTENANCE

1. INSPECT ALL TREATED SURFACES FORTNIGHTLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. CHECK FOR RILL EROSION, OR DISLODGMENT OF THE GRAVEL.

3. REPLACE ANY DISPLACED GRAVEL TO MAINTAIN THE REQUIRED COVERAGE.

4. IF WASH-OUTS OCCUR, REPAIR THE SLOPE AND REINSTALL SURFACE COVER.

5. IF THE GRAVELLING IS NOT EFFECTIVE IN CONTAINING THE SOIL EROSION IT SHOULD BE REPLACED, OR AN ALTERNATIVE EROSION CONTROL PROCEDURE ADOPTED.

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Dec-09	Gravelling	Gravel-01

MATERIALS

MULCH: TO THE MAXIMUM DEGREE PRACTICAL THE MULCH MUST BE FREE OF WEED SPECIES ESPECIALLY PROHIBITED NOXIOUS WEED SEED. DO NOT USE WOODCHIP MULCH THAT IS TOO FRESH OR CONTAINS SAPPY SOFTWOOD. DO NOT USE RESINOUS PINE MATERIALS THAT CAN TRANSFER WATER REPELLENCE TO THE SOIL.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. ENSURE THE SURFACE IS FREE OF DEEP TRACK MARKS OF OTHER FEATURES THAT MAY RESULT IN FLOW CONCENTRATION DOWN THE SLOPE. WHERE NECESSARY, ESTABLISH UP-SLOPE DRAINAGE CONTROLS TO LIMIT RUN-ON WATER THAT MAY DISTURB THE MULCH.

3. SPREAD ENOUGH MULCH TO COMPLETELY COVER THE SURFACE OF THE SOIL AT THE DENSITY OR THICKNESS SPECIFIED IN THE APPROVED PLANS, OR OTHERWISE NOT LESS THAN 100mm.

4. SUITABLE ANCHORAGE OF THE MULCH MUST BE ACCOMPLISHED IMMEDIATELY AFTER THE MULCH HAS BEEN PLACED.

5. ENSURE THE MULCH IS RESTRAINED FROM EXCESSIVE MOVEMENT BY WIND OR STORMWATER RUNOFF BY APPROPRIATELY ANCHORING OR GLUING THE MULCH WITH AN APPROVED TACKIFIER.

6. APPLICATION (SPRAYING) OF A TACKIFIER MUST NOT BE PERFORMED DURING PERIODS OF WINDY CONDITIONS THAT WOULD PREVENT THE PROPER PLACEMENT OF ADHESIVE.

7. THE CONTRACTOR MUST TAKE APPROPRIATE STEPS TO PROTECT ALL TRAFFIC, SIGNS, STRUCTURES, AND OTHER OBJECTS FROM BEING MARKED OR DISFIGURED BY THE TACKIFIER MATERIAL.

MAINTENANCE

1. INSPECT ALL MULCHES FORTNIGHTLY AND AFTER RUNOFF-PRODUCING RAINFALL AND STRONG WINDS.

2. CHECK FOR RILL EROSION, OR DISLODGMENT OF THE MULCH.

3. REPLACE ANY DISPLACED MULCH TO MAINTAIN THE REQUIRED COVERAGE.

4. IF STORMWATER RUNOFF DISPLACES MORE THAN 10% OF THE MULCH, THEN INVESTIGATE THE NEED FOR ADDITIONAL DRAINAGE CONTROLS TO PREVENT FURTHER DISPLACEMENT.

Catchments & Creeks Pty Ltd

Drawn:	Date:		
GMW	Dec-09	Heavy Mulching	MH-01

MATERIALS (GENERAL)

MULCH: TO THE MAXIMUM DEGREE PRACTICAL THE MULCH SHALL BE FREE OF WEED SPECIES ESPECIALLY PROHIBITED NOXIOUS WEED SEED. DO NOT USE WOODY OR OTHER HEAVY MATERIALS THAN MAY INTERFERE WITH THE EMERGENCE OF SEEDLINGS.

APPLICATION (GENERAL)

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. ENSURE THE SURFACE IS FREE OF DEEP TRACK MARKS OF OTHER FEATURES THAT MAY RESULT IN FLOW CONCENTRATION DOWN THE SLOPE. WHERE NECESSARY, ESTABLISH UP-SLOPE DRAINAGE CONTROLS TO LIMIT RUN-ON WATER THAT MAY DISTURB THE MULCH.

3. SPREAD ENOUGH MULCH TO COMPLETELY COVER THE SURFACE OF THE SOIL AT THE DENSITY OR THICKNESS SPECIFIED IN THE APPROVED PLANS, BUT NOT GREATER THAN 50mm.

4. MACHINE APPLICATIONS SHALL COMPRISE A MINIMUM OF TWO PASSES IN OPPOSITE DIRECTIONS UNLESS OTHERWISE SPECIFIED.

5. DURING APPLICATION, ALL REASONABLE EFFORTS SHALL BE TAKEN TO AVOID SPRAY ONTO ROADS, PATHWAYS, DRAINAGE CHANNELS NOT INTENDED FOR APPLICATION, AND EXISTING VEGETATION.

6. SUITABLE ANCHORAGE OF THE MULCH MUST BE ACCOMPLISHED IMMEDIATELY AFTER THE MULCH HAS BEEN PLACED.

7. ENSURE THE MULCH IS RESTRAINED FROM EXCESSIVE MOVEMENT BY WIND OR STORMWATER RUNOFF BY THE APPROPRIATELY APPLICATION OF AN APPROVED TACKIFIER. ON FLAT OR GENTLE SLOPES, STRAW MULCH MAY BE FIXED TO THE SOIL BY MECHANICAL CRIMPING.

8. IF THE TREATED AREA WAS SEEDED, CONTINUE TO WATER AFTER MULCHING IN ACCORDANCE WITH WEATHER CONDITIONS, OR AS REQUIRED TO OBTAIN SUITABLE GERMINATION AND PLANT ESTABLISHMENT.

9. APPLICATION (SPRAYING) OF A TACKIFIER MUST NOT BE PERFORMED DURING PERIODS OF WINDY CONDITIONS THAT WOULD PREVENT THE PROPER PLACEMENT OF ADHESIVE.

10. THE CONTRACTOR MUST TAKE APPROPRIATE STEPS TO PROTECT ALL TRAFFIC, SIGNS, STRUCTURES, AND OTHER OBJECTS FROM BEING MARKED OR DISFIGURED BY THE TACKIFIER MATERIAL.

APPLICATION (HYDROMULCHING)

THE FOLLOWING SPECIFICATION APPLIES TO GRASS SEEDING, NOT THE APPLICATION OF NATIVE TREE OR SHRUB SEED.

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. ENSURE THE SURFACE IS FREE OF DEEP TRACK MARKS OF OTHER FEATURES THAT MAY RESULT IN FLOW CONCENTRATION DOWN THE SLOPE. WHERE NECESSARY, ESTABLISH UP-SLOPE DRAINAGE CONTROLS TO LIMIT RUN-ON WATER THAT MAY DISTURB THE MULCH.

3. PRIOR TO APPLICATION, ROUGHEN THE SOIL SURFACE AND FILL AREAS BY ROLLING WITH A CRIMPING OR PUNCHING TYPE ROLLER OR BY TRACK WALKING WHERE PRACTICAL.

4. IF THE SOIL IS DRY, WATER THE TREATMENT AREA BEFORE HYDROSEEDING TO INCREASE PENETRATION OF THE ADHESIVE AND FERTILISER ADDITIVES.

5. ADD STRAW, WOOD OR PAPER CELLULOSE FIBRE MULCH TO THE SLURRY AT THE SPECIFIED RATE, OTHERWISE AT A RATE OF 2 TO 3 TONNES PER HECTARE.

6. MACHINE APPLICATIONS SHALL COMPRISE A MINIMUM OF TWO PASSES IN OPPOSITE DIRECTIONS UNLESS OTHERWISE SPECIFIED.

7. DURING APPLICATION, ALL REASONABLE EFFORTS SHALL BE TAKEN TO AVOID SPRAY ONTO ROADS, PATHWAYS, DRAINAGE CHANNELS NOT INTENDED FOR APPLICATION, AND EXISTING VEGETATION.

8. THE CONTRACTOR MUST TAKE APPROPRIATE STEPS TO PROTECT ALL TRAFFIC, SIGNS, STRUCTURES, AND OTHER OBJECTS FROM BEING MARKED OR DISFIGURED BY THE MULCH AND/OR ASSOCIATED TACKIFIER.

9. CONTINUE TO WATER AFTER ALLOWING 24 HOURS DRYING TIME. WATER IN ACCORDANCE WITH THE WEATHER CONDITIONS, OR AS REQUIRED TO MAINTAIN SUITABLE GERMINATION AND PLANT GROWTH. THE WOOD-FIBRE SHOULD BE KEPT MOIST UNTIL GERMINATION OCCURS.

MAINTENANCE

1. INSPECT ALL MULCHES FORTNIGHTLY AND AFTER RUNOFF-PRODUCING RAINFALL AND STRONG WINDS.

2. CHECK FOR RILL EROSION, OR DISLODGMENT OF THE MULCH.

3. REPLACE ANY DISPLACED MULCH TO MAINTAIN THE REQUIRED COVERAGE.

4. IF STORMWATER RUNOFF DISPLACES MORE THAN 10% OF THE MULCH, THEN INVESTIGATE THE NEED FOR ADDITIONAL DRAINAGE CONTROLS TO PREVENT FURTHER DISPLACEMENT.

5. CONTINUE INSPECTIONS UNTIL VEGETATION IS SUITABLY ESTABLISHED OR EROSION CONTROL IS NO LONGER REQUIRED.

6. IF THE MULCHING IS NOT EFFECTIVE IN CONTAINING THE SOIL EROSION IT SHOULD BE REPLACED, OR AN ALTERNATIVE EROSION CONTROL PROCEDURE ADOPTED.

Drawn:	Date:		
GMW	Dec-09	Mulching (light)	M-01

Catchments & Creeks Pty Ltd

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Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	I.Edgeley	K.Kerr	On file	P. Bradley		20/07/2020
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