PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2021/1168

Date: 17 May 2022

Undullah – Master Planned Community

Rice, Dairy and Wyatt Roads, Undullah, QLD

Tranche 1A Clearing Phase Erosion and Sediment Control Management Plan

Pioneer Fortune Pty Ltd

17 December 2020

Document Verification

Job Title **Undullah – Master Planned Community**

Job Number 23165

Document Title Tranche 1A Clearing Phase Erosion and Sediment Control Management Plan

Document Control

Date	Document	Revision No.	Author	Reviewer
17.12.2020	Draft – Consultant review	01	J. Frew	M. Lepelaar
21.12.2020	VMP Lodgement Issue	02	J. Frew	M. Lepelaar

Approval for Issue

Name	Signature	Date
Michael Lepelaar (RPEQ)		21/12/2020

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1 INTRODUCTION

ADG Engineers (Aust.) Pty Ltd has been engaged by Pioneer Fortune Pty Ltd to prepare a Sediment and Erosion Control Management Plan to support the proposed Vegetation Clearing Phase for Tranche 1A as identified in the Saunders Havill Vegetation Management Plan of the proposed development at Undullah, QLD.

Tranche 1A of the development is located at the north-east corner of the site boundary and comprises of a section of Trunk Connector Road, a section of Urban Arterial Road, Urban Residential Neighbourhoods, a District Centre Transition Area and a Neighbourhood Centre. The purpose of this report is to provide advice on the proposed development with regards to erosion and sediment control throughout the clearing phase of the project. Further details of the property for the proposed clearing are summarised in **Table 1**. We advise that further sediment and erosion control documentation will be provided as part of the future civil works.

Table 1 - Property Details

Title	Undullah – Master Planned Community – Tranche 1A
Street Address	Rice, Dairy and Wyatt Roads, Undullah, QLD 4285
Lot Details	Lot 3 on RP45236
Approximate Development Area	55.552ha

The report has been prepared based on the following information available at the time of writing the report:

- Veris Australia Pty Ltd.'s Overall Site Context Plan – Issue AB (dated 20/10/20);
- Economic Development Queensland PDA Guideline no. 13 – Engineering Standards (2017);
- Economic Development Queensland PDA Guideline no. 14 – Environmental (2015);
- Queensland Government – Department of Natural Resources Soil and Land Information Records;
- Saunders Havill Vegetation Management Plan (dated 09/12/20);
- Catchments and Creeks – Sediment Control Techniques V1 (2010);
- Queensland Urban Drainage Manual (2017); and
- International Erosion Control Association (IECA) Standards and Guidelines.

2 SITE LOCATION & CHARACTERISTICS

2.1 Site Location

The proposed Undullah Master Planned Community is to be located within the Greater Flagstone Priority Development Area (PDA) currently under the control of Economic Development Queensland and Department of State Development, Local Government and Infrastructure Planning. Tranche 1A of the works is located in the north-eastern corner of the site. The top of Tranche 1A runs adjacent to the Sandy Creek environmental buffer and the bottom of Tranche 1A is adjacent to a small waterway dissecting the eastern boundary of the site. The boundary of Tranche 1A within the overall site can be seen below in **Figure 1**.

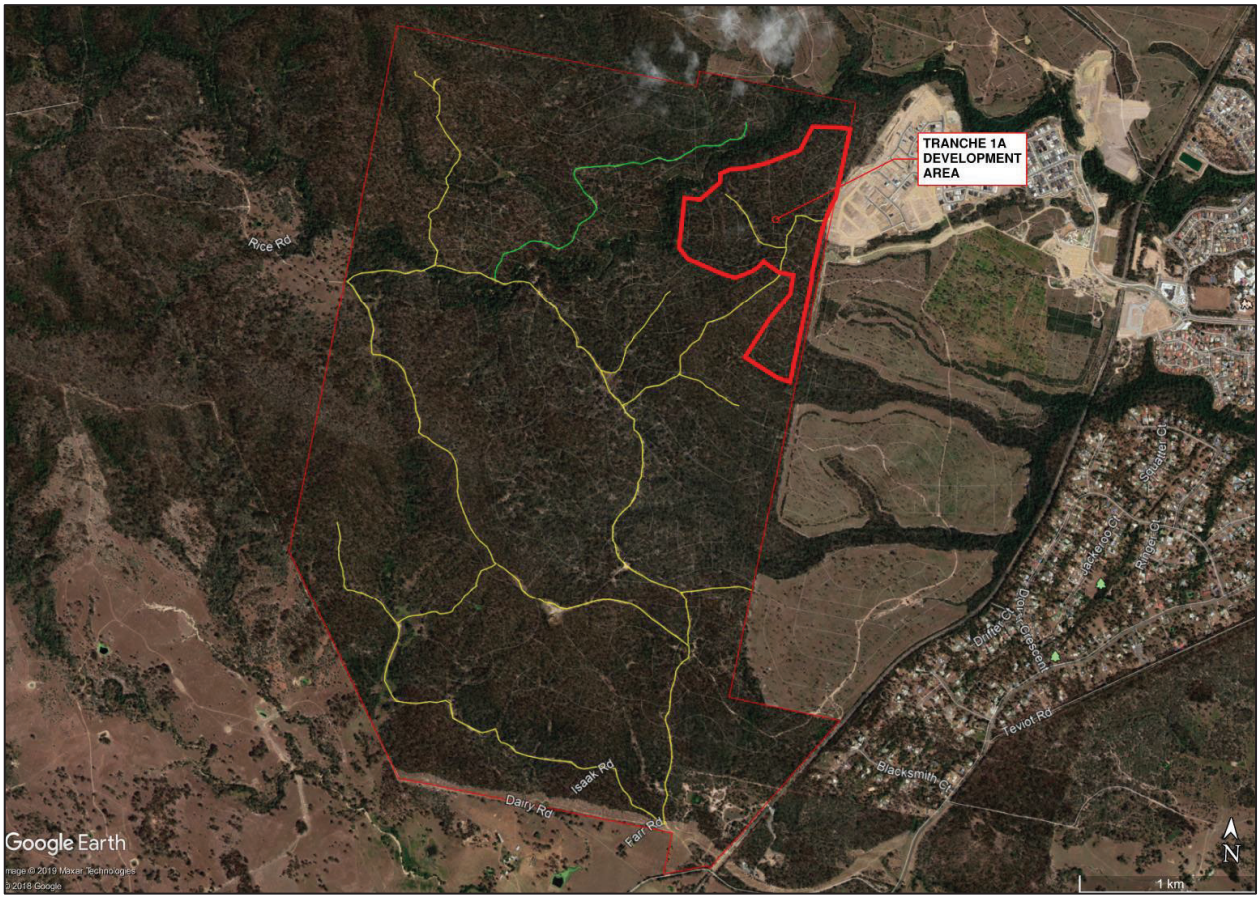

Figure 1 – Tranche 1A Site Location (As accessed from Google Earth 12/11/2020)

2.2 Local Authority

As the site is located within the Flagstone PDA, assessment will be undertaken by Economic Development Queensland (EDQ) and hence, will need to comply with the relevant EDQ guidelines.

2.3 Rainfall

The climate of the Undullah area is described by the Bureau of Meteorology as Subtropical and is generally subject to more rainfall from October through to March. The average monthly rainfall for the area is presented in **Figure 2**. The mean annual rainfall for the Undullah area is 805.1mm. Rainfall data was gathered using the Bureau of Meteorology's Yarrahappini Weather Station, which is in close proximity to Undullah.

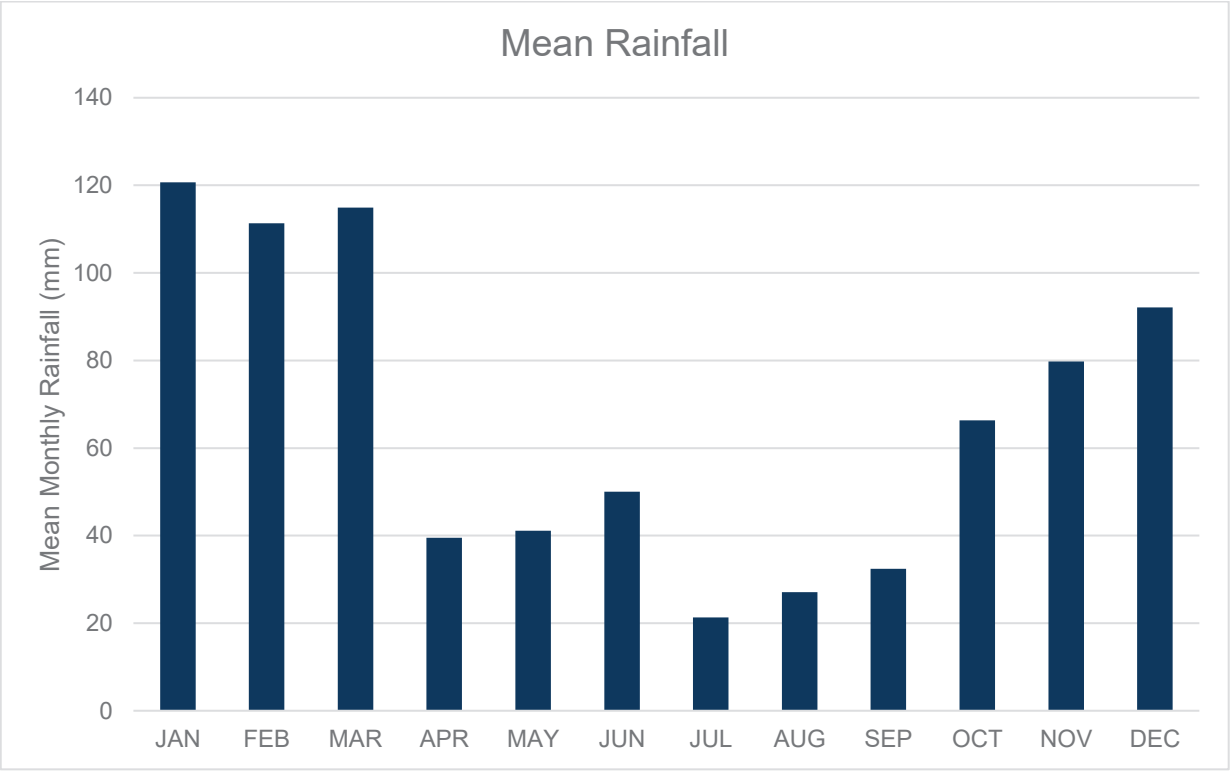

Figure 2 - Undullah Mean Rainfall

2.4 Soil Characteristics

A Queensland Government Soil and Land Information Site Listing Report was obtained for the subject area (**Appendix D**). The soil samples relevant to Tranche 1A are termed Lara 157 and Lara 158 in the report. In summary, the relevant findings of the report include:

- Tests of the soil stratum were taken to a depth of ~0.6 m;
- The natural soil stratum layers consist of:
  - Fine sandy loam; and
  - Light medium clay
- The surface soil layer is moderately permeable (50-500mm/day); and
- The substrate consists of a Sandstone lithology.

2.5 Catchment Details

Tranche 1A consists of nine (9) identified internal catchments that will be cleared for development as shown in **Figure 3** below. Further information regarding the catchments for Tranche 1A can be found in the Tranche 1A Clearing Phase Sediment and Erosion Control Catchment Plan (SED01) in **Appendix A**.

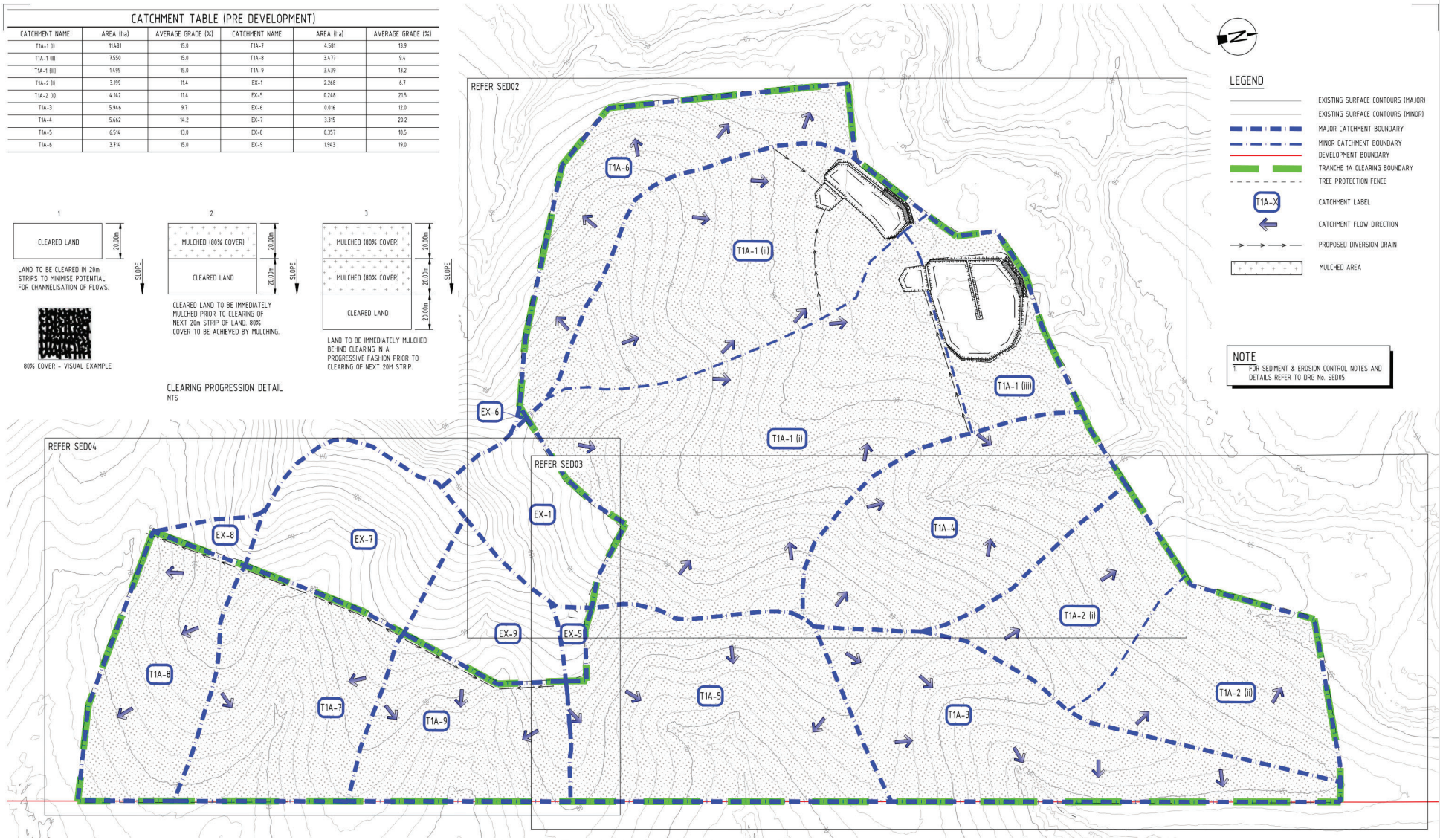

Figure 3 – Tranche 1A Clearing Phase Catchment Plan (not to scale)

3 EROSION AND SEDIMENT CONTROL OBJECTIVES - CLEARING PHASE

To mitigate the risk of erosion on site and sediment deposition downstream of the clearing works, the following objectives have been outlined for the clearing phase:

3.1 Drainage Control

- Direct the clean water flows from the upstream, undisturbed catchments through designated temporary erosion protected channels or uncleared areas of the site.

3.2 Erosion Control

- Limit the ability for sheet flow to generate runnels or gully erosion within the cleared areas of the site during the clearing process.
- Mitigate the risk of total sediment soil losses by staging the clearing works to reduce the area of cleared and partially disturbed land at any one time.
- Provide immediate erosion protection of the cleared, partially disturbed land as each clearing stage is finished.
- Ensure that all cleared, partially disturbed land is effectively covered or stabilised prior to any forecasted rain event.

3.3 Sediment Control

- Implement sediment controls that mitigate the risk of sediment laden water from the clearing phase stages flowing downstream.
- For the catchments of highest risk, provide sediment basins and divert all runoff from the catchment to the basins to achieve the clearing phase water quality objectives set out in this report prior to the water being discharged from the site or used as dust suppression.

4 EROSION RISK

In order to assess the potential risk and gain an understanding to the volume of potential sediment contained within stormwater runoff an erosion hazard assessment has been undertaken combined with a sediment loss predication based on RUSLE.

4.1 Hazard Assessment

Based on the below erosion hazard assessments (Table 3.1 - IECA), disturbance within the site catchments associated within the proposed development has the potential to be “high risk”.

Table 2 – IECA Hazard Assessment

Condition		Points	Score	Trigger Value
AVERAGE SLOPE OF DISTURBANCE AREA [1]			4	**4**
• not more than 3%	[3% . 33H:1V]	0		
• more than 3% but not more than 5%	[5% = 20H:1V]	1		
• 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]			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]			4	**6**
• Class 4, 6, 7, or 8		0		
• Class 5		2		
• Class 3, (default value if soils are untested)		4		
• Class 1 or 2		6		
DURATION OF SOIL DISTURBANCE [4]			2	**6**
• not more than 1 month		0		
• more than 1 month but not more than 4 months		2		
• more than 4 months but not more than 6 months		4		
• more than 6 months		6		
AREA OF DISTURBANCE [5]			6	**4**
• not more than 1000 m^2		0		
• more than 1000 m^2 but not more than 5000 m^2		1		
• 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]			2	**2**
• No disturbance to a watercourse, open drain or channel		0		
• 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).			2	
• 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]			2	
• Saline waters only		0		
• Freshwater body (e.g. creek or freshwater lake or river)		2		
SUBSOIL EXPOSURE [9]			0 Clearing phase only	
• No subsoil exposure except of service trenches		0		
• Subsoils are likely to be exposed		2		
EXTERNAL CATCHMENTS [10]			2	
• No external catchment		0		

• External catchment diverted around the soil disturbance	1		
• External catchment not diverted around the soil disturbance	2		
ROAD CONSTRUCTION [11]		0	
• No road construction	0		
• Involves road construction works	2		
pH OF SOILS TO BE REVEGETATED [12]		1	
• more than pH 5.5 but less than pH 8	0		
• other pH values, or if soils are untested	1		
Total Score [13]		**27**	

4.2 RUSLE

In order to gain an estimate of the potential volume of soil loss from each exposed catchment the Revised Universal Soil Loss Equation (RUSLE) (**Equation 1**) has been relied upon.

$$A = R \cdot K \cdot LS \cdot P \cdot C$$ **Equation 1**

Where:

$A =$ Annual Soil Loss due to erosion (t / ha / yr)

$R = Rainfall\ Erosivity\ Factor = 164.74 \cdot 1.1177^{S} \cdot S^{0.6444}$

$S = 2\ year\ ARI, 6\ hour\ storm\ event = 10.40\ as\ per\ BOM\ IFD\ for\ Undullah$

$K = Soil\ Erodibility\ Factor\ (Table\ E5\ \ IECA\ Best\ Practice\ Erosion\ \&\ Sediment\ Control\ Guidelines)$

$LS = \ Topographic\ Factor\ (Table\ E3\ \ IECA\ Best\ Practice\ Erosion\ \&\ Sediment\ Control\ Guidelines)$

$C = Cover\ Management\ Factor$

$P = Erosion\ Control\ Practice\ Factor\ (default\ of\ 1.3)$

The average annual soil loss for each catchment of Tranche 1A has been estimated in the first instance based on the assumption that clearing operations will result in the exposure of soil surfaces and hence, a cover management factor (C value) of 1 and an erosion control practice factor (P value) of 1.3 have been used. Calculations were made in accordance with Section E3 of IECA 2012, Best Practice Erosions and Sediment Control with results presented in **Table 3**.

Table 3 – Sediment Loss Risk Assessment for Tranche 1A Clearing (No Control Measures)

Catchment ID	Area (ha)	R	K	LS	P	C	A (t/ha/yr)	A (t/yr)	Control
T1A-1(i)	11.481	2370	0.03	2.75	1.3	1	254.2	2918.3	TYPE 1
T1A-1(ii)	7.55	2370	0.03	2.15	1.3	1	198.7	1500.4	TYPE 1
T1A-1(iii)	1.495	2370	0.03	2.15	1.3	1	198.7	297.1	TYPE 1
T1A-2 (i)	3.199	2370	0.03	2.15	1.3	1	198.7	635.7	TYPE 1
T1A-2 (ii)	4.142	2370	0.03	2.15	1.3	1	198.7	823.1	TYPE 1
T1A-3	5.948	2370	0.03	2.04	1.3	1	188.6	1121.5	TYPE 1
T1A-4	5.662	2370	0.03	2.5	1.3	1	231.1	1308.3	TYPE 1
T1A-5	6.514	2370	0.03	2.53	1.3	1	233.8	1523.3	TYPE 1
T1A-6	3.714	2370	0.03	2.75	1.3	1	254.2	944.0	TYPE 1
T1A-7	4.581	2370	0.03	2.5	1.3	1	231.1	1058.6	TYPE 1
T1A-8	3.477	2370	0.03	2	1.3	1	184.9	642.8	TYPE 1
T1A-9	3.439	2370	0.03	2.55	1.3	1	235.7	810.6	TYPE 1

Based on the results in **Table 3** soil loss estimates of between 184.9 t/ha/yr to 254.2 t/ha/yr would be expected for the cleared catchment areas. Based on these average soil loss estimates and in accordance with **Table 4** below (IECA Appendix B, Table B1 - 2018), Type 1 sediment controls would be necessary to mitigate impacts to downstream receiving environments. As demonstrated in **Section 5.2.1**, ADG propose to implement a strategy to reduce the C value by applying a cover to the exposed surface.

Table 4 – Sediment Control Standard (default) Based on Soil Loss Rate

Catchment Area (m^2)	Soil Loss (t/ha/yr)		
	Type 1	Type 2	Type 3
250	N/A	N/A	N/A
1000	N/A	N/A	All Cases
2500	N/A	>75	75
>2500	>150	150	75
>10,000	>75	N/A	75

In accordance with Catchments and Creeks (2010), the following controls are considered suitable for use within each of the exposed catchments to minimise the possibility of sediment discharge into the downstream environments (**Table 5**).

Table 5 – Control Measure Defaults for IECA Control Types

Type 1	Type 2	Type 3
Sheet Flow Treatment Techniques		
• Sediment basins capable of capturing 100% of the nominated design rainfall event	• Buffer Zones capable of infiltrating the nominated design rainfall event • Mulch cover	• Buffer Zones • Sediment Fence • Mulch cover
Concentrated and Instream Flow Treatment Techniques		
• Sediment basins capable of capturing 100% of the nominated design rainfall event	• Rock Filter Dams • Geotextile Lining	• Rock Check Dams • Geotextile Lining • Rock Filter Dams

5 CLEARING PHASE EROSION AND SEDIMENT CONTROL STRATEGY

In order to ensure that the discharge of sediment laden stormwater is avoided (for events up to and including the nominated design storm), where practicable, and minimised when the nominated design storm is exceeded, best practice site management procedures have been developed for the clearing phase of each catchment.

Controls have been developed based on the following key areas of control:

- Drainage Control;
- Erosion Control; and
- Sediment Control.

5.1 Drainage Control

In order to ensure that external catchment "clean water flows" are conveyed through the disturbed catchments without coming into contact with exposed surfaces, clean water flows are to be collected and conveyed via clean water diversion channels and diversion chutes.

5.1.1 External Catchment Hydrology

To determine the design requirements for the necessary diversion structures, a hydrological analysis has been undertaken. Equation 4.2 (QUDM, 2016) was utilised and is shown below.

$$Q_y = \frac{C_y \cdot I_y^t \cdot A}{360}$$ **Equation 2**

Where:

$Q_y = peak\ flow\ rate\ \left(\frac{m^3}{s}\right) for\ annual exceedance\ probability\ (AEP) of\ 1\ in\ 'y'\ years$

$C_y = coefficient\ of\ discharge\ for\ AEP\ of\ 1\ in\ 'y'\ years$

$A = catchment\ area\ (ha)$

$I_y^t = average\ rainfall\ intensity\ \left(\frac{mm}{hr}\right) for\ a\ design\ duration\ of\ 't'\ (hrs) and\ 'y'\ years$

$t = the\ nominal\ design\ storm\ duration\ as\ defined\ by\ the\ time\ of\ concentration$

The design peak discharge for each clean water diversion drain and chute is presented in **Table 6** and **Table 7**. A design rainfall event Average Recurrence Interval (ARI) of 2 years has been adopted in accordance with IECA Appendix A – Table A1. Initial design was prepared with an unlined base for all diversion structures, where velocities exceeded bare earth scour criteria and hence, a turf lining has been proposed for the channel of the structures. Typical diversion structure details are shown in **Figure 4** and **Figure 5**. Further information regarding the diversion structures is shown in the ADG drawings (**Appendix A**) and IECA Standard Drawings (**Appendix B**).

Table 6 – Clean Water Diversion Drain Hydrology

Drain ID	Catchment Area (ha)	Slope (%)	Manning's n	TOC (mins)	ARI (years)	Intensity (mm/hr)	C factor	Flow (m3/s)
EX-7-D1	1.658	20.2	0.045	8	2	99.70	0.595	0.27
EX-7-D2	1.658	20.2	0.045	8	2	99.70	0.595	0.27
EX-8-D1	0.357	18.5	0.045	8	2	99.70	0.595	0.06
EX-9-D1	1.011	19.0	0.045	8	2	99.70	0.595	0.17
EX-9-D2	0.932	19.0	0.045	8	2	99.70	0.595	0.15

Table 7 – Drainage Chute Hydrology

Chute ID	Catchment Area (ha)	Slope (%)	Manning's n	TOC (mins)	ARI (years)	Intensity (mm/hr)	C factor	Flow (m3/s)
T1A-3-C1	4.181	9.7	0.045	10	2	96.10	0.595	0.66
T1A-4-C1	5.662	14.2	0.045	9	2	99.70	0.595	0.93
T1A-5-C1	6.514	13.0	0.045	9	2	99.70	0.595	1.07
T1A-5-C2	6.514	13.0	0.045	9	2	99.70	0.595	1.07
T1A-7-C1	7.896	13.9	0.045	9	2	99.70	0.595	1.30
T1A-9-C1	5.382	13.2	0.045	9	2	99.70	0.595	0.89

5.1.2 Diversion Channel Capacity Design

Table 8 – Clean Water Diversion Channel Capacity Design

Drain ID	Slope (m/m)	Manning's n	Base Width (m)	Side Slope (1 in X)	Freeboard (m)	Flow Depth (m)	Total Depth Inc. Freeboard (m)	Flow Area (m^2)	Wetted Perimeter	Hydraulic Radius	Velocity (m/s)	Capacity (m^3/s)
EX-7-D1	0.10	0.04	2	4	0.22	0.08	0.30	0.20	2.70	0.07	1.38	0.27
EX-7-D2	0.08	0.04	2	4	0.21	0.09	0.30	0.21	2.74	0.08	1.28	0.27
EX-8-D1	0.12	0.04	0	4	0.19	0.11	0.30	0.05	0.90	0.05	1.23	0.06
EX-9-D1	0.08	0.04	0	4	0.15	0.17	0.32	0.12	1.44	0.08	1.37	0.17
EX-9-D2	0.11	0.04	1	4	0.22	0.08	0.30	0.11	1.70	0.07	1.36	0.15

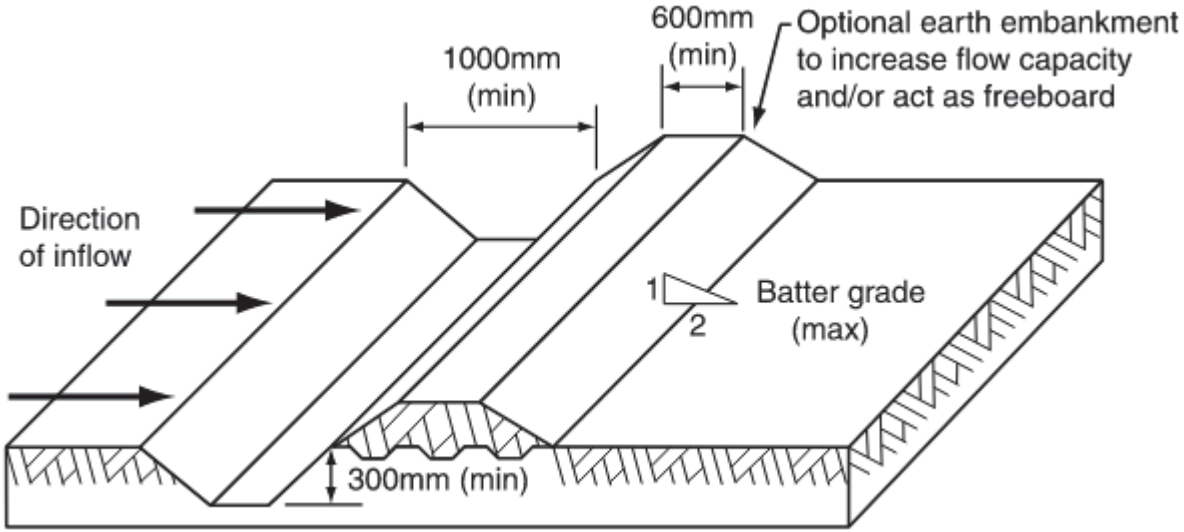

Figure 4 – Typical Diversion Channel Detail (IECA 2018)

Table 9 –Diversion Chute Capacity Design

Chute ID	Slope (m/m)	Manning's n	Base Width (m)	Side Slope (1 in X)	Freeboard (m)	Flow Depth (m)	Total Depth Inc. Freeboard (m)	Flow Area (m^2)	Wetted Perimeter	Hydraulic Radius	Velocity (m/s)	Capacity (m^3/s)
T1A-3-C1	0.11	0.04	5.5	3	0.15	0.08	0.23	0.45	6.00	0.08	1.47	0.67
T1A-4-C1	0.05	0.04	3.5	3	0.15	0.16	0.31	0.62	4.49	0.14	1.50	0.93
T1A-5-C1	0.07	0.04	6	3	0.15	0.11	0.26	0.72	6.72	0.11	1.49	1.07
T1A-5-C2	0.07	0.04	6	3	0.15	0.11	0.26	0.72	6.72	0.11	1.49	1.07
T1A-7-C1	0.06	0.04	6.5	3	0.15	0.13	0.28	0.87	7.30	0.12	1.49	1.30
T1A-9-C1	0.06	0.04	5	3	0.15	0.12	0.27	0.63	5.75	0.11	1.40	0.89

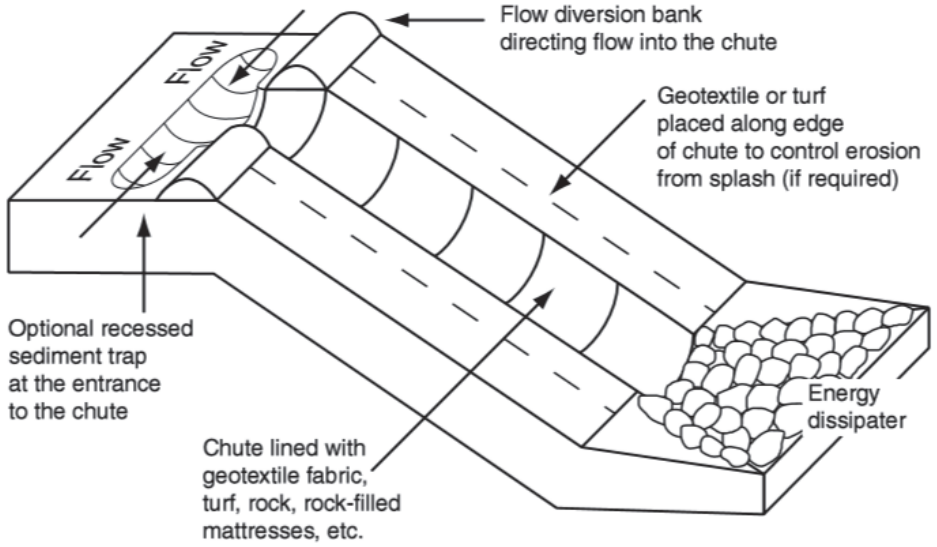

Figure 5 – Typical Drainage Chute Detail (IECA 2018)

5.2 Erosion Control

The following controls have been specified to mitigate the potential for erosion to occur during the clearing phase of Tranche 1A.

5.2.1 Cover

Given that disturbance in each catchment will be limited to vegetation clearing and no earthworks are proposed, the introduction of cover by spreading site won mulch over the cleared surface as a primary erosion control is considered advantageous. The application of cover as part of clearing works will significantly reduce the potential for soil loss within each catchment. A revised RUSLE calculation has been undertaken to take into effect the application of forest mulch cover. Achieving a minimum mulch-cover of 80% of the disturbed surface will lower the C value from 1 to 0.2 (IECA Table E8) and the P value from 1.3 to 1.2 (IECA Table E3.6). **Figure 6** below gives guidance as to the visualisation of 80% mulch cover. The revised RUSLE calculation was made based on the assumption of 80% cover achieved immediately after clearing and is presented below in **Table 10**.

Table 10 – Sediment Loss Risk Assessment for Tranche 1A Clearing (with 80% Mulch Cover)

Catchment ID	Area (ha)	R	K	LS	P	C	A (t/ha/yr)	A (t/yr)	Control
T1A-1(i)	11.481	2370	0.03	2.75	1.2	0.2	46.9	538.8	TYPE 3
T1A-1(ii)	7.55	2370	0.03	2.15	1.2	0.2	36.7	277.0	TYPE 3
T1A-1(iii)	1.495	2370	0.03	2.15	1.2	0.2	36.7	54.8	TYPE 3
T1A-2 (i)	3.199	2370	0.03	2.15	1.2	0.2	36.7	117.4	TYPE 3
T1A-2 (ii)	4.142	2370	0.03	2.15	1.2	0.2	36.7	152.0	TYPE 3
T1A-3	5.948	2370	0.03	2.04	1.2	0.2	34.8	207.1	TYPE 3
T1A-4	5.662	2370	0.03	2.5	1.2	0.2	42.7	241.5	TYPE 3
T1A-5	6.514	2370	0.03	2.53	1.2	0.2	43.2	281.2	TYPE 3
T1A-6	3.714	2370	0.03	2.75	1.2	0.2	46.9	174.3	TYPE 3
T1A-7	4.581	2370	0.03	2.5	1.2	0.2	42.7	195.4	TYPE 3
T1A-8	3.477	2370	0.03	2	1.2	0.2	34.1	118.7	TYPE 3
T1A-9	3.439	2370	0.03	2.55	1.2	0.2	43.5	149.6	TYPE 3

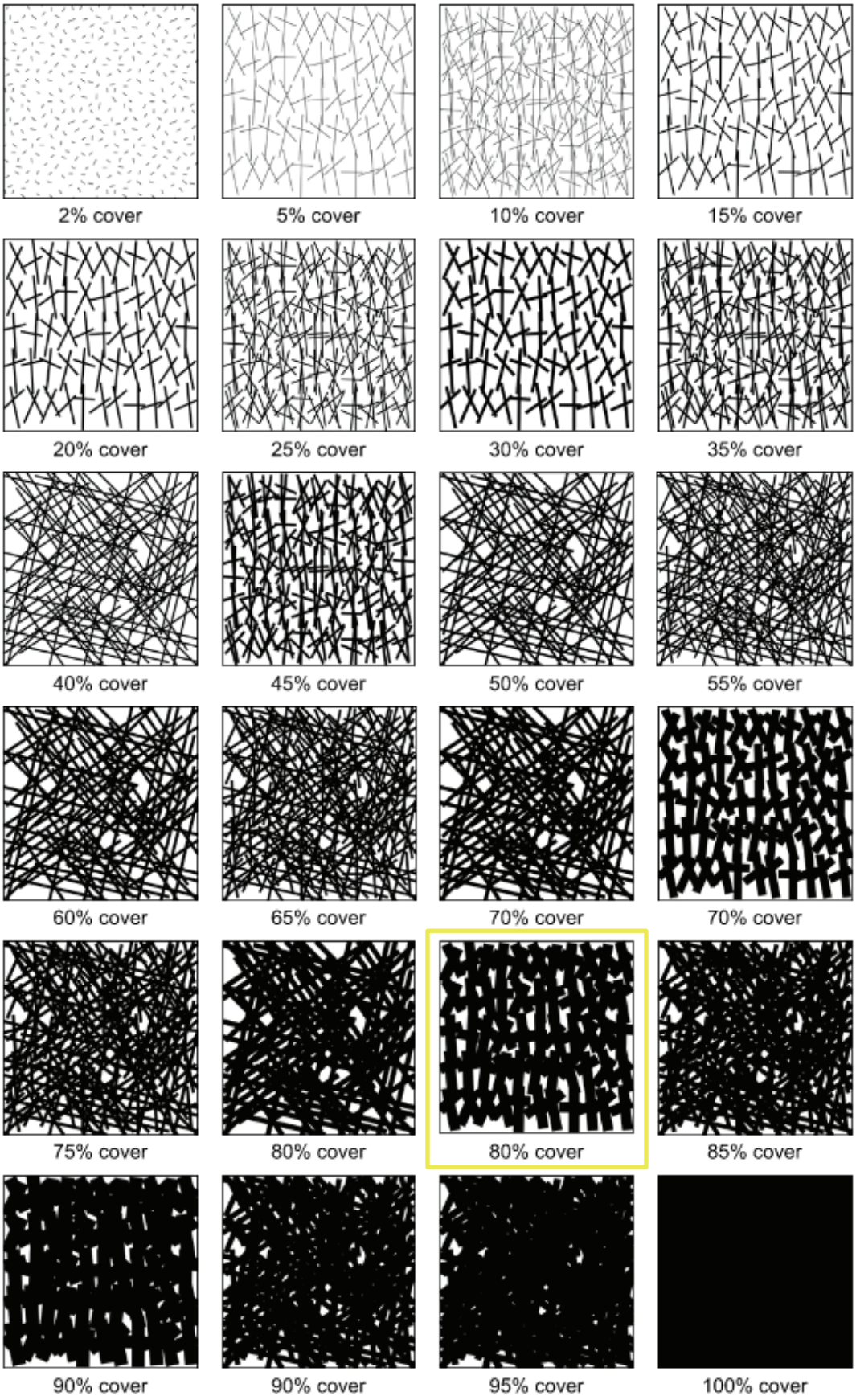

Figure 6 – Visual Cover Estimation Template (adopted from IECA Revegetation Erosion Control Technique V1 (January 2010))

5.2.2 Limitations of Exposed Surface

To further minimise the possibility of erosion occurring during the clearing process, the length of exposed slope shall be limited via the use of a staged clearing method (**Figure 7**). Table 4.5.4 of the Queensland Urban Drainage Manual (2017) suggests that sheet flow over steep (>10%) grassland will channelise in an assumed maximum flow length of 20m, hence the specification of 20m clearing strips parallel with the contour of the land.

The 20m strips must be cleared along the contour and immediately covered with the mulch product of the vegetation to 80% cover (**Figure 6**) prior to clearing the next 20m strip and before any forecasted rain event.

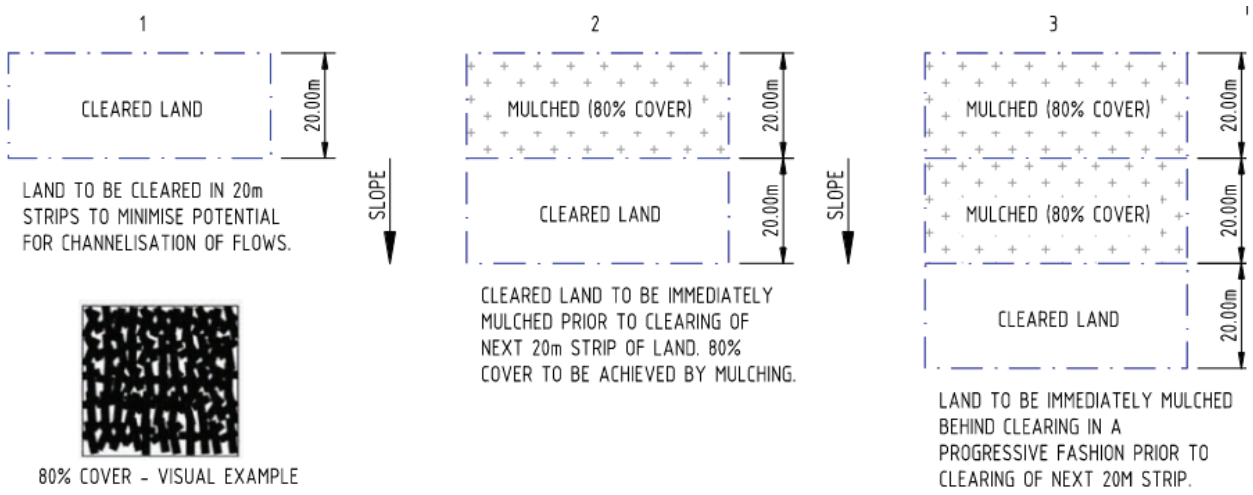

Figure 7 – Clearing Progression Detail

5.3 Sediment Controls

A number of sediment controls have been specified for inclusion within the cleared catchment areas. The subsequent sections of the report provide details on the following sediment controls which are specified for the clearing phase of Tranche 1A:

- Rock Check Dams;
- Sediment Fence;
- Rock Filter Dams;
- Sediment Basins;
- Sediment Basin Flocculation; and
- Sediment Basin Diversion Drains.

5.3.1 Rock Check Dams

Rock check dams shall be placed within channels in accordance with the ADG drawings shown in **Appendix A** of this report to provide velocity control and pond water within the drains to allow coarse sediment to drop out through gravity induced settlement. The check dams should be shaped to provide a flat crest within the centre of the drain and the crest shall be lower than the rock on the sides of the drain as per IECA standard drawing RCD-01.

5.3.2 Sediment Fence

Sediment fence should be used to trap and pond sediment laden water to allow sediment to drop out through gravity induced settlement. Returns should be placed along the fence to aid in ponding water. The toe of the fence shall be dug into the existing soil. Further information regarding sediment fences and their specific locations are shown in the ADG Erosion and Sediment Control Plans (**Appendix A**) and IECA Standard Drawing FF-01 (**Appendix B**).

5.3.3 Rock Filter Dams

As shown on ADG drawings in **Appendix A**, Rock Filter Dams are to be constructed on the clearing boundary of catchments T1A-2, 3, 4, 5 &7 to capture the potential sediment laden, channelised water flowing from the catchment. The Rock Filter Dams are to be constructed in accordance with IECA Standard Drawings SD-RFD-03 and SD-RFD-04 found in **Appendix B**.

Due to the potential for the Rock Filter Dams to become blocked with sediment, causing a lack of functionality, it is imperative that the Rock Filter Dams be maintained in accordance with **Section 7** of this report.

5.3.4 Sediment Basins

Type B sediment basins have been proposed to capture and treat flows from Catchments T1A-1 (i) and T1A-1 (ii). Based RUSLE estimates these catchments have the potential to generate large sediment volumes to Sandy Creek.

The IECA Best Practice Erosion and Sediment Control guidelines – Appendix B – Sediment Basin Design and Operation suggests that a Type B basins are best suited for this application due to the clearing works for the corresponding catchments construction times being less than 12 months and that an automated flocculant dosage system is considered practical.

Type B Basins comprise of a sediment forebay at the entry, a level spreader which dissipates the flow velocity of the stormwater entering the basin, a settling zone, a sediment storage zone and a spillway crest. **Figure 8** below shows the long section of a typical Type B Basin. The design criteria as outlined in IECA Appendix B is shown in **Table 11** below.

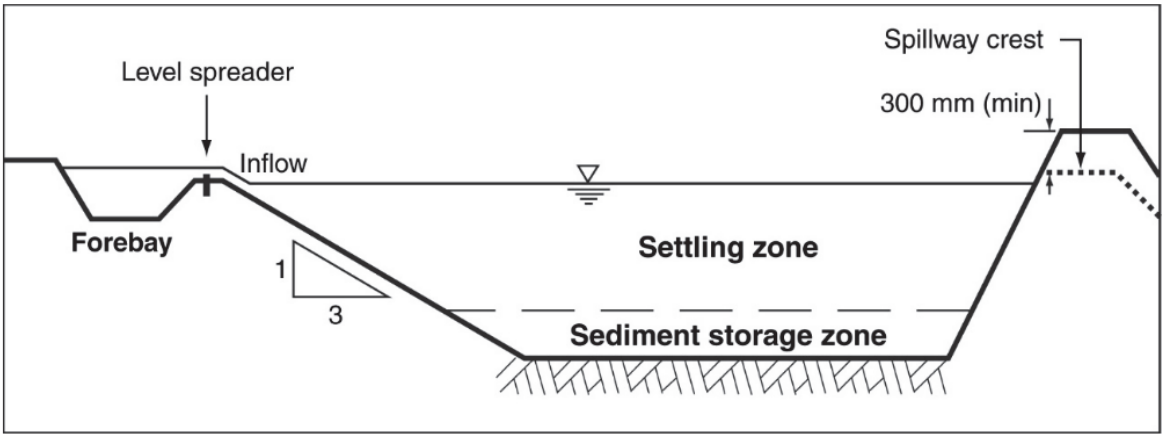

Figure 8 – Typical Type B Basin Detail

Table 11 – IECA Type B Basin Design Criteria

Parameter	Design Criteria
Design Discharge (Q)	0.5 peak discharge for the 1 in 1-year ARI design storm (Q1) (m^3/s)
Sediment Settlement Coefficient (K_s)	Jar Testing Default K_s = 12,000
Minimum Average Surface Area (A_s)	$A_s = K_s.Q$
Minimum Depth of Settling Zone (D_s)	Refer Table B17 IECA Minimum recommended depth = 0.5 m
Settling Zone Volume (V_s)	$V_s = A_s.D_s$
Length Width Ratio (L_s:W_s)	3:1
Maximum Inlet Bank Slope	1:3
Maximum All Other Bank Slopes	1:2
Average Length (L_s)	$L_s = (3 \times A_s)^{0.5}$
Top Length (L_T)	$L_T = L_s + D_s$ x (Inlet Bank Slope + Bank Slope)/2
Top Width (W_T)	$L_T = L_s + D_s$ x Bank Slope
Depth of Sediment Storage Zone (D_{ss})	0.2 m
Sediment Storage Volume (V_{ss})	Minimum 30% of V_s
Forebay Volume (V_f)	10% of V_s
Forebay Depth	Minimum 1 m
Forebay Length	Minimum 5 m
Width of Overflow Spillway	Spillway crest width = or just less than W_s.
Freeboard from maximum pond water level to top of virgin soil bank	150 mm (min)
Freeboard from maximum pond water level to top of fill embankment	300 mm (min)
Minimum freeboard along spillway chute	300 mm (min)
Minimum embankment crest width	2.5 m
Check Re-suspension potential v_c flow velocity of the clear water supernatant	v_c should not exceed 0.015 m/s $v_c = Q/(Ds.Ws)$ W_s = average width of settling zone (m)
Length of Settling Zone (L_s)	Less than $L_{s(critical)}$ $L_{s(critical)} = 0.015.K_s.D_s$

5.3.5 Sediment Basin Hydrology and Design

To size the required sediment basins, the hydrology of their corresponding catchments has been assessed. IECA Appendix B (2018) – Table B3 states that temporary sediment basins are to be sized to cater for half of the 1-year ARI critical duration rainfall event. **Table 12** below presents the hydrological parameters used for the sediment basins.

Table 12 – Sediment Basin Hydrology

Catchment Name	Catchment Area (ha)	Fraction Impervious (%)	C_{10}	C_1	TOC (mins)	I (mm/h)	Q_1 Flow (m^3/s)	$0.5*Q_1$ Flow (m^3/s)
T1A-1 (i)	11.481	0	0.53	0.42	16	68.80	0.930	0.465
T1A-1 (ii)	7.550	0	0.53	0.42	13	75.80	0.674	0.337

The following assumptions/decisions were made when sizing the sediment basins:

- The Ks Factor was determined using Table B18 of IECA 2018, Best Practice Erosion and Sediment Control Appendix B. A jar test settlement after 15min of 100mm was assumed based on local knowledge of similar soils in the Undullah area.
- The emergency spillway for each basin was sized for a 1 in 20-year storm ARI as per Table B35 of IECA 2018, Best Practice Erosion and Sediment Control Appendix B. The following parameters were used to size the spillway for the sediment basin:
  - The 1 in 20-year storm event peak flow for each catchment was calculated using the Rational Method. A summary of the Rational Method calculations is provided in **Table 12**.
  - The C20 coefficient of discharge was determined by multiplying the C10 coefficient of discharge by the 20-year ARI frequency factor identified in Table A7 of IECA 2012, Best Practice Erosion and Sediment Control Appendix A.
  - A freeboard of 300mm was applied to the spillway as the basins are to be cut into the ground (IECA 2018, Best Practice Erosion and Sediment Control Appendix B. International Erosion Control Association (Australasia), Picton NSW. Page B.60.)
- The sediment basins shall have a forebay to collect flows from multiple inlets and disperse the coagulant/flocculant.

Table 13 – Sediment Basin Sizing Summary

Basin ID	Max 0.5*Q_1 Flow (m^3/s)	Batters (1 in X)	L:W Ratio	Settling Depth, D_s (m)	Jar Test Settlement after 15mins (mm)	Floc Settling Depth, D_F (m)	Min A_s (m^2)	V_s (m^3)	Sed Storage (m^3)	Total Volume (m^3)
T1A-1 (i)	0.465	3	3	0.80	100	0.75	7038	4186	216	4402
T1A-1 (ii)	0.337	3	3	0.80	100	0.67	4941	2710	111	2820

Table 14 – Sediment Basin Dimensions

Basin ID	Length at Spillway (m)	Width at Spillway (m)	Depth at Spillway (m)	Sediment Storage Depth (m)	Settling Volume (m^3)	Volume at Spillway (m^3)	V_c (m/s)	Check V_c<0.015m/s
T1A-1 (i)	*132.5	44.2	1.0	0.2	4186	4402	0.0148	Y
T1A-1 (ii)	*108.0	36.0	1.0	0.2	2710	2820	0.0148	Y

* Length may be achieved with the use of a baffle

Table 15 – Sediment Basin Spillway Hydrology

Basin ID	Max Catchment Area (ha)	Fraction Impervious (%)	C_{10}	C_{50}	TOC (mins)	I (mm/h)	Q_{50} Flow (m^3/s)
T1A-1 (i)	11.481	0	0.53	0.61	16	169.00	3.29
T1A-1 (ii)	7.550	0	0.53	0.61	13	180.00	2.30

Table 16 – Sediment Basin Spillway Sizing

Basin ID	Q_{50} Flow (m^3/s)	Base Width (m)	Side Slope (1 in X)	Weir			Chute							
				U/S Water Level (m)	Freeboard (m)	Depth with Freeboard (m)	Slope (%)	Lining	Manning's 'n'	Velocity (m/s)	Max. Permissible Velocity of Lining (m/s)	Velocity Check	Depth of Flow (m)	Depth with Freeboard (m)
T1A-1 (i)	3.29	44.2	2	0.12	0.45	0.57	25	Rock (100mm)	0.10	0.93	1.0	Y	0.08	0.38
T1A-1 (ii)	2.30	36.0	2	0.11	0.45	0.56	25	Rock (100mm)	0.10	0.87	1.0	Y	0.07	0.37

5.3.6 Sediment Basin Artificial Flocculation

In order to function properly, Type B sediment basins must be equipped with an automated flocculation device that automatically doses the incoming flows with a chemical that will assist in the flocculation/coagulation of the sediment and hence, increase the efficiency of the sediment basins. **Table 17** below details the dosing rates based on jar test results of the site surface soils.

Table 17 –Flocculant Dosing Rates

Agent	Indicative Dosage (Based on Jar Testing) & Form	Pros	Cons	Precautions
ACH (Aluminium Chloro-hydrate)	25 - 50 ppm – Liquid form only	High stability, fast acting. Low Dose Rates. Higher Basicity than PAC and Alum. Little pH Change	Requires Low Levels of Alkalinity to perform	Potential Ecotoxicity to Aquatic Organisms due to bioavailability at pH <5.

5.3.7 Sediment Basin Catch Drains

As Type B sediment basins are designed to capture all flows from their designated catchment and convey them through a sediment forebay for the dispersing of flocculant, catch drains are required to divert the catchment flows that would otherwise bypass, into the forebay for treatment.

Initial design was prepared with an unlined base for all diversion drains, where velocities exceeded bare earth scour criteria and hence, a geotextile lining has been proposed for the channel of the drains.

Table 18 – Basin Catch Drain Catchment Hydrology

Drain ID	Area (ha)	Slope (%)	Manning's n	TOC (mins)	Intensity (mm/hr)	C factor	Flow (m^3/s)
T1A-1(i)-D1	1.155	7.5	0.045	13	83.90	0.595	0.16
T1A-1(ii)-D1	3.764	4.8	0.045	16	76.40	0.595	0.48
T1A-1(ii)-D2	0.420	2.4	0.045	19	70.10	0.595	0.05

Table 19 – Basin Catch Drain Channel Capacity Design

Drain ID	Slope (m/m)	Manning's n	Freeboard (m)	Side Slope (1 in X)	Flow Depth (m)	Total Depth Inc. Freeboard (m)	Flow Area (m^2)	Wetted Perimeter	Hydraulic Radius	Velocity (m/s)	Capacity (m^3/s)
T1A-1(i)-D1	0.02	0.022	0.15	4	0.18	0.33	0.13	1.47	0.09	1.26	0.16
T1A-1(ii)-D1	0.01	0.022	0.15	4	0.31	0.46	0.37	2.52	0.15	1.27	0.48
T1A-1(ii)-D2	0.03	0.022	0.15	4	0.11	0.26	0.04	0.87	0.05	1.08	0.05

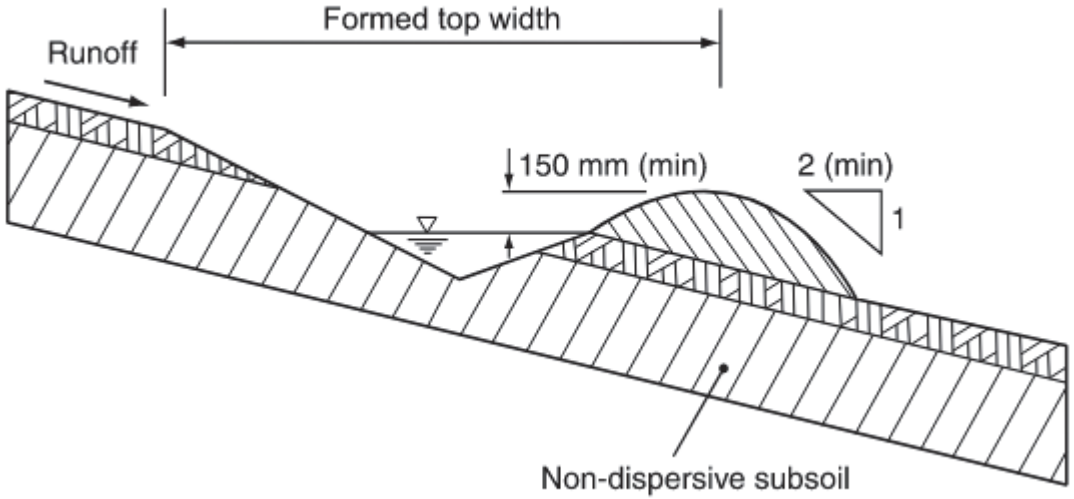

Figure 9 – Typical Diversion Channel Detail (IECA 2018)

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6 OPERATION, MAINTENANCE & MONITORING

6.1 Water Quality Objectives

Table B40 of IECA 2018, Best Practice Erosion and Sediment Control Appendix B recommends all releases of stormwater captured onsite must not exceed the following limits:

- 50mg/L as a maximum concentration.
- PH value must be in the range 6.5 to 8.5.

IECA 2018, Best Practice Erosion and Sediment Control Appendix B also states that a site-specific calibration of the relationship between the suspended solids concentrations (mg/L) and Nephelometric Turbidity Units (NTU) readings can be established once sufficient laboratory testing has been completed (minimum of 5 water samples between 20 mg/L and 150mg/L). This allows the use of Turbidity Meters to determine when the water quality is likely to have reached the equivalent of 50mg/L.

6.2 Sediment Basins

6.2.1 De-watering

When dewatering the basins, the water must meet the water quality objectives described in **Section 6.1** prior to being dewatered. The Contractor may use the water within the basin (providing it achieves the water quality objectives) as construction water for use as dust suppression, compaction and other construction activities.

6.2.2 De-silting

The sediment storage depths for each basin are summarised in **Table 20** (refer **Section 5.3.5** for the basin sizing summary). A marker post with a painted marking should be placed within each basin to indicate the top of the sediment storage zone. The basin shall be desilted if the next storm is likely to cause the settled sediment to rise above the marker point, or if the settled sediment is already at or above the marker point.

Table 20 - Sediment Storage Depth

Basin ID	Sediment Storage Depth (m)
T1A-1 (i)	0.2
T1A-1 (ii)	0.2

If desired, the settlement storage zone can be resized based on the annual soil loss estimated in **Table 10** to provide a larger storage zone that requires desilting less frequently. This may be desirable to a contractor who wishes to perform minimal desilting operations over the construction phase of the project. However, resizing the settlement storage zone will result in an increase to the basin size as the current settlement storage zones are sized to the minimum requirement.

6.2.3 Basin Performance

The performance of the sediment basin shall be assessed using the basin assessment process outlined in **Figure 10**. A Basin Performance Report has been included in **Appendix E** in accordance with IECA Appendix B (2018) and is intended to be used during the clearing phase in conjunction with **Table 21** below so that the basins remain functional and continue to treat the design flows.

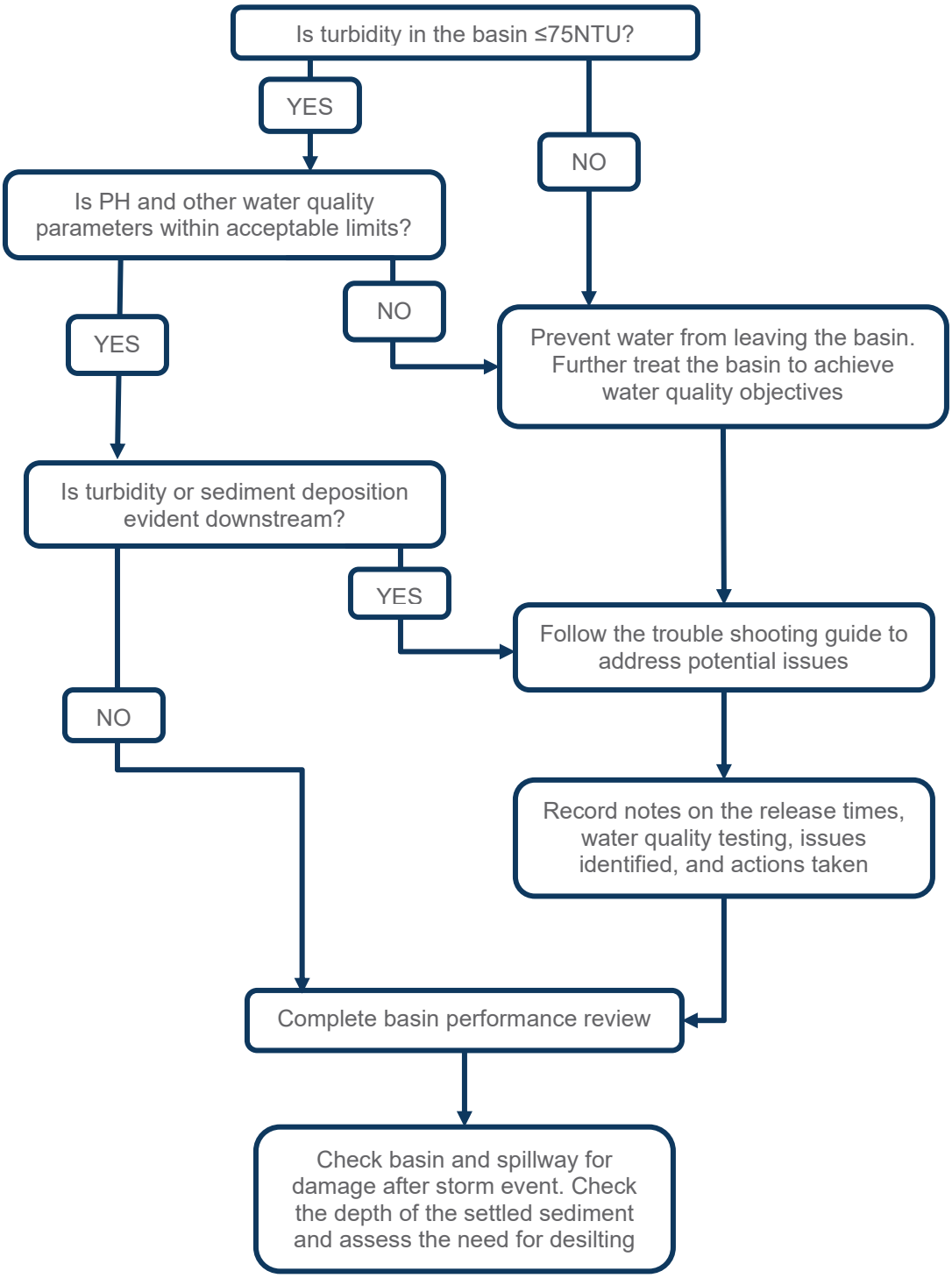

Figure 10 - Basin Performance Assessment Process

Table 21 - Basin Troubleshooting

Issue		Potential reason for issue	Proposed remediation action
Inflow channel	Channel/pipe overtopped	• Channel/pipe undersized • Rainfall event exceeded design capacity	• Check drain is constructed as per design • If not an over-design event and drain is constructed as per design, review design
	Scour in channel	• Lining not installed as per design • Rainfall event exceeded design capacity	• Check drain is constructed as per design • If not an over-design event and drain is constructed as per design, review design
	Chemical not mixing with inflow runoff in channel	• Channel not well defined and runoff bypassing during low flows	• Formalise channel to ensure all flows achieve mixing with chemical
	Catchment bypassing channel	• Upslope drainage not adequate	• Refer to ESCP on drainage required and modify if required to ensure the design catchment enters basin
	Lateral inflow to main basin cell	• Runoff not conveyed back to single inflow point • Runoff on side of basin cannot be conveyed back to inflow point due to levels	• Construct drain to convey runoff back to inflow point • If drain cannot be constructed due to levels, form bund on edge of basin to limit lateral inflow
Chemical	Coagulant or flocculant not working	• No dosing occurred • Poor mixing • Incorrect dose rate • Incorrect chemical • Other site constraints such as pH and Total Alkalinity	• Refer to dosing system • Ensure defined inlet and mixing is promoted as it enters forebay • Test raw water with chemical and dose rates as per testing process to determine required augmentation

Issue		Potential reason for issue	Proposed remediation action
Dosing System	No dosing	• System not operated or maintained as per the supplier's specification • System/componentry failure • Dose line/dispensing material blocked	• Refer to supplier's specification or contact supplier of dosing system • Clean dose line and modify line to minimize potential for repeat blockage
	Incorrect dose rate	• Incorrect parameters input to dosing system or placement of chemical dispenser • Additional runoff pumped or directed to basin • Insufficient chemical available for runoff volume that occurred	• Refer to supplier's specification or contact supplier of dosing system • Review inflow catchment and determine if in accordance with design and rectify if required • Ensure enough chemical is available for expected rain events
Forebay	Sediment being resuspended	• Sediment built up on floor of basin • No dissipation at inlet to forebay	• Remove sediment from forebay • Provide dissipation to inlet to forebay
Level spreader	Concentrated flow over level spreader	• Level spreader not level	• Reshape level spreader to get level or mount aluminium section to get within tolerance
	Scour on backside of level spreader	• Batter Slope into main basin too steep • Lining to backside of level spreader not adequate	• Flatten batter slope if possible • Armour batter
Settling Pond	Flow short circuiting in main basin	• Level spreader not level • Shape of basin is concentrating flow	• Fix level spreader • Install permeable baffles to promote uniform flow
	Erosion on side of basin batters	• Wind action • Erosive soils	• Armour/protect batters of basin
Emergency Spillway	Concentrated flow on spillway	• Spillway not level	• Level spillway
	Spillway too low	• Incorrect construction • Cut off wall not installed	• Check design and rectify
	Spillway too high with limited freeboard	• Incorrect construction • Rock placement incorrect' • Poor design	• Check design and rectify

6.2.4 Basin Maintenance

The maintenance of the sediment basin should be as outlined in Section B5 of IECA 2018, Best Practice Erosion and Sediment Control Appendix B.

- Inspect the sediment basin during the following periods:
  - 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.
  - After each runoff event. Inspect the erosion damage at flow entry and exit points. If damage has occurred, make the necessary repairs.
  - At least weekly during the nominated wet season (if any) otherwise at least fortnightly.
  - Prior to, and immediately after, periods of 'stop work' or site 'shutdown'.
- 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.
- Do not dispose of sediment in a manner that will create an erosion or pollution hazard.
- Check all visible pipe connections for leaks, and repair as necessary.
- Check fill material in the basin for excessive settlement, slumping of the slopes or piping between the conduit and the embankment; make all necessary repairs.
- Remove all trash and other debris from the basin and riser.
- Submerged inflow pipes must be inspected and de-silted (as required) after each inflow event.

6.2.5 Basin Removal

The removal of the sediment basin should be as outline in Section B5 of IECA 2018, Best Practice Erosion and Sediment Control Appendix B.

- 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.
- Before starting any maintenance work on the basin or spillway, install all necessary short-term sediment control measures downstream of the sediment basin (i.e. sediment fence).
- All water and sediment must be removed from the basin prior to the basin's removal. Dispose of sediment and water in a manner that will not create an erosion or pollution hazard.
- Bring the disturbed area to a proper grade, then smooth, compact, and stabilise and/or revegetate as required to establish a stable land surface.

6.3 Erosion and Sediment Control Devices

The maintenance of sediment and erosion control devices other than a sediment basin shall be carried out in accordance with **Table 22**.

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Table 22 - ESC Maintenance Schedule

ESC Measure	Maintenance	Maintenance Trigger	Timeframe for Completion of Maintenance
Sediment Fence	Replace or Reinstate	Sediment fence has collapsed / broken / not toed in	Prior to the next storm
	Desilting	The capacity of the sediment fence falls below 70%	Prior to the next storm
	Remove	Once the area upstream has been stabilised	Prior to handover
Rock Check Dams and Filter Dams	Replace or Reinstate	Dam has collapsed /been washed out	Prior to the next storm
	Desilting	The capacity of the dam falls below 70%	Prior to the next storm
	Remove	Once the area upstream has been stabilised, when catch drain is removed / no longer required or when drain is made a permanent drain	Prior to handover
Diversion / Catch Drains	Replace or Reinstate Lining	If lining has been punctured / torn or damaged	Prior to the next storm
	Desilting	When sediment control devices in drain are at 70% capacity	Prior to the next storm
	Remove	Once area upstream has been stabilised and/or a permanent drainage solution has been implemented making the drain redundant	Prior to handover

All ESC measures shall be regularly monitored throughout the construction phase by the site manager/responsible ESC officer. Inspections of ESC devices shall be completed at the following times:

- At least daily when rain is occurring (wet season)
- At least weekly throughout the construction phase (even when works are not progressing 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.

A monthly inspection and report should be completed by the site manager/responsible ESC officer.

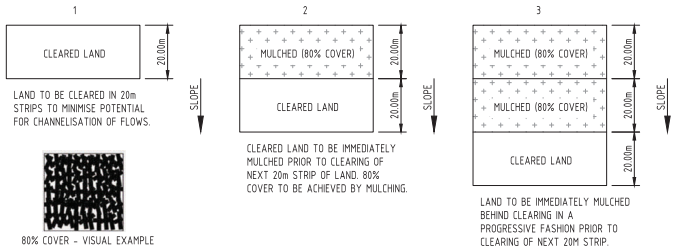
7 CONCLUSION

ADG Engineers (Aust.) Pty Ltd was engaged by Pioneer Fortune Pty Ltd to carry out a Clearing Phase Stormwater Management Plan for a development at Undullah, QLD. The report provides a sediment and erosion control strategy to be implemented throughout the clearing phase of Tranche 1A. Erosion and sediment control devices should be implemented and maintained in accordance with the proposed strategy until such time as the cleared surfaces have sufficient ground cover for stabilisation.

Appendix A
ADG Engineers Sediment and Erosion Control Plans

CATCHMENT TABLE (PRE DEVELOPMENT)

CATCHMENT NAME	AREA (ha)	AVERAGE GRADE (%)	CATCHMENT NAME	AREA (ha)	AVERAGE GRADE (%)
T1A-1 (i)	11.481	15.0	T1A-7	4.581	13.9
T1A-1 (ii)	7.550	15.0	T1A-8	3.477	9.4
T1A-1 (iii)	1.495	15.0	T1A-9	3.439	13.2
T1A-2 (i)	3.199	11.4	EX-1	2.268	6.7
T1A-2 (ii)	4.142	11.4	EX-5	0.248	21.5
T1A-3	5.946	9.7	EX-6	0.016	12.0
T1A-4	5.662	14.2	EX-7	3.315	20.2
T1A-5	6.514	13.0	EX-8	0.357	18.5
T1A-6	3.714	15.0	EX-9	1.943	19.0



LAND TO BE CLEARED IN 20m STRIPS TO MINIMISE POTENTIAL FOR CHANNELISATION OF FLOWS.

80% COVER - VISUAL EXAMPLE

CLEARED LAND TO BE IMMEDIATELY MULCHED PRIOR TO CLEARING OF NEXT 20m STRIP OF LAND. 80% COVER TO BE ACHIEVED BY MULCHING.

LAND TO BE IMMEDIATELY MULCHED BEHIND CLEARING IN A PROGRESSIVE FASHION PRIOR TO CLEARING OF NEXT 20M STRIP.

CLEARING PROGRESSION DETAIL
NTS

LEGEND

- EXISTING SURFACE CONTOURS (MAJOR)
- EXISTING SURFACE CONTOURS (MINOR)
- MAJOR CATCHMENT BOUNDARY
- MINOR CATCHMENT BOUNDARY
- DEVELOPMENT BOUNDARY
- TRANCHE 1A CLEARING BOUNDARY
- TREE PROTECTION FENCE
- T1A-X — CATCHMENT LABEL
- CATCHMENT FLOW DIRECTION
- PROPOSED DIVERSION DRAIN
- MULCHED AREA

NOTE
1. FOR SEDIMENT & EROSION CONTROL NOTES AND DETAILS REFER TO DRG No. SED05

ISSUED FOR
INFORMATION ONLY

Rev	Date	Description	By	Chk
02	21.12.20	FOR INFORMATION	JF	ML
01	15.12.20	FOR INFORMATION	JF	MRB

SCALE 1:2000
AT ORIGINAL SIZE (A1)

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Client	PIONEER FORTUNE PTY LTD
Project Name	MASTER PLANNED COMMUNITY RICE, DAIRY AND WYATT ROADS UNDULLAH, QLD 4285
Discipline	CIVIL
Status	PRELIMINARY
Designed By	JF
Checked By	MRB
Approved By	ML
Project No.	23165
Drawn By	JF
Scale at A1	1:2000

Title	TRANCHE 1A CLEARING PHASE SEDIMENT AND EROSION CONTROL CATCHMENT PLAN
Drawing No.	SED01
Revision	02

PLOT DATE: 12/21/2020 5:00 PM FILENAME: J:\23000\23165\CIV\DWG\23165_SED01_T1A CATCHMENT PLAN.DWG

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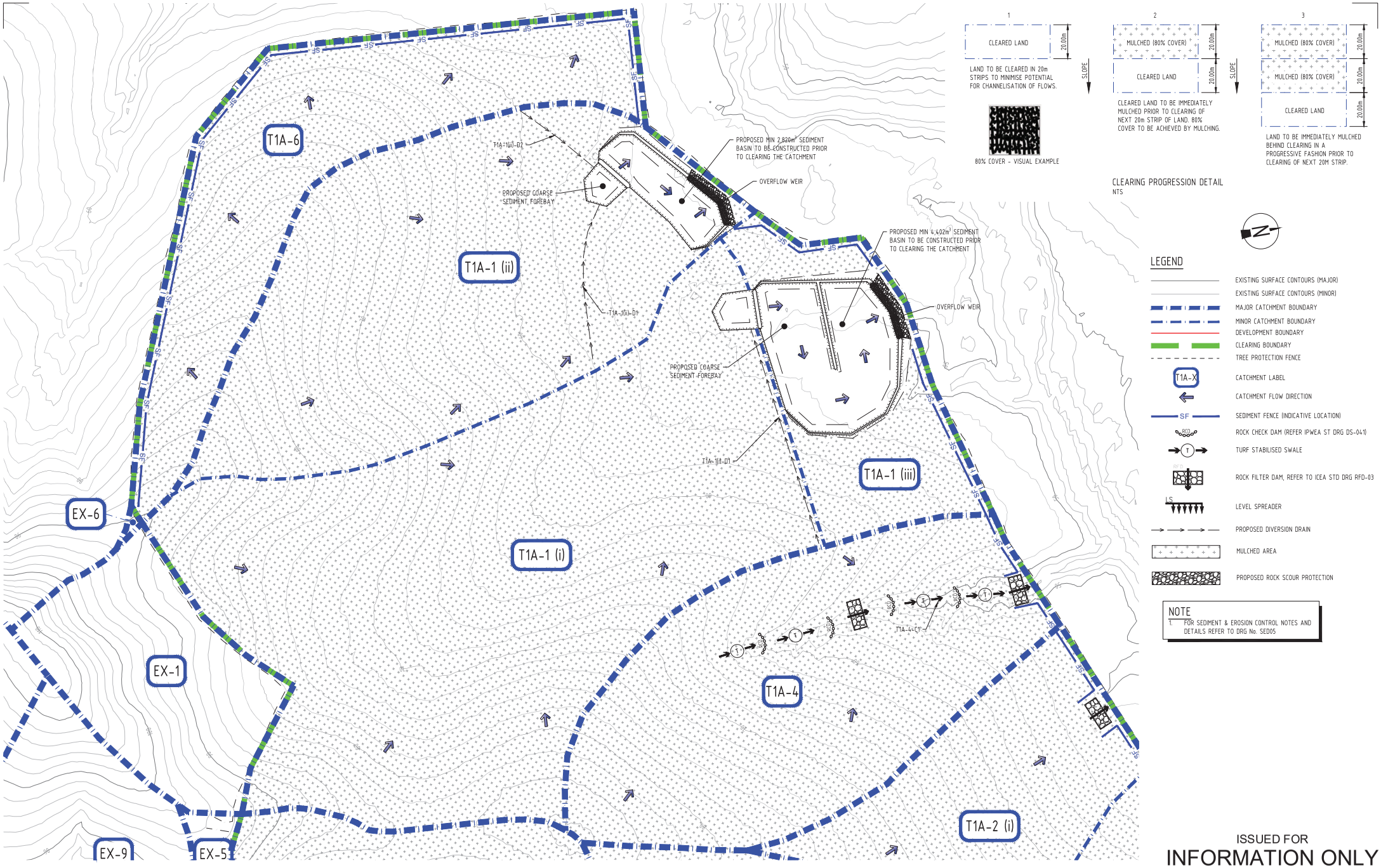

1
CLEARED LAND
20.00m
LAND TO BE CLEARED IN 20m STRIPS TO MINIMISE POTENTIAL FOR CHANNELISATION OF FLOWS.

2
MULCHED (80% COVER)
20.00m
CLEARED LAND
20.00m
SLOPE
CLEARED LAND TO BE IMMEDIATELY MULCHED PRIOR TO CLEARING OF NEXT 20m STRIP OF LAND. 80% COVER TO BE ACHIEVED BY MULCHING.

3
MULCHED (80% COVER)
20.00m
MULCHED (80% COVER)
20.00m
CLEARED LAND
20.00m
LAND TO BE IMMEDIATELY MULCHED BEHIND CLEARING IN A PROGRESSIVE FASHION PRIOR TO CLEARING OF NEXT 20M STRIP.

80% COVER - VISUAL EXAMPLE

CLEARING PROGRESSION DETAIL
NTS

LEGEND

- EXISTING SURFACE CONTOURS (MAJOR)
- EXISTING SURFACE CONTOURS (MINOR)
- MAJOR CATCHMENT BOUNDARY
- MINOR CATCHMENT BOUNDARY
- DEVELOPMENT BOUNDARY
- CLEARING BOUNDARY
- TREE PROTECTION FENCE
- T1A-X — CATCHMENT LABEL
- CATCHMENT FLOW DIRECTION
- SF — SEDIMENT FENCE (INDICATIVE LOCATION)
- RCD — ROCK CHECK DAM (REFER IPWEA ST DRG DS-041)
- T — TURF STABILISED SWALE
- RFD — ROCK FILTER DAM, REFER TO ICEA STD DRG RFD-03
- LS — LEVEL SPREADER
- PROPOSED DIVERSION DRAIN
- MULCHED AREA
- PROPOSED ROCK SCOUR PROTECTION

NOTE
1. FOR SEDIMENT & EROSION CONTROL NOTES AND DETAILS REFER TO DRG No. SED05

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INFORMATION ONLY

Rev	Date	Description	By	Chk
02	21.12.20	FOR INFORMATION	JF	ML
01	15.12.20	FOR INFORMATION	JF	MRB

0 25 50 75m
SCALE 1:1250
AT ORIGINAL SIZE (A1)

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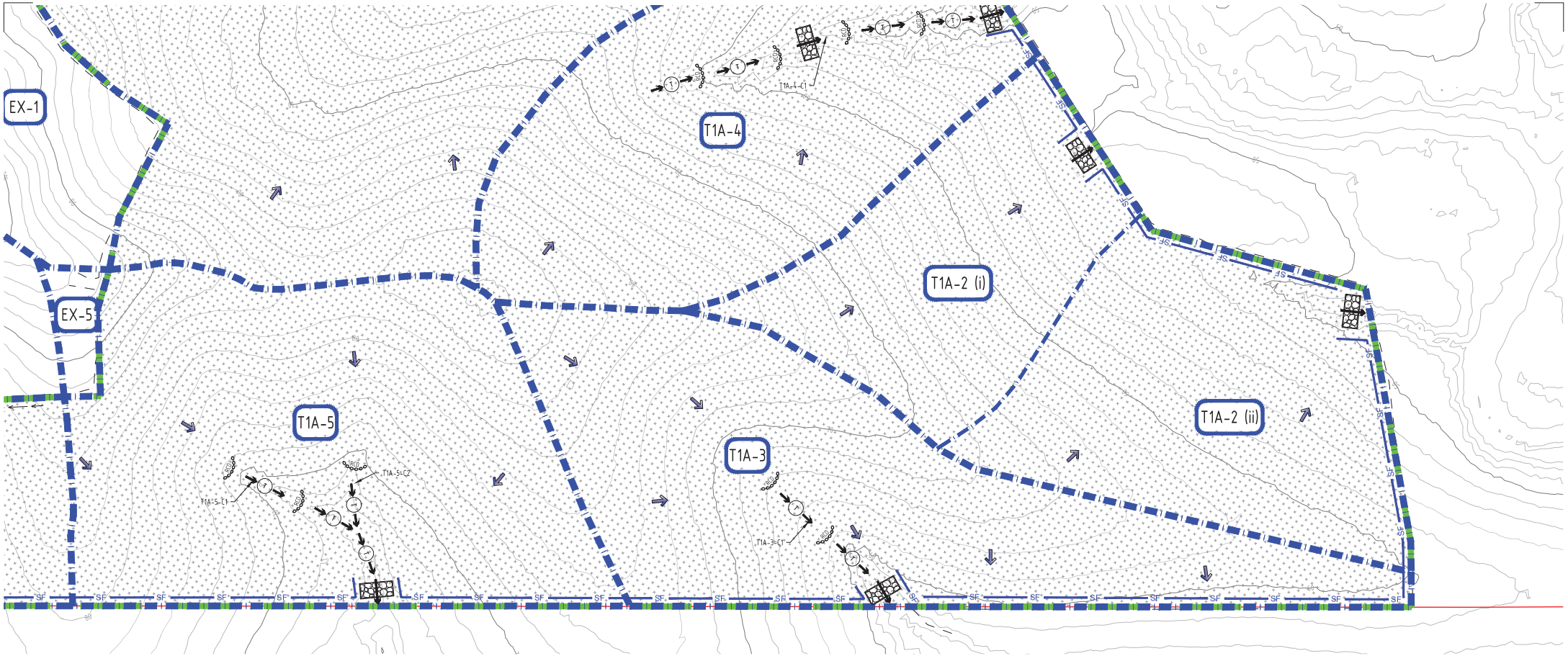
Client	PIONEER FORTUNE PTY LTD
Project Name	MASTER PLANNED COMMUNITY RICE, DAIRY AND WYATT ROADS UNDULLAH, QLD 4285
Discipline	CIVIL
Status	PRELIMINARY
Designed By	JF
Checked By	MRB
Approved By	ML
Project No.	23165
Drawn By	JF
Scale at A1	1:1250

Title	TRANCHE 1A CATCHMENTS T1A-1, T1A-4 & T1A-6 CLEARING PLAN
Drawing No.	SED02
Revision	02

PLOT DATE: 12/21/2020 5:03 PM FILENAME: J:\23000\23165\CIV\DWG\23165_SED02_T1A-1 T1A-4 T1A-6 CATCHMENT CLEARING PLAN.DWG

FULL SIZE ON ORIGINAL 0 10 20 30 40 50 60 70 80 90 100mm



LEGEND

- EXISTING SURFACE CONTOURS (MAJOR)
- EXISTING SURFACE CONTOURS (MINOR)
- MAJOR CATCHMENT BOUNDARY
- MINOR CATCHMENT BOUNDARY
- DEVELOPMENT BOUNDARY
- TRANCHE 1A CLEARING BOUNDARY
- TREE PROTECTION FENCE
- T1A-X — CATCHMENT LABEL
- CATCHMENT FLOW DIRECTION
- SF — SEDIMENT FENCE (INDICATIVE LOCATION)
- RCD — ROCK CHECK DAM (REFER IPWEA ST DRG DS-041)
- T — TURF STABILISED SWALE
- RFD — ROCK FILTER DAM, REFER TO ICEA STD DRG RFD-03
- LS — LEVEL SPREADER
- PROPOSED CLEAN WATER DIVERSION DRAIN
- MULCHED AREA
- PROPOSED ROCK SCOUR PROTECTION

N

NOTE

1. FOR SEDIMENT & EROSION CONTROL NOTES AND DETAILS REFER TO DRG No. SED05

ISSUED FOR
INFORMATION ONLY

Rev	Date	Description	By	Chk
02	21.12.20	FOR INFORMATION	JF	ML
01	14.12.20	FOR INFORMATION	JF	MRB

0 25 50 75m
SCALE 1:1250
AT ORIGINAL SIZE (A1)

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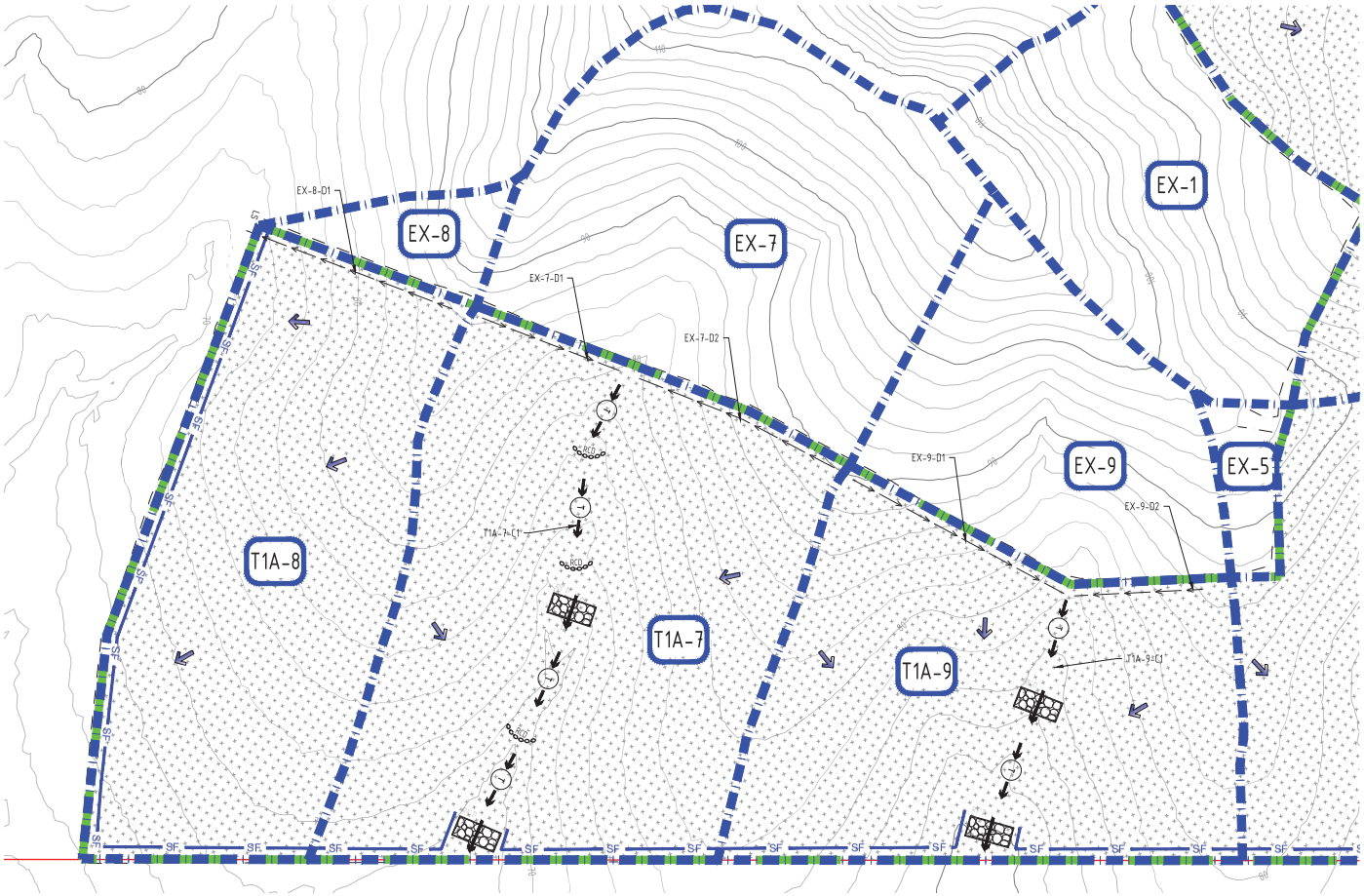
Client	PIONEER FORTUNE PTY LTD
Project Name	MASTER PLANNED COMMUNITY RICE, DAIRY AND WYATT ROADS UNDULLAH, QLD 4285
Discipline	CIVIL
Status	PRELIMINARY
Designed By	JF
Checked By	MRB
Approved By	ML
Project No.	23165
Drawn By	JF
Scale at A1	1:1250

Title	TRANCHE 1A CATCHMENTS T1A-2, T1A-3 & T1A-5 CLEARING PLAN
Drawing No.	SED03
Revision	02

PLOT DATE: 12/21/2020 5:04 PM FILENAME: J:\23000\23165\CIVIL\DWG\23165_SED03_T1A-2 T1A-3 T1A-5 CATCHMENT CLEARING PLAN.DWG

FULL SIZE ON ORIGINAL 0 10 20 30 40 50 60 70 80 90 100mm



LEGEND

- EXISTING SURFACE CONTOURS (MAJOR)
- EXISTING SURFACE CONTOURS (MINOR)
- MAJOR CATCHMENT BOUNDARY
- MINOR CATCHMENT BOUNDARY
- DEVELOPMENT BOUNDARY
- TRANCHE 1A CLEARING BOUNDARY
- TREE PROTECTION FENCE
- T1A-X — CATCHMENT LABEL
- CATCHMENT FLOW DIRECTION
- SF — SEDIMENT FENCE (INDICATIVE LOCATION)
- RCD — ROCK CHECK DAM (REFER IPWEA ST DRG DS-041)
- T — TURF STABILISED SWALE
- RFD — ROCK FILTER DAM, REFER TO ICEA STD DRG RFD-03
- LS — LEVEL SPREADER
- PROPOSED CLEAN WATER DIVERSION DRAIN
- MULCHED AREA
- PROPOSED ROCK SCOUR PROTECTION

NOTE

1. FOR SEDIMENT & EROSION CONTROL NOTES AND DETAILS REFER TO DRG No. SED05

ISSUED FOR
INFORMATION ONLY

Rev	Date	Description	By	Chk
02	21.12.20	FOR INFORMATION	JF	ML
01	14.12.20	FOR INFORMATION	JF	MRB

PLOT DATE: 12/21/2020 5:14 PM FILENAME: J:\23000\23165\CIV\DWG\23165_SED04_T1A-7 T1A-8 T1A-9 CATCHMENT CLEARING PLAN.DWG

0 25 50 75m
SCALE 1:1250
AT ORIGINAL SIZE (A1)

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BRISBANE / DARWIN / GOLD COAST / MELBOURNE / PERTH / SUNSHINE COAST / SYDNEY / TOOWOOMBA

Client	PIONEER FORTUNE PTY LTD
Project Name	MASTER PLANNED COMMUNITY RICE, DAIRY AND WYATT ROADS UNDULLAH, QLD 4285
Discipline	CIVIL
Status	PRELIMINARY
Designed By	JF
Checked By	MRB
Approved By	ML
Project No.	23165
Drawn By	JF
Scale at A1	1:1000

Title	TRANCHE 1A CATCHMENTS T1A-7, T1A-8 & T1A-9 CLEARING PLAN
Drawing No.	SED04
Revision	02

FULL SIZE ON ORIGINAL 0 10 20 30 40 50 60 70 80 90 100mm

NOTES:

SEDIMENT CONTROL

1. ALL SEDIMENT & EROSION CONTROL MEASURES TO BE IN ACCORDANCE WITH INTERNATIONAL EROSION CONTROL ASSOCIATION (IECA) AUSTRALIA GUIDELINES AND THE SPECIFICATIONS.
2. SEDIMENT & EROSION CONTROL DETAILS SHOWN ARE MINIMUM REQUIREMENTS. IT IS THE CONTRACTORS RESPONSIBILITY TO INSTALL ADDITIONAL CONTROL MEASURES AS DEEMED NECESSARY THROUGHOUT CONSTRUCTION.
3. THE CONTRACTOR IS RESPONSIBLE TO MAINTAIN ALL SEDIMENT CONTROL DEVICES IN A FUNCTIONAL ORDER AND REPLACE ALL BLOCKED SEDIMENT DEVICES AS REQUIRED UNTIL SUCCESSFUL OFF MAINTENANCE OF WORKS.
4. CONSTRUCTION OF ALL SEDIMENT MANAGEMENT DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT SHALL BE COMPLETED AND EFFECTIVE PRIOR TO:
   a. STRIPPING OF TOPSOIL AND GRASS.
   b. BULK EARTHWORKS TO THE SITE.
   c. SERVICES INSTALLATION.
   d. PAVEMENT CONSTRUCTION.
5. ALL SEDIMENT MANAGEMENT MEASURES ARE TO REMAIN IN PLACE UNTIL INSTRUCTION IS RECEIVED IN WRITING FROM THE SUPERINTENDENT TO REMOVE ALL OR PART OF THE SILT CONTROL APPLICATIONS.
6. THE BULK EARTHWORKS AND SEDIMENT CONTROL LAYOUT PLAN SHALL BE READ IN CONJUNCTION WITH THE APPROVED DRAWINGS.
7. PRIOR TO COMMENCEMENT OF CONSTRUCTION APPROVAL IS TO BE OBTAINED FROM THE SUPERINTENDENT FOR THE LOCATION OF THE SITE ACCESS POINT AND WASH DOWN AREA WHICH ARE TO BE MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.
8. IF EROSION AND SEDIMENT CONTROL DEVICES HAVE BEEN FOUND TO BE DIFFERENT OR FAILED IN SERVICE, CORRECTIVE ACTION IS TO BE UNDERTAKEN IMMEDIATELY WHICH MAY INCLUDE AMENDMENTS' ADDITIONS TO THE ORIGINAL APPROVED EROSION CONTROL PLANS. SUCH AMENDMENTS ARE TO BE APPROVED BY SUPERINTENDENT, IF DEEMED NECESSARY AND RELEVANT.

OVERALL

9.
   a. TEMPORARY DRAINAGE CONTROL FLOW SHOULD BE DIVERTED AROUND THE WORK SITE WHERE POSSIBLE.
   b. ALL DRAINAGE, EROSION AND SEDIMENT CONTROLS TO BE INSTALLED AND BE OPERATIONAL BEFORE COMMENCING UP-SLOPE EARTHWORKS.
   c. IN AREAS WHERE RUNOFF TURBIDITY IS TO BE CONTROLLED, EXPOSED SURFACES TO BE EITHER MULCHED, COVERED WITH EROSION CONTROL BLANKETS OR TURFED IF EARTHWORKS ARE EXPECTED TO BE DELAYED FOR MORE THAN 14 DAYS.

SEDIMENT FENCE

10. FOR SEDIMENT FENCE STANDARD DETAIL AND SPECIFICATION REFER TO INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (IECA) BEST PRACTICES STANDARD DRAWINGS SF-01 AND SF-02 SEDIMENT FENCE.

TEMPORARY CONSTRUCTION ENTRY/EXIT

11. FOR CONSTRUCTION ENTRY / EXIT STANDARD DETAIL AND SPECIFICATION REFER TO INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (IECA) BEST PRACTICES STANDARD DRAWINGS EXIT-01 AND EXIT-02 CONSTRUCTION EXIT - ROCK PAD (CONSTRUCTION SITES ONLY), EXIT-04 AND EXIT-05 CONSTRUCTION EXIT - VIBRATION GRID.

CHECK DAMS

12. FOR CHECK DAM STANDARD DETAIL AND SPECIFICATION REFER TO INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (IECA) BEST PRACTICES STANDARD DRAWING RCD-01 CHECK DAMS.

REVEGETATION

13. FOR REVEGETATION STANDARD SPECIFICATION REFER TO INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (IECA) BEST PRACTICES STANDARD DRAWING R-01 REVEGETATION GENERAL.

FIELD INLET SEDIMENT TRAP

14. FOR FIELD INLET STANDARD DETAIL AND SPECIFICATION REFER TO INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (IECA) BEST PRACTICES STANDARD DRAWING ESC-02 GRATED STORMWATER (FIELD) INLET SEDIMENT TRAP.

ROCK FILTER DAM

15. FOR ROCK FILTER DAM DETAIL & SPECIFICATION REFER TO INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (IECA) BEST PRACTICES STANDARD DRAWING RFD-03 ROCK FILTER DAM PART 1 & RFD-04 ROCK FILTER DAM PART 2.

OPERATION AND MAINTENANCE

16. IN ACCORDANCE WITH DENR REQUIREMENTS, ALL ESC MEASURES SHALL BE INSPECTED:
   - AT LEAST DAILY (WHEN WORK IS OCCURRING ON SITE) OR WEEKLY (WHEN WORK IS NOT OCCURRING ON SITE)
   - WITHIN 24 HOURS OF EXPECTED RAIN; AND
   - WITHIN 18 HOURS OF A RAINFALL EVENT (I.E. AN EVENT OF SUFFICIENT INTENSITY AND DURATION TO MOBILISE SEDIMENT ON SITE).
18. IN ACCORDANCE WITH DENR REQUIREMENTS, MAINTENANCE OF ESC MEASURES SHALL OCCUR IN ACCORDANCE WITH THE FOLLOWING TABLE:

MAINTENANCE SCHEDULE

ESC MEASURE	MAINTENANCE TRIGGER	TIMEFRAME FOR COMPLETION OF MAINTENANCE
SEDIMENT BASINS	WHEN SETTLED SEDIMENT EXCEEDS THE VOLUME OF THE SEDIMENT STORAGE ZONE.	WITHIN 7 DAYS OF THE INSPECTION
OTHER ESC MEASURES	THE CAPACITY OF ESC MEASURES FALLS BELOW 75%	BY THE END OF THE DAY

DUST SUPPRESSION

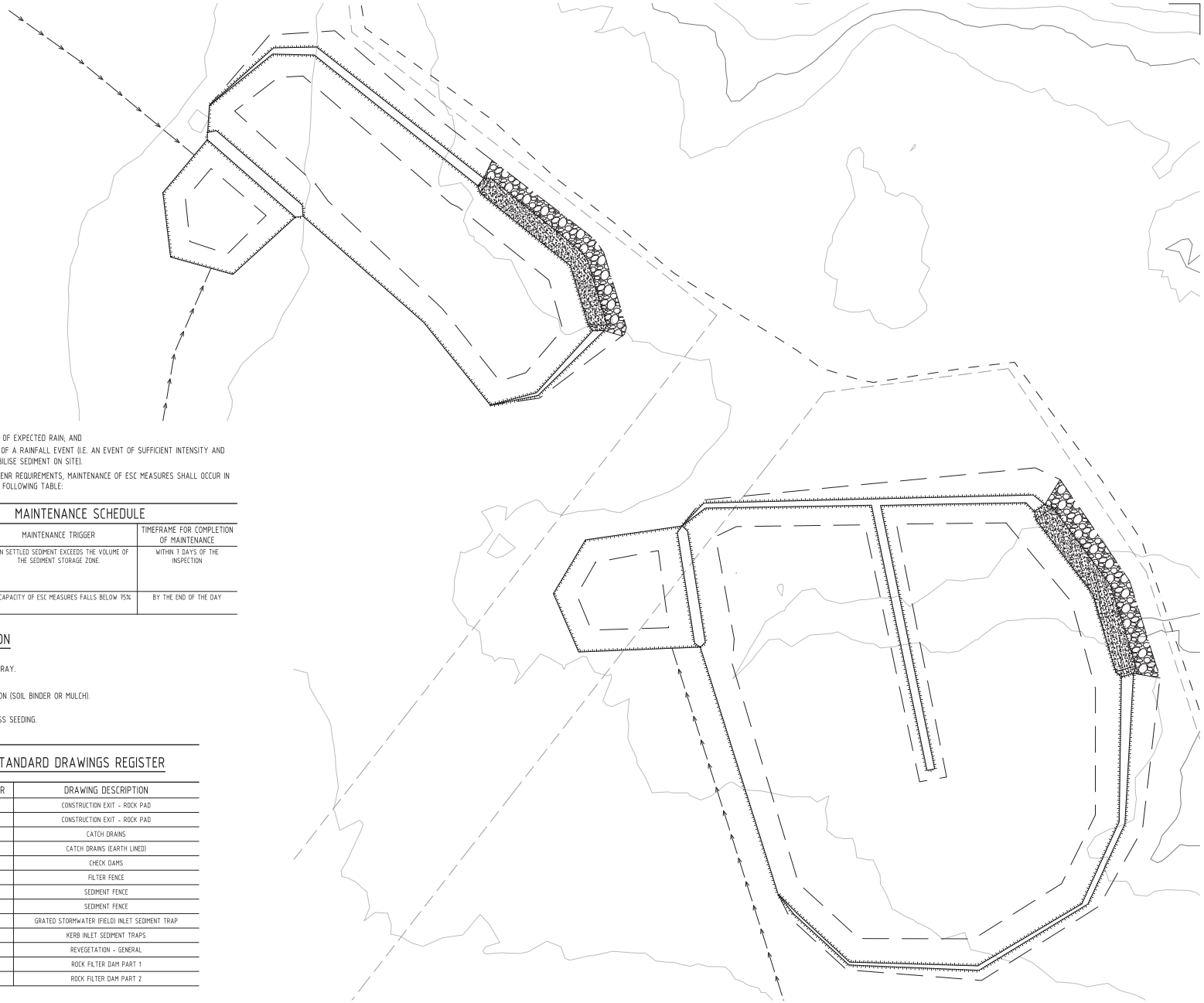
19. SHORT TERM
   - WATER TRUCK SPRAY.
20. LONG TERM
   - SOIL STABILISATION (SOIL BINDER OR MULCH).
   - GRAVEL COVER.
   - TEMPORARY GRASS SEEDING.

IECA STANDARD DRAWINGS REGISTER

DRAWING NUMBER	DRAWING DESCRIPTION
EXIT-01	CONSTRUCTION EXIT - ROCK PAD
EXIT-02	CONSTRUCTION EXIT - ROCK PAD
CD-01	CATCH DRAINS
CD-02	CATCH DRAINS (EARTH LINED)
RCD-01	CHECK DAMS
FF-01	FILTER FENCE
SF-01	SEDIMENT FENCE
SF-02	SEDIMENT FENCE
ESC-02	GRATED STORMWATER (FIELD) INLET SEDIMENT TRAP
ESC-03	KERB INLET SEDIMENT TRAPS
R-01	REVEGETATION - GENERAL
RFD-03	ROCK FILTER DAM PART 1
RFD-04	ROCK FILTER DAM PART 2

*DRAWINGS TO BE READ IN CONJUNCTION WITH INTERNATIONAL EROSION CONTROL ASSOCIATION AUSTRALASIA (IECA) BEST PRACTICES STANDARD DRAWINGS AND SPECIFICATIONS.

NOTE
1. FOR SEDIMENT & EROSION CONTROL LAYOUT PLAN REFER TO DRGS SED01 - SED04.



SEDIMENT BASINS - PLAN VIEW
SCALE: 1:500

ISSUED FOR
INFORMATION ONLY

Rev	Date	Description	By	Chk
02	21.12.20	FOR INFORMATION	JF	ML
01	14.12.20	FOR INFORMATION	JF	MRB

0 10 20 30m
SCALE 1:500
AT ORIGINAL SIZE (A1)

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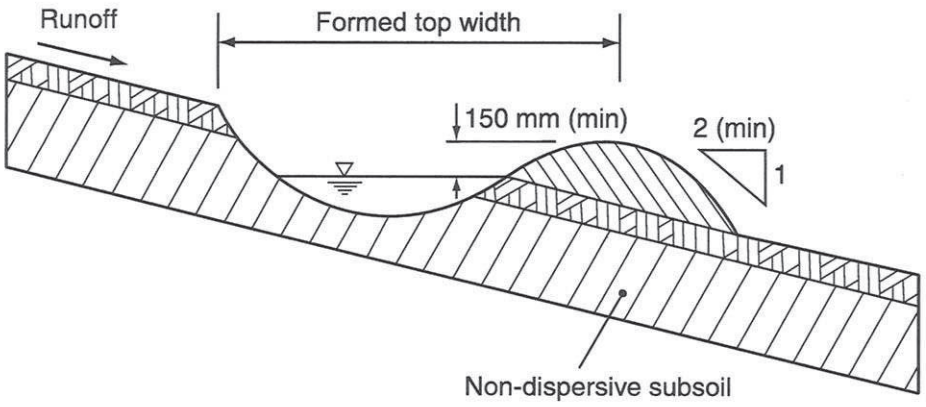
Client	PIONEER FORTUNE PTY LTD
Project Name	MASTER PLANNED COMMUNITY RICE, DAIRY AND WYATT ROADS UNDULLAH, QLD 4285
Discipline	CIVIL
Status	PRELIMINARY
Designed By	JF
Checked By	MRB
Approved By	ML
Project No.	23165
Drawn By	JF
Scale at A1	1:500

Title	TRANCHE 1A SEDIMENT AND EROSION CONTROL NOTES & DETAILS
Drawing No.	SED05
Revision	02

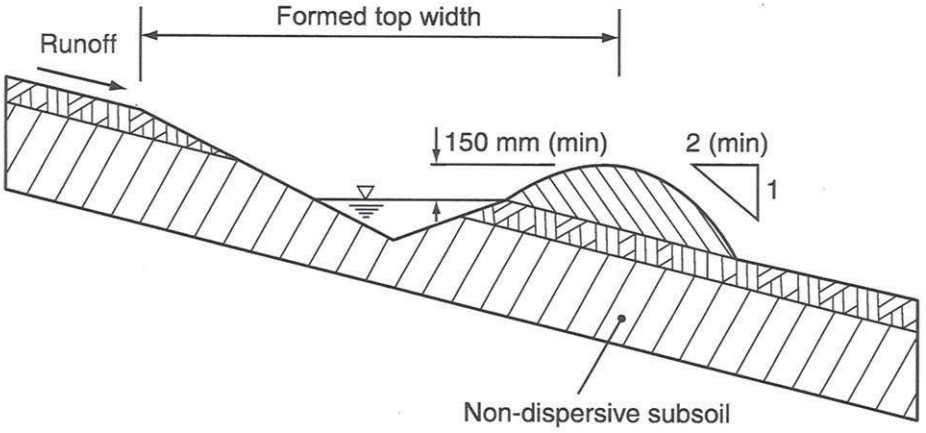
PLOT DATE: 12/21/2020 5:23 PM FILENAME: J:\23000\23165\CIVIL\DWG\23165_SED05_SEDIMENT AND EROSION CONTROL NOTES AND DETAILS.DWG

FULL SIZE ON ORIGINAL 0 10 20 30 40 50 60 70 80 90 100mm

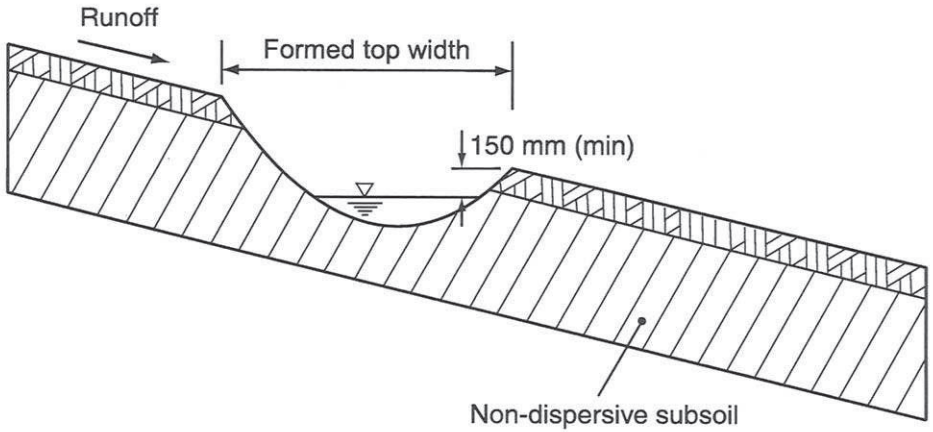
Appendix B
IECA Standard Drawings



(a) Parabolic catch drain with down-slope bank



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



(c) Parabolic catch drain without 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

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.

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.

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.

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GMW	May-10	Catch Drains - Geotextile Lined	CD-04

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.

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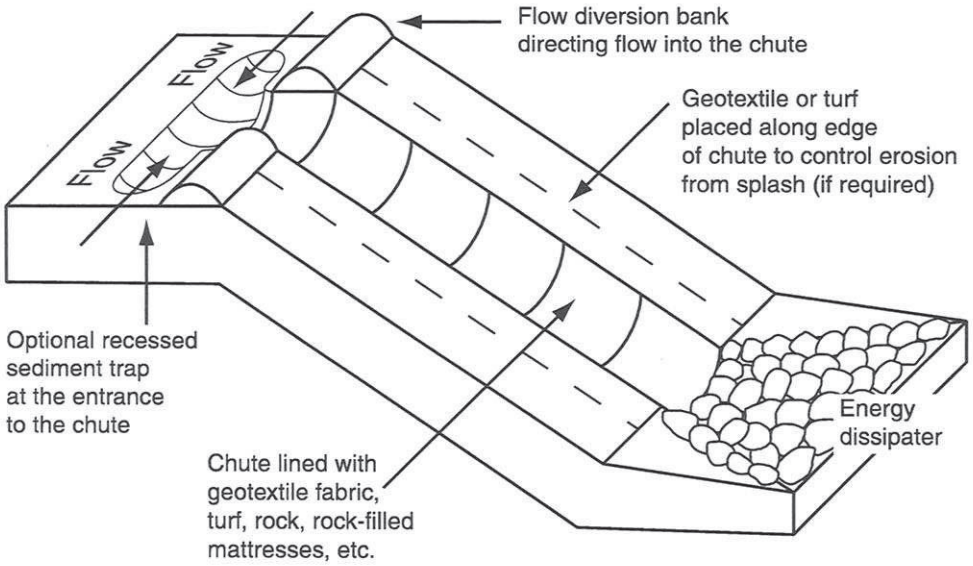
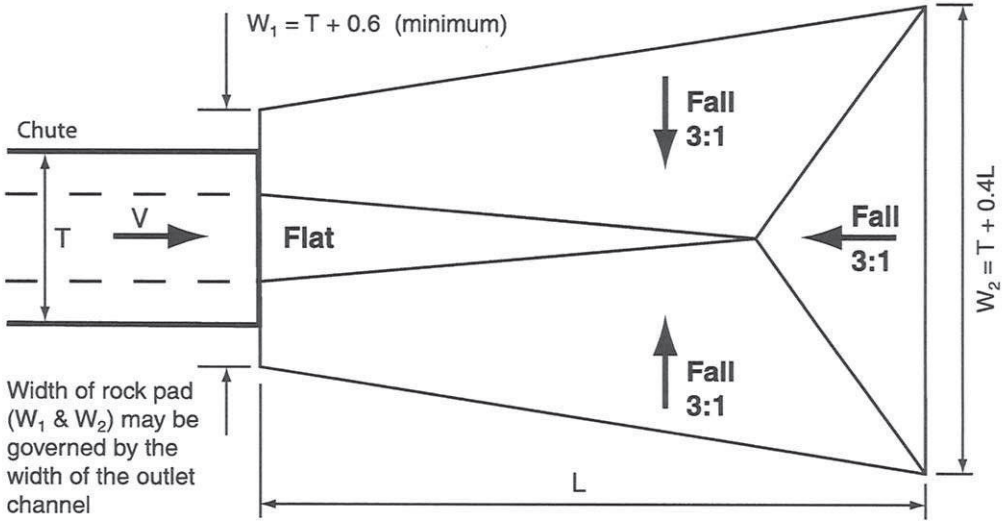
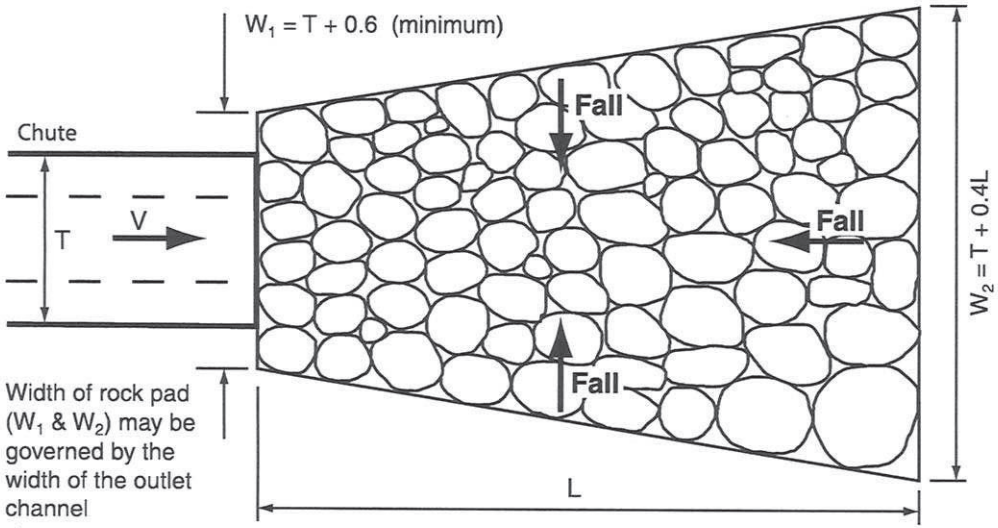


(a) Temporary drainage chute with rock pad outlet structure

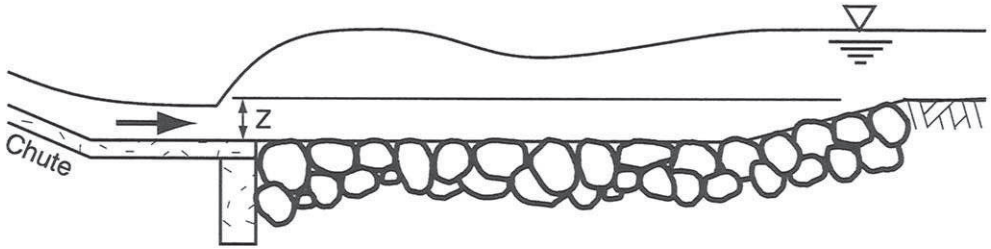


T = Maximum top width of flow at base of chute

(b) Typical layout of an outlet energy dissipater 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, **not** basin spillways.
2. A rock pad outlet structure is just one option for the design of the outlet energy dissipater.

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GMW	Dec-09	Chutes - General	CH-01

CHUTES - GENERAL SPECIFICATIONS

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. CONSTRUCT THE SUBGRADE TO THE ELEVATIONS SHOWN ON THE PLANS. REMOVE ALL UNSUITABLE MATERIAL AND REPLACE WITH STABLE MATERIAL TO ACHIEVE THE DESIRED FOUNDATIONS.

3. IF THE CHUTE IS TEMPORARY, THEN COMPACT THE SUBGRADE TO A FIRM CONSISTENCY. IF THE CHUTE IS INTENDED TO BE PERMANENT, THEN COMPACT AND FINISH THE SUBGRADE AS SPECIFIED WITHIN THE DESIGN PLANS.

4. IF THE CHUTE IS TO BE LINED WITH ROCK, THEN AVOID COMPACTING THE SUBGRADE TO A CONDITION THAT WOULD PREVENT THE ROCK LINING FROM ADEQUATELY BEDDING INTO THE SUBGRADE.

5. ENSURE THE SUBGRADE IS FIRM ENOUGH TO MINIMISE WATER SEEPAGE.

6. ON FILL SLOPES, ENSURE THAT THE SOIL IS ADEQUATELY COMPACTED FOR A WIDTH OF AT LEAST ONE METRE EACH SIDE OF THE CHUTE TO MINIMISE THE RISK OF SOIL EROSION, OTHERWISE PROTECT THE SOIL WITH SUITABLE SCOUR PROTECTION MEASURES SUCH AS TURF OR EROSION CONTROL MATS.

7. PLACE AND SECURE THE CHUTE LINING AS DIRECTED.

8. IF CONCRETE IS USED AS A LINING, THEN KEEP THE SUBGRADE MOIST AT THE TIME CONCRETE IS PLACED. FORM, CUT-OFF WALLS AND ANCHOR BLOCKS AS DIRECTED IN THE APPROVED PLANS.

9. INSTALL AN APPROPRIATE OUTLET STRUCTURE (ENERGY DISSIPATER) AT THE BASE OF THE CHUTE (REFER TO SEPARATE SPECIFICATIONS).

10. ENSURE WATER LEAVING THE CHUTE AND THE OUTLET STRUCTURE WILL FLOW FREELY WITHOUT CAUSING UNDESIRABLE PONDING OR SCOUR.

11. APPROPRIATELY STABILISE ALL DISTURBED AREAS IMMEDIATELY AFTER CONSTRUCTION.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL CHUTES 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 CHUTE LINING, INCLUDING SURFACE CRACKING.

3. CHECK FOR SOIL SCOUR ADJACENT THE CHUTE. INVESTIGATE THE CAUSE OF ANY SCOUR, AND REPAIR AS NECESSARY.

4. WHEN MAKING REPAIRS, ALWAYS RESTORE THE CHUTE TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED.

REMOVAL

1. TEMPORARY CHUTES 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.

ADDITIONAL SPECIFICATIONS FOR ROCK PAD OUTLET STRUCTURE AT BASE OF CHUTE:

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 (ROCK OUTLET 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.

Drawn:	Date:		
GMW	Dec-09	Chutes - General	CH-02

INSTALLATION (CHUTE FORMATION)

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 LOCATION FOR THE CHUTE 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.

4. CONSTRUCT THE SUBGRADE TO THE ELEVATIONS SHOWN ON THE PLANS. REMOVE ALL UNSUITABLE MATERIAL AND REPLACE WITH STABLE MATERIAL TO ACHIEVE THE DESIRED FOUNDATIONS.

5. IF THE CHUTE IS TEMPORARY, THEN COMPACT THE SUBGRADE TO A FIRM CONSISTENCY. IF THE CHUTE IS INTENDED TO BE PERMANENT, THEN COMPACT AND FINISH THE SUBGRADE AS SPECIFIED WITHIN THE DESIGN PLANS.

6. ENSURE THE SUBGRADE IS FIRM ENOUGH TO MINIMISE WATER SEEPAGE.

7. ENSURE THE SIDES OF THE CHUTE ARE NO STEEPER THAN A 1.5:1 (H:V) SLOPE.

8. ENSURE THE COMPLETED CHUTE HAS SUFFICIENT DEEP ALONG ITS FULL LENGTH.

9. ENSURE THE CHUTE IS STRAIGHT FROM ITS CREST TO THE TOE OF THE CHUTE.

10. ON FILL SLOPES, ENSURE THAT THE SOIL IS ADEQUATELY COMPACTED FOR A WIDTH OF AT LEAST ONE METRE EACH SIDE OF THE CHUTE TO MINIMISE THE RISK OF SOIL EROSION, OTHERWISE PROTECT THE SOIL WITH SUITABLE SCOUR PROTECTION MEASURES SUCH AS TURF OR EROSION CONTROL MATS.

11. PLACE AND SECURE THE CHUTE LINING (REFER TO SEPARATE SPECIFICATIONS).

12. IF CONCRETE IS USED AS A LINING, THEN KEEP THE SUBGRADE MOIST AT THE TIME CONCRETE IS PLACED. FORM, CUT-OFF WALLS AND ANCHOR BLOCKS AS DIRECTED IN THE APPROVED PLANS.

13. INSTALL AN APPROPRIATE OUTLET STRUCTURE (ENERGY DISSIPATER) AT THE BASE OF THE CHUTE (REFER TO SEPARATE SPECIFICATIONS).

14. ENSURE WATER LEAVING THE CHUTE AND THE OUTLET STRUCTURE WILL FLOW FREELY WITHOUT CAUSING UNDESIRABLE PONDING OR SCOUR.

15. APPROPRIATELY STABILISE ALL DISTURBED AREAS IMMEDIATELY AFTER CONSTRUCTION.

INSTALLATION (FABRIC PLACEMENT)

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

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

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

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

4. 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.

5. WHEN FABRIC HAS BEEN ANCHORED WITHIN THE TRENCH, THEN BACKFILLED THE TRENCH AND COMPACT.

6. WHEN SPREADING THE FABRIC, AVOID STRETCHING THE MATERIAL.

7. ENSURE THE FABRIC REMAINS IN GOOD CONTACT WITH THE SOIL.

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

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

10. INSTALL INTERMEDIATE ANCHOR TRENCHES AT 3m (MAX) INTERVALS.

11. IF THE CHUTE EXTENDS BEYOND THE LENGTH OF THE FABRIC, THEN FORM A NEW TRENCH IS FORMED AT LEAST 300mm UP-SLOPE OF THE END OF THE FABRIC SUCH THAT THE END OF THE FABRIC WILL BE ABLE TO FULLY COVER THE TRENCH. A NEW ROLL OF FABRIC IS THEN ANCHORED WITHIN THIS TRENCH AS PER THE FIRST. THE PROCESS IS CONTINUED DOWN THE SLOPE UNTIL THE DESIRED AREA IS FULLY COVERED.

12. IF CHUTE IS SUBJECT TO LATERAL INFLOWS, TEN ANCHOR THE OUTER MOST SIDES OF THE FABRIC IN A 300mm DEEP TRENCH AND STAPLE AT 200 TO 250mm CENTRES.

13. THE INSTALLATION PROCEDURE MUST ENSURE THAT THE FABRIC ACHIEVES AND RETAINS GOOD CONTACT WITH THE SOIL.

14. DAMAGED FABRIC MUST BE REPAIRED OR REPLACED.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL CHUTES 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 CHUTE LINING, INCLUDING SURFACE CRACKING.

3. CHECK FOR SOIL SCOUR ADJACENT THE CHUTE. INVESTIGATE THE CAUSE OF ANY SCOUR, AND REPAIR AS NECESSARY.

4. ENSURE SEDIMENT IS NOT PARTIALLY BLOCKING FLOW ENTRY INTO THE CHUTE. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

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

6. WHEN MAKING REPAIRS, ALWAYS RESTORE THE CHUTE TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED.

REMOVAL

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

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

3. GRADE THE AREA IN PREPARATION FOR STABILISATION, THEN STABILISE THE AREA AS SPECIFIED IN THE APPROVED PLAN.

Drawn:	Date:		
GMW	Dec-09	Chutes - Synthetic Linings	CH-03

INSTALLATION (CHUTE FORMATION)

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. 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 CHUTE 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.

5. CONSTRUCT THE SUBGRADE TO THE ELEVATIONS SHOWN ON THE PLANS. REMOVE ALL UNSUITABLE MATERIAL AND REPLACE WITH STABLE MATERIAL TO ACHIEVE THE DESIRED FOUNDATIONS.

6. IF THE CHUTE IS TEMPORARY, THEN COMPACT THE SUBGRADE TO A FIRM CONSISTENCY. IF THE CHUTE IS INTENDED TO BE PERMANENT, THEN COMPACT AND FINISH THE SUBGRADE AS SPECIFIED WITHIN THE DESIGN PLANS.

7. AVOID COMPACTING THE SUBGRADE TO A CONDITION THAT WOULD PREVENT THE TURF FROM BONDING WITH THE SUBGRADE.

8. ENSURE THE SIDES OF THE CHUTE ARE NO STEEPER THAN A 1.5:1 (H:V) SLOPE.

9. ENSURE THE COMPLETED CHUTE HAS SUFFICIENT DEEP ALONG ITS FULL LENGTH.

10. ENSURE THE CHUTE IS STRAIGHT FROM ITS CREST TO THE TOE OF THE CHUTE.

11. ON FILL SLOPES, ENSURE THAT THE SOIL IS ADEQUATELY COMPACTED FOR A WIDTH OF AT LEAST 1m EACH SIDE OF THE CHUTE TO MINIMISE THE RISK OF SOIL EROSION, OTHERWISE PROTECT THE SOIL WITH SUITABLE SCOUR PROTECTION MEASURES SUCH AS TURF OR EROSION CONTROL MATS.

12. PLACE AND SECURE THE TURF AS DIRECTED.

13. INSTALL AN APPROPRIATE OUTLET STRUCTURE (ENERGY DISSIPATER) AT THE BASE OF THE CHUTE (REFER TO SEPARATE SPECIFICATIONS).

14. ENSURE WATER LEAVING THE CHUTE AND THE OUTLET STRUCTURE WILL FLOW FREELY WITHOUT CAUSING UNDESIRABLE PONDING OR SCOUR.

15. APPROPRIATELY STABILISE ALL DISTURBED AREAS IMMEDIATELY AFTER CONSTRUCTION.

ADDITIONAL REQUIREMENTS WHEN LAYING TURF WITHIN A CHUTE:

1. TURF SHOULD BE USED WITHIN 12-HOURS OF DELIVERY, OTHERWISE ENSURE THE TURF IS STORED IN CONDITIONS APPROPRIATE FOR THE WEATHER CONDITIONS.

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. 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.

7. ENSURE THE TURF EXTENDS UP THE SIDES OF THE CHANNEL AT LEAST 100mm ABOVE THE ELEVATION OF THE CHANNEL BED, OR AT LEAST TO A SUFFICIENT ELEVATION TO FULLY CONTAIN THE EXPECTED CHANNEL FLOW THAT IS CONSIDERED LIKELY TO OCCUR WITHIN THE FIRST MONTH AFTER PLACEMENT.

8. ON CHUTE GRADIENTS OF 3:1(H:V) OR STEEPER, OR WHEREVER EROSION MAY BE A PROBLEM, 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.

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

10. WHERE PRACTICABLE, ONCE FIXED IN PLACE, THE TURF SHOULD BE ROLLED WITH A ROLLER WEIGHING 60 TO 90kg/m WIDTH, THEN WATERED.

11. AFTER ROLLING, LIGHTLY SPREAD SCREENED TOPSOIL TO REPLACE TOPSOIL LOST FROM THE TURF AND TO FILL ANY GAPS BETWEEN THE ROWS.

12. 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 CONSTRUCTION PERIOD, INSPECT ALL CHUTES 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. MAINTAIN A HEALTHY AND VIGOROUS GRASS CONDITION WHENEVER AND WHEREVER POSSIBLE, INCLUDING WATERING AND FERTILISING AS NEEDED.

3. ENSURE A MINIMUM GRASS LEAF BLADE LENGTH OF 50mm IS MAINTAINED IN AREAS SUBJECT TO MEDIUM TO HIGH FLOW VELOCITIES, AND 20 TO 50mm IN LOW VELOCITY AREAS.

4. MOWING SHOULD NOT BE ATTEMPTED UNTIL THE TURF IS FIRMLY ROOTED, USUALLY 2 TO 3 WEEKS AFTER LAYING.

5. CHECK FOR MOVEMENT OF, OR DAMAGE TO, THE TURF LINING.

6. CHECK FOR SOIL SCOUR ADJACENT THE CHUTE. INVESTIGATE THE CAUSE OF ANY SCOUR, AND REPAIR AS NECESSARY.

7. ENSURE SEDIMENT IS NOT PARTIALLY BLOCKING FLOW ENTRY INTO THE CHUTE. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

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

9. WHEN MAKING REPAIRS, ALWAYS RESTORE THE CHUTE TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED.

REMOVAL

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

2. GRADE THE AREA IN PREPARATION FOR STABILISATION, THEN STABILISE THE AREA AS SPECIFIED IN THE APPROVED PLAN.

Drawn:	Date:		
GMW	Dec-09	Chutes - Grass Linings	CH-04

THE FOLLOWING INSTALLATION PROCEDURE SHOULD BE CONFIRMED WITH THE PRODUCT MANUFACTURER OR DISTRIBUTOR.

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 (ROCK MATTRESSES)

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 TWO-THIRDS 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. DURING THE CONSTRUCTION PERIOD, INSPECT ALL CHUTES 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 SOIL SCOUR ADJACENT THE CHUTE. INVESTIGATE THE CAUSE OF ANY SCOUR, AND REPAIR AS NECESSARY.

3. ENSURE SEDIMENT IS NOT PARTIALLY BLOCKING FLOW ENTRY INTO THE CHUTE. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

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

5. WHEN MAKING REPAIRS, ALWAYS RESTORE THE CHUTE TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED.

Drawn:	Date:		
GMW	May-10	Chutes - Rock Mattress Linings	CH-05

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 (CHUTE FORMATION)

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. 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 CHUTE 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.

5. CONSTRUCT THE SUBGRADE TO THE ELEVATIONS SHOWN ON THE PLANS. REMOVE ALL UNSUITABLE MATERIAL AND REPLACE WITH STABLE MATERIAL TO ACHIEVE THE DESIRED FOUNDATIONS.

6. IF THE CHUTE IS TEMPORARY, THEN COMPACT THE SUBGRADE TO A FIRM CONSISTENCY. IF THE CHUTE IS INTENDED TO BE PERMANENT, THEN COMPACT AND FINISH THE SUBGRADE AS SPECIFIED WITHIN THE DESIGN PLANS.

7. AVOID COMPACTING THE SUBGRADE TO A CONDITION THAT WOULD PREVENT THE TURF FROM BONDING WITH THE SUBGRADE.

8. ENSURE THE SIDES OF THE CHUTE ARE NO STEEPER THAN A 1.5:1 (H:V) SLOPE.

9. ENSURE THE COMPLETED CHUTE HAS SUFFICIENT DEEP ALONG ITS FULL LENGTH.

10. ENSURE THE CHUTE IS STRAIGHT FROM ITS CREST TO THE TOE OF THE CHUTE.

11. ON FILL SLOPES, ENSURE THAT THE SOIL IS ADEQUATELY COMPACTED FOR A WIDTH OF AT LEAST ONE METRE EACH SIDE OF THE CHUTE TO MINIMISE THE RISK OF SOIL EROSION, OTHERWISE PROTECT THE SOIL WITH SUITABLE SCOUR PROTECTION MEASURES SUCH AS TURF OR EROSION CONTROL MATS.

12. PLACE AND SECURE THE TURF AS DIRECTED.

13. INSTALL AN APPROPRIATE OUTLET STRUCTURE (ENERGY DISSIPATER) AT THE BASE OF THE CHUTE (REFER TO SEPARATE SPECIFICATIONS).

14. ENSURE WATER LEAVING THE CHUTE AND THE OUTLET STRUCTURE WILL FLOW FREELY WITHOUT CAUSING UNDESIRABLE PONDING OR SCOUR.

15. APPROPRIATELY STABILISE ALL DISTURBED AREAS IMMEDIATELY AFTER CONSTRUCTION.

INSTALLATION (ROCK PLACEMENT)

1. 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.

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

3. 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.

4. 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.

5. 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.

6. 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.

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

8. 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.

9. 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.

10. 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.

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

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

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL CHUTES 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 SCOUR OR DISLODGED ROCK. REPAIR DAMAGED AREAS IMMEDIATELY.

3. 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.

4. INVESTIGATE THE CAUSE OF ANY SCOUR, AND REPAIR AS NECESSARY.

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

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

7. ENSURE SEDIMENT IS NOT PARTIALLY BLOCKING FLOW ENTRY INTO THE CHUTE. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

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

9. WHEN MAKING REPAIRS, ALWAYS RESTORE THE CHUTE TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED.

Drawn:	Date:		
GMW	May-10	Chutes - Rock Linings	CH-06

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.

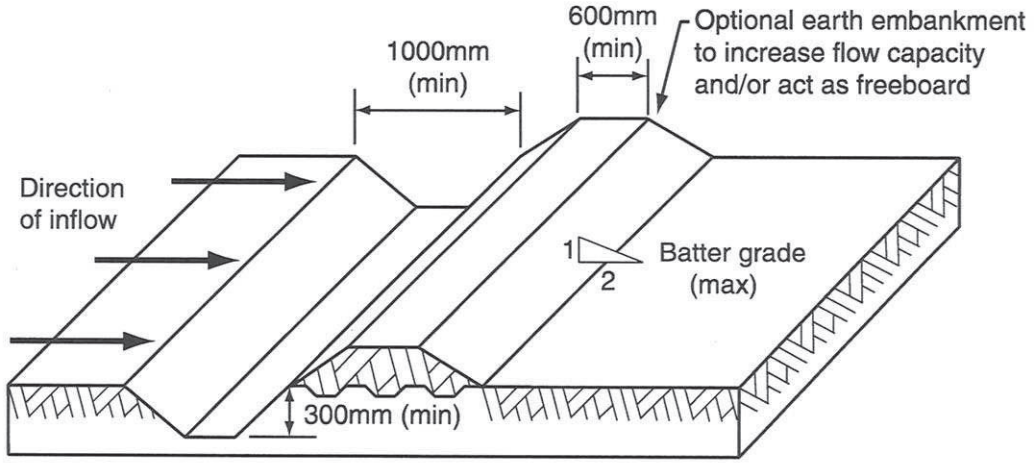


Figure 1 - Typical profile of diversion channel with bank

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

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.

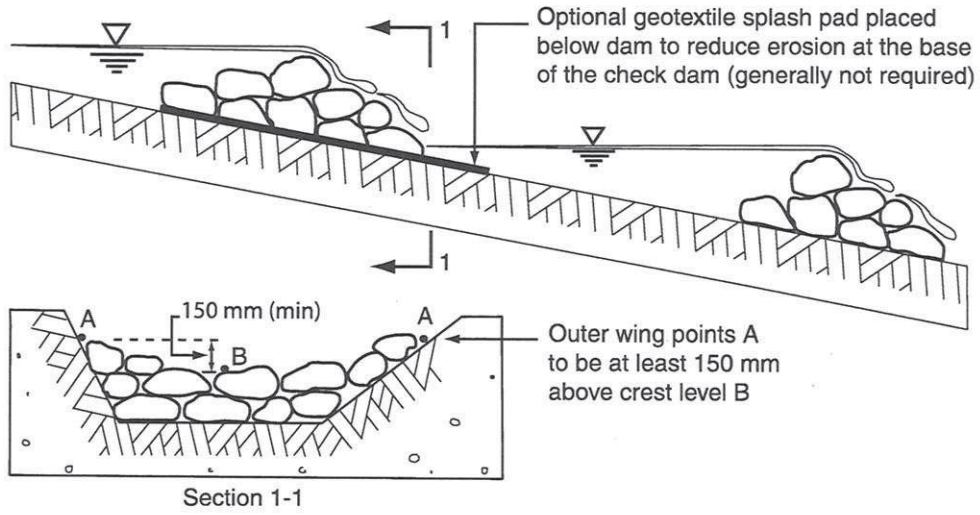


Figure 1 - Layout and profile of check dams (rock check dams shown)

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

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.

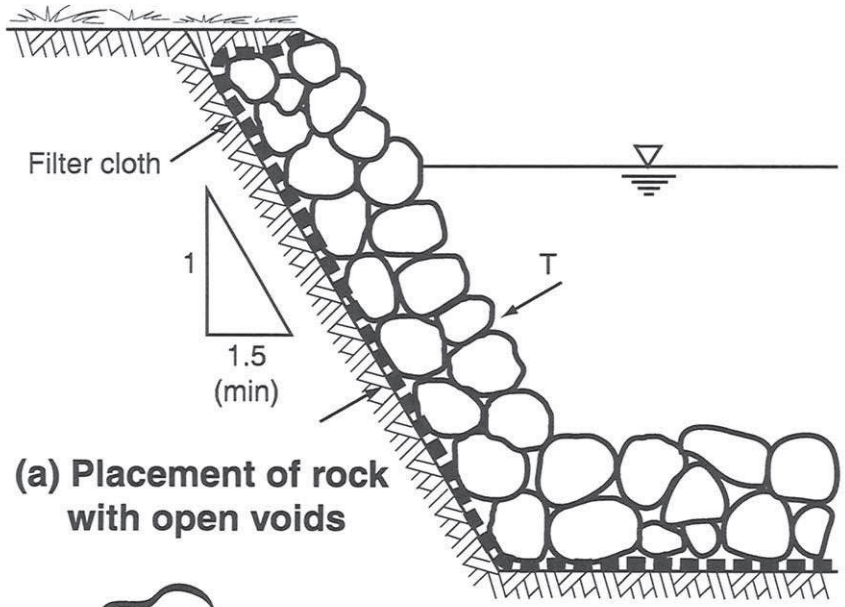
MAINTENANCE

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

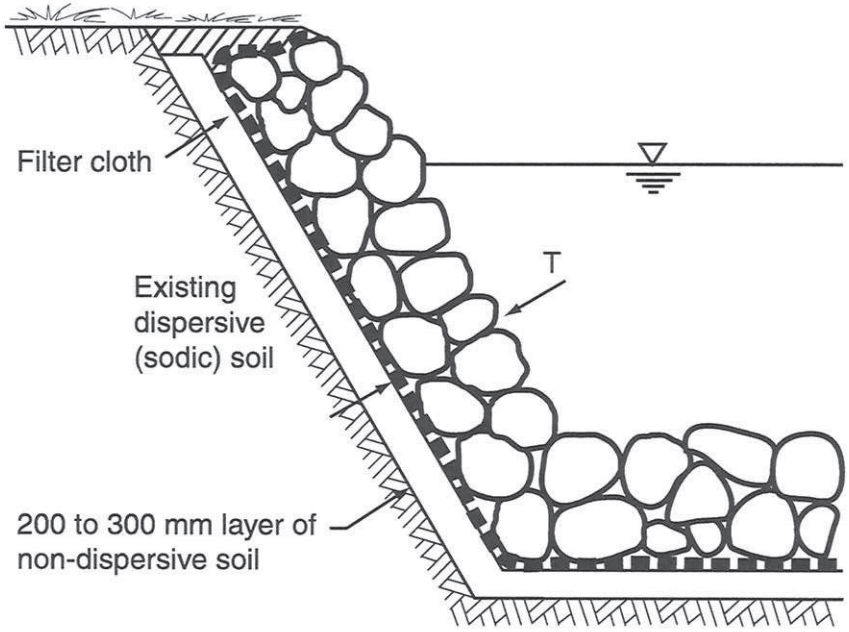
2. CLOSELY INSPECT THE OUTER EDGES OF THE TREATED AREA. ENSURE WATER ENTRY INTO THE CHANNEL OR CHUTE IS NOT CAUSING EROSION ALONG THE EDGE OF THE MATTRESSES.

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

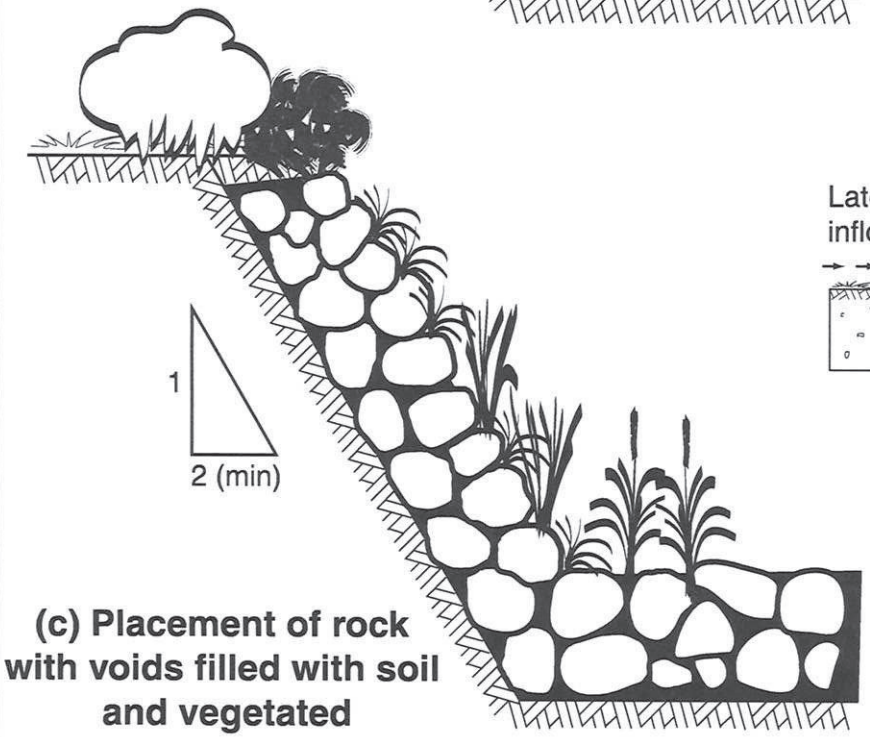
Drawn:	Date:		
GMW	May-10	Rock Mattress Linings	RM-01



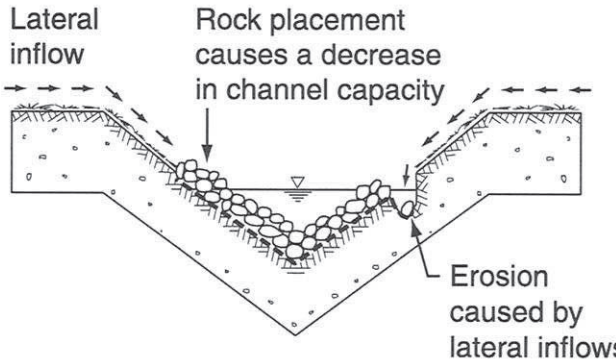
(a) Placement of rock with open voids



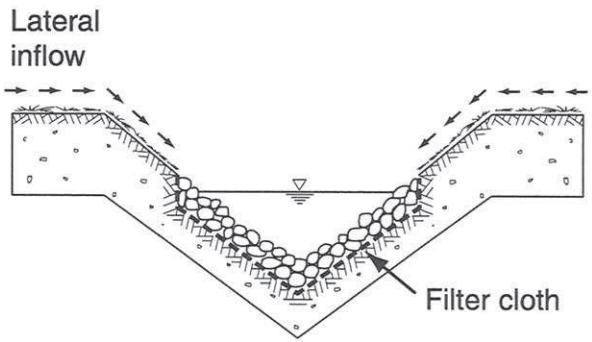
(b) Placement of rock within a channel cut into dispersive soils



(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

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.

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

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

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

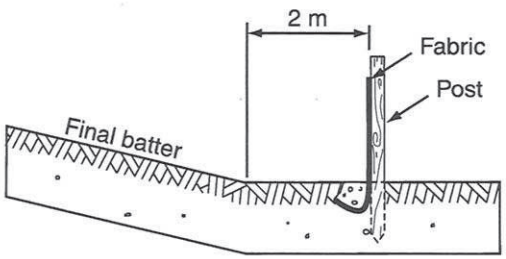
1. INSPECT ALL MULCHES FORTNIGHTLY AND AFTER RUNOFF-PRODUCING RAINFALL AND STRONG WINDS.

2. CHECK FOR RILL EROSION, OR DISLODGMENT OF THE MULCH.

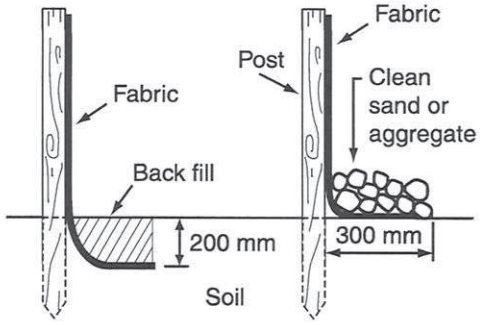
3. REPLACE ANY DISPLACED MULCH TO MAINTAIN THE REQUIRED COVERAGE.

4. IF STORMWATER RUNOFF DISPLACES MORE THAN 10% OF THE MULCH, THEN INVESTIGATE THE NEED FOR ADDITIONAL DRAINAGE CONTROLS TO PREVENT FURTHER DISPLACEMENT.

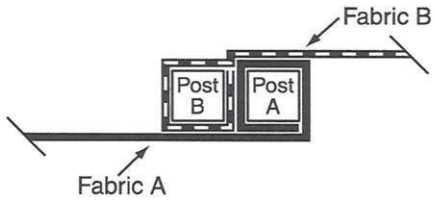
Drawn:	Date:		
GMW	Dec-09	Heavy Mulching	MH-01



(a) Location of fence relative to base of slope

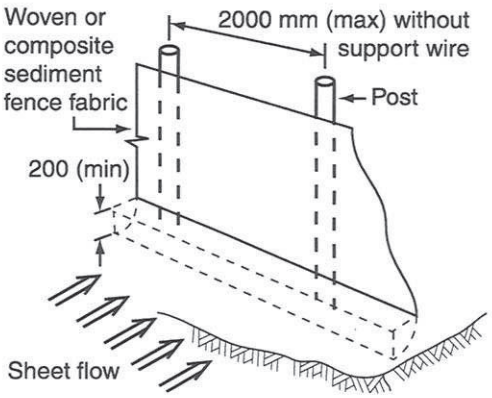


(b) Anchoring base of fabric

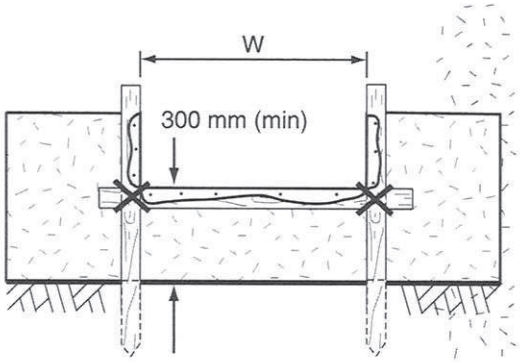


Fabric to fold around each stake one full turn.
Stake B to be drive tightly against Stake A.
The tops of both stakes to be secured with wire.

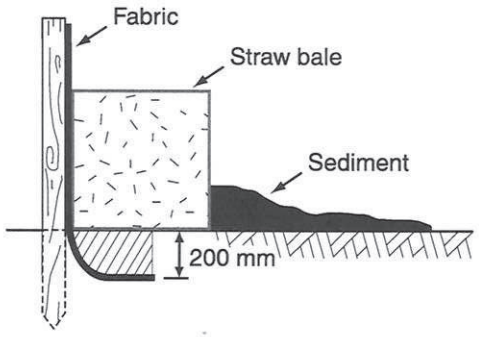
(c) Joining fabric - Method 1



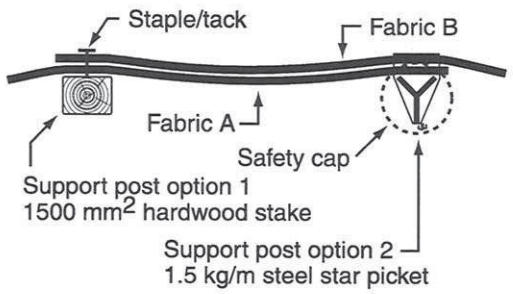
(d) Installation without backing support



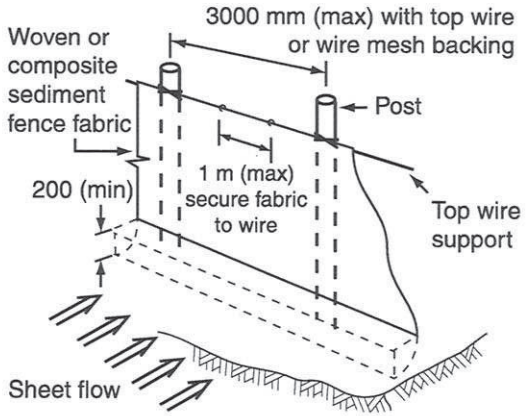
(e) Spill-through weir



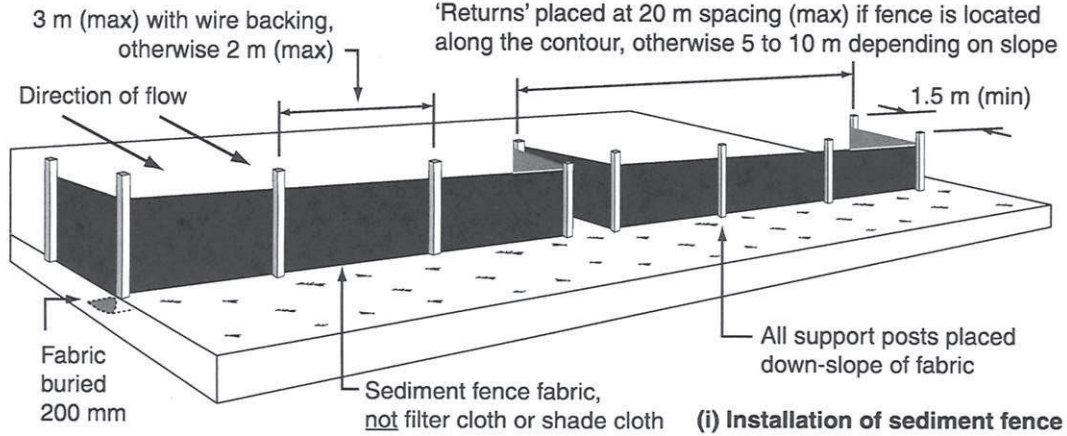
(f) Placement of up-slope straw bale



(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	ESC-04

MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140g/m^2. 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	May-10	Sediment Fence	ESC-05

MATERIALS

ROCK: 150 TO 300mm EQUIVALENT DIAMETER, HARD, EROSION RESISTANT ROCK.

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

INSTALLATION (ROCK CHECK DAM)

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 SEDIMENT TRAP, ENSURE THE DRAINAGE CHANNEL IS DEEP ENOUGH TO PREVENT WATER BEING UNSAFELY DIVERTED OUT OF THE DRAIN ONCE THE CHECK DAMS ARE INSTALLED.

3. LOCATE EACH CHECK DAM SEDIMENT TRAP AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AT SUCH A SPACING TO ACHIEVE THE REQUIRED SEDIMENT TRAPPING OUTCOMES.

4. IF THE CHECK DAMS ARE ALSO BEING USED TO CONTROL EROSION WITHIN THE DRAINAGE CHANNEL, THEN LOCATE EACH SUCCESSIVE CHECK DAM SUCH THAT THE CREST OF THE IMMEDIATE DOWNSTREAM DAM IS LEVEL WITH THE CHANNEL INVERT AT THE IMMEDIATE UPSTREAM CHECK DAM.

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

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

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

INSTALLATION (COMPOST-FILLED SOCKS)

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 SEDIMENT TRAP, ENSURE THE DRAINAGE CHANNEL IS DEEP ENOUGH TO PREVENT WATER BEING UNSAFELY DIVERTED OUT OF THE DRAIN ONCE THE CHECK DAMS ARE INSTALLED.

3. LOCATE EACH SOCK AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AT SUCH A SPACING TO ACHIEVE THE REQUIRED SEDIMENT TRAPPING OUTCOMES.

4. PLACE EACH SOCK TO THE LINES AND PROFILE SHOWN IN THE APPROVED PLAN OR AS DIRECTED BY THE SITE SUPERVISOR.

5. ENSURE EACH SOCK EXTENDS UP THE CHANNEL BANKS (WHERE PRACTICAL) TO A LEVEL AT LEAST 100mm ABOVE THE CREST LEVEL OF THE CHECK 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 THE 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. DE-SILT SEDIMENT TRAP IF THE SEDIMENT LEVEL EXCEEDS 1/3 THE CREST HEIGHT.

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 DISTURBED AREAS SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE DAMS MUST BE REMOVED, UNLESS THE SEDIMENT TRAPS ARE TO REMAIN AS A PERMANENT FEATURE.

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 ALL MATERIALS INCLUDING ANY GEOTEXTILE FABRIC.

4. STABILISE THE DISTURBED CHANNEL WITH A LINING OF FABRIC AND ROCK, OR ESTABLISH VEGETATION AS APPROPRIATE.

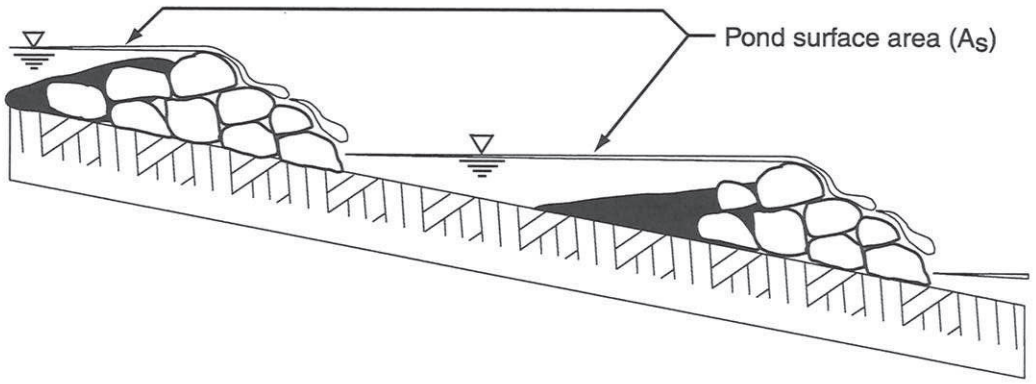
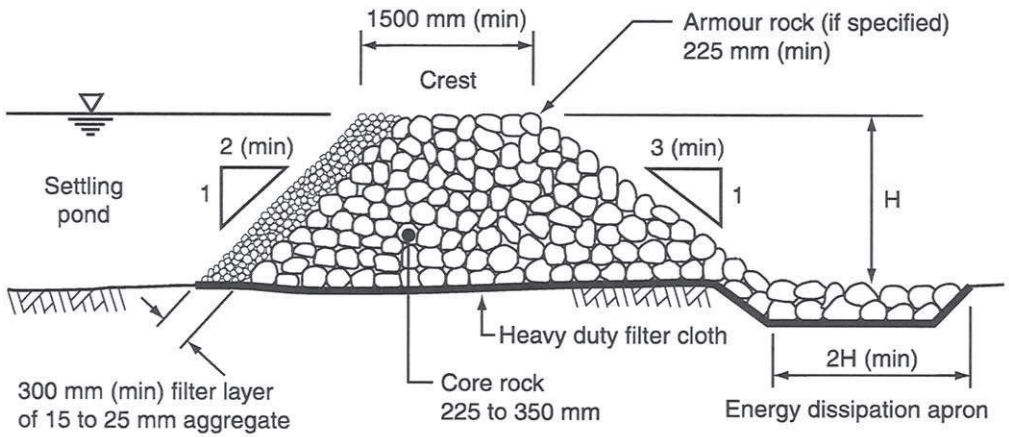
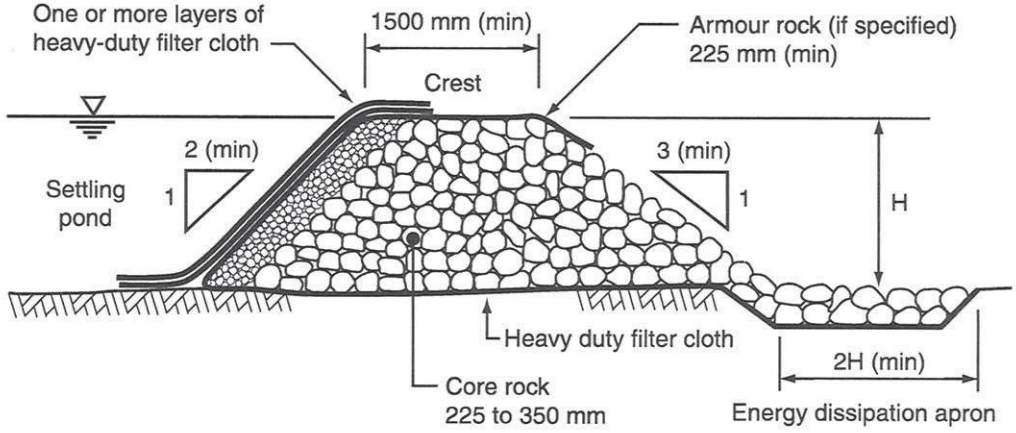


Figure 1 - Placement of check dam sediment traps

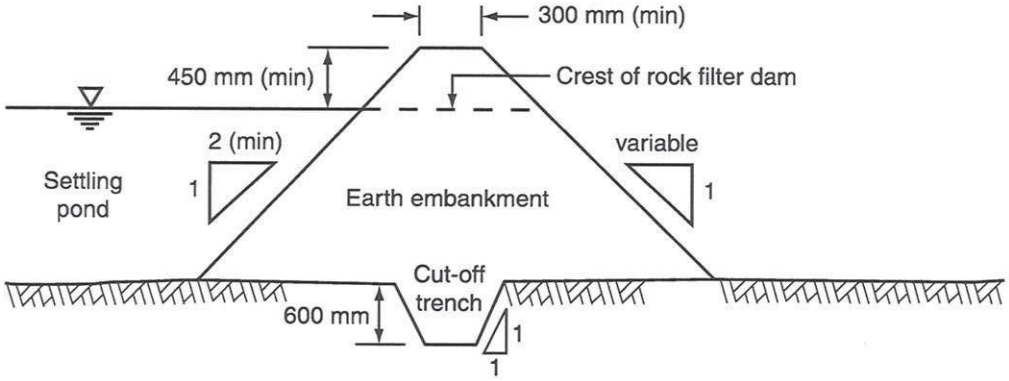
Drawn:	Date:		
GMW	Apr-10	Check Dam Sediment Trap	CDT-01



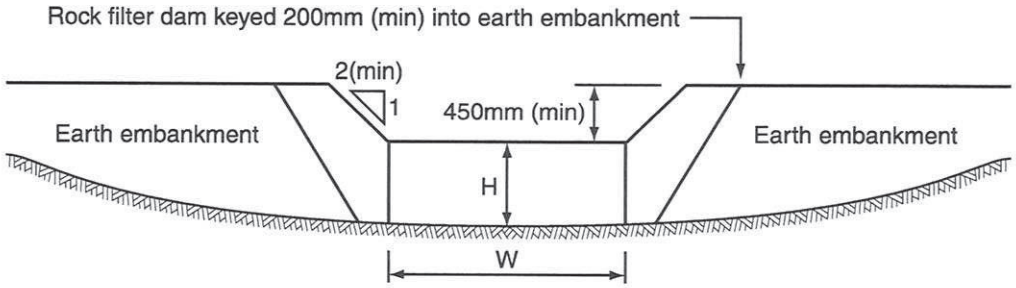
(a) Rock filter dam with aggregate filter



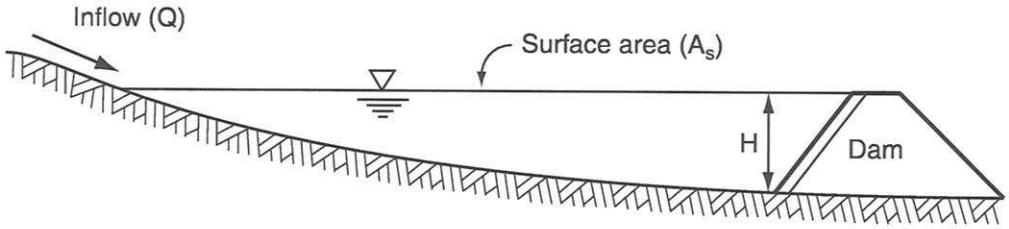
(b) Rock filter dam with geotextile and aggregate filter



(c) Typical cross-section of constructed earth abutment



(d) Typical profile of rock filter dam crest when integrated into an earth embankment



(e) Settling pond

Drawn:	Date:		
GMW	Feb-10	Rock Filter Dam	RFD-01

MATERIALS

PRIMARY CORE ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm, OR GREATER THAN 350mm.

ARMOUR ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm.

AGGREGATE FILTER: 15 TO 25mm CLEAN AGGREGATE.

GEOTEXTILE FILTER FABRIC: HEAVY-DUTY NON-WOVEN, NEEDLE-PUNCHED FILTER FABRIC, MINIMUM 'BIDIM' A34 OR EQUIVALENT.

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. CLEAR THE FOUNDATION AREA OF THE ROCK FILTER DAM OF WOODY VEGETATION AND ORGANIC MATTER. DELAY CLEARING THE UP-SLOPE POND AREA UNTIL THE DAM IS FORMED AND IS ABLE TO ACT AS A SUITABLE SEDIMENT TRAP, OTHERWISE AN ALTERNATIVE TEMPORARY DOWNSTREAM SEDIMENT TRAP MAY BE REQUIRED DURING CONSTRUCTION OF THE ROCK FILTER DAM.

3. IF SPECIFIED ON THE PLANS, EXCAVATE A CUT-OFF TRENCH ALONG THE CENTRE-LINE OF THE DAM AND EARTH ABUTMENTS (IF ANY).

4. COVER THE FOUNDATION AREA AND CUT-OFF TRENCH WITH HEAVY-DUTY FILTER FABRIC BEFORE BACKFILLING WITH THE CORE ROCK. OVERLAP ADJOINING FABRIC SHEETS A MINIMUM OF 600mm.

5. CONSTRUCT THE ASSOCIATED EARTH ABUTMENT (IF ANY). ALL CUT AND FILL SLOPES SHOULD BE 2:1(H:V) OR FLATTER. THE DOWNSTREAM FACE OF EARTH ABUTMENTS SHOULD BE 3:1(H:V) OR FLATTER. EARTH ABUTMENTS SHOULD BE CONSTRUCTED OF WELL-COMPACTED, EROSION RESISTANT SOIL THAT IS FREE OF VEGETATION AND ROOTS. OVERFILL EARTH ABUTMENTS 150mm TO ALLOW FOR SETTLEMENT.

6. PLACE THE CORE ROCK FOR THE ROCK FILTER DAM. ENSURE THE UPSTREAM FACE IS 2:1(H:V) OR FLATTER, AND THE DOWNSTREAM FACE IS 3:1(H:V) OR FLATTER.

7. ENSURE THE ROCK IS MACHINE PLACED WITH THE SMALLER ROCKS WORKED INTO THE VOIDS OF THE LARGER ROCKS.

8. IF SPECIFIED, CONSTRUCT THE SPILLWAY SECTION USING THE SPECIFIED ARMOUR ROCK. THE SPILLWAY SHOULD HAVE A MINIMUM PROFILE DEPTH OF 300mm. THE SPILLWAY WEIR CREST MUST BE LEVEL ACROSS ITS FULL WIDTH. THE MAXIMUM LONGITUDINAL SLOPE OF THE ROCK SPILLWAY SHOULD BE 3:1(H:V). THE MINIMUM THICKNESS OF ARMOUR ROCK PROTECTION SHOULD BE 500mm, OR TWICE THE NOMINAL ROCK SIZE, WHICHEVER IS THE GREATER.

9. ENSURE THE SPILLWAY OUTLET SECTION EXTENDS DOWNSTREAM PAST THE TOE OF THE FORMED EMBANKMENT UNTIL STABLE CONDITIONS ARE REACHED, OR A DISTANCE EQUAL TO THE HEIGHT OF THE DAM, WHICHEVER IS THE GREATER. THE EDGES OF THE SPILLWAY SHOULD BE LEFT FLUSH WITH THE SURROUNDING GROUND.

10. INSTALL THE SPECIFIED FILTER (AGGREGATE AND/OR FILTER CLOTH) ON THE UPSTREAM FACE OF THE ROCK FILTER DAM.

11. IF FILTER CLOTH IS USED, THEN:
(i) EXTEND THE FABRIC OVER THE CREST OF THE ROCK FILTER DAM INTO THE SPILLWAY CHUTE;
(ii) CONSIDER THE PLACEMENT OF SEVERAL LAYERS OF OVERLAPPING FABRIC, THUS ALLOWING EACH LAYER TO BE REMOVED INDIVIDUALLY ONCE THE FABRIC BECOMES BLOCKED WITH SEDIMENT.

12. CLEAR THE SETTLING POND AREA OF WOODY VEGETATION AND ORGANIC MATTER TO THE DIMENSIONS SPECIFIED WITHIN THE PLANS.

13. WHERE NECESSARY, EXCAVATE THE UPSTREAM SETTLING POND AND/OR SEDIMENT STORAGE PIT IN ACCORDANCE WITH THE APPROVED PLANS. EXCAVATED PITS TYPICALLY HAVE SIDE SLOPES OF 2:1(H:V) OR FLATTER UNLESS STEEPER SLOPES ARE KNOWN TO BE STABLE.

14. STABILISE ANY ASSOCIATED EARTH EMBANKMENTS IMMEDIATELY AFTER CONSTRUCTION THROUGH APPROPRIATE COMPACTION, VEGETATION AND/OR EROSION CONTROL MATTING.

15. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT-LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.

16. TAKE ALL NECESSARY MEASURE TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE.

MAINTENANCE

1. CHECK ALL ROCK FILTER DAMS AFTER EACH RUNOFF EVENT AND MAKE REPAIRS IMMEDIATELY.

2. INSPECT ALL ROCK AND EARTH EMBANKMENTS FOR UNDERCUTTING OR UNDESIRABLE SEEPAGE FLOWS.

3. IDEALLY, ROCK FILTER DAMS SHOULD DISCHARGE (FROM FULL) OVER NO LESS THAN 8 HOURS. IF DRAINAGE IS TOO RAPID, THEN ADDITIONAL FILTER AGGREGATE MAYBE REQUIRED TO ACHIEVE OPTIMUM HYDRAULIC PERFORMANCE.

4. IF FLOW THROUGH THE STRUCTURE IS REDUCED TO AN UNACCEPTABLE LEVEL, THE UPSTREAM FILTER MEDIUM (AGGREGATE OR FILTER CLOTH) SHOULD BE REMOVED AND REPLACED.

5. IF A GREATER DEGREE OF WATER TREATMENT (FILTRATION) IS REQUIRED, EXTRA GEOTEXTILE FILTER FABRIC SHOULD BE PLACED OVER THE UPSTREAM FACE OF THE STRUCTURE.

6. CHECK THE STRUCTURE AND DOWNSTREAM CHANNEL BANKS FOR DAMAGE FROM OVERTOPPING FLOWS. MAKE REPAIRS AS NECESSARY.

7. IMMEDIATELY REPLACE ANY ROCK DISPLACED FROM THE SPILLWAY.

8. REMOVE SEDIMENT AND RESTORE ORIGINAL SEDIMENT STORAGE VOLUME WHEN COLLECTED SEDIMENT EXCEEDS 10% OF THE SPECIFIED STORAGE VOLUME.

9. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

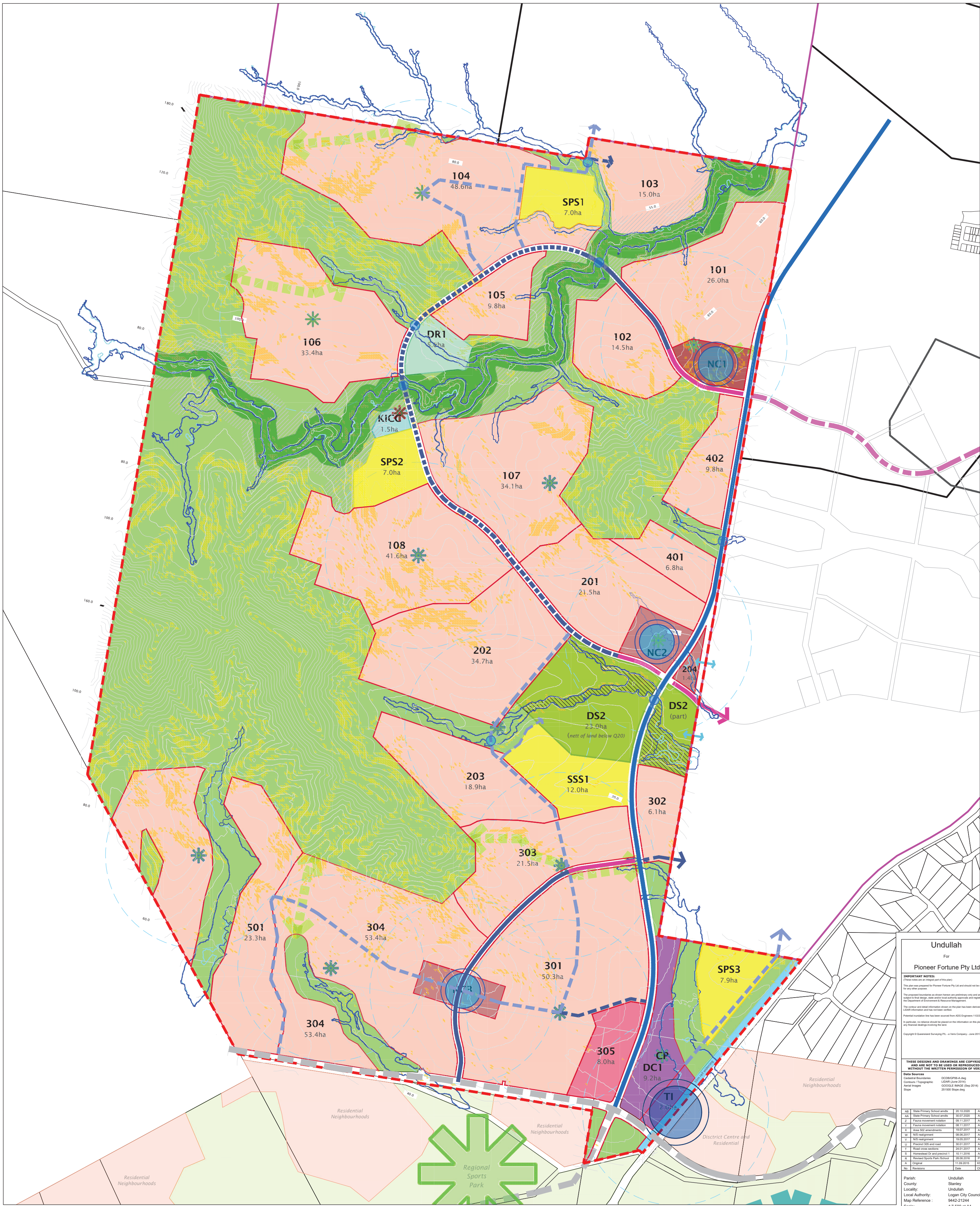
1. WHEN THE UP-SLOPE DRAINAGE AREA HAS BEEN STABILISED, REMOVE ALL MATERIALS INCLUDED DEPOSITED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

2. ALL WATER AND SEDIMENT SHOULD BE REMOVED FROM THE SETTLING POND 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 TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Rock Filter Dam	RFD-02

Appendix C
Veris Australia Pty Ltd Site Context Plan



Land Uses

Residential		Av Density	Area
District Centre		40dw/ha	9.3ha
District Centre Transition		25dw/ha	8ha
Neighbourhood Centre		20dw/ha	9.0ha
Urban Res Neighbourhoods		14.5dw/ha	
Urban	10%	18dw/ha	
Semi-Urban	40%	15dw/ha	
Suburban	45%	12.5dw/ha	
Urban Fringe	5%	8dw/ha	

Education Facilities		Area
State Primary School	SPS1	7.0ha
State Secondary School	SSS1	12.0ha

Centres and Employment		Area
District Centre	DC	4.5ha
Transport Interchange	TI	2.0ha
Neighbourhood Centre	NC	6.5ha
Karawatha Interpretive Community Centre	KICC	1.5ha
Employment Land	EL	2.0ha

Roads
38m Urban Arterial Road
32.6m Trunk Connector (4 lane)
23.4m Trunk Connector (no parking)
23.4m Trunk Connector (parking)
22.4m Neighbourhood Connector

Open Space	
Environmental / Buffers / Waterways	
District Sports	DS
District Recreation	DR
Neighbourhood Recreation Park	
Civic Park	CP
Urban Linkages (integrated into layout)	
Biodiversity Corridor (Development Scheme)	
400m walkable neighbourhood (around N/R)	
Potential location of fauna movement structure *(subject to detailed assessment at ROL stage)*	

Site Information
Site Boundary
Gradient - 0% - 16%
Gradient - 16% - 20%
Gradient (over 20%)
Flood Line (Q20)
Flood Line (Q100)
Ridgelines (major)
Endangered Vegetation
Sandy Creek 100m Core
Sandy Creek Buffer
Connected Watercourse
Unconnected Watercourse
Powerful Owl Site

0 375m 750m 1125m
50 mm 100 mm 150 mm SCALE BAR

Undullah

For

Pioneer Fortune Pty Ltd

IMPORTANT NOTES:
(These notes are an integral part of this plan)

This plan was prepared for Pioneer Fortune Pty Ltd and should not be used for any other purpose.

The proposed boundaries as shown hereon are preliminary only and are subject to final design, state and/or local authority approvals and registration in the Department of Environment & Resource Management.

The contour and detail information shown on the plan has been derived from LIDAR information and has not been verified.

Potential inundation line has been sourced from ADG Engineers 11/2/2015.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

Data Sources

Cadastral Boundaries	DCDB/GP06-A.dwg
Contours / Topographic	LIDAR (June 2014)
Aerial Images	GOOGLE IMAGE (Sep 2014)
Slope	251500 Slope.dwg

No	Revisions	Date	Chkd
AB	State Primary School amdts	20.10.2020	AC
AA	State Primary School amdts	30.07.2020	AC
Z	Fauna movement notation	09.11.2017	AC
Y	Fauna movement notation	08.11.2017	AC
X	Area 502 amendments	19.07.2017	AC
W	N/S realignment	08.06.2017	AC
V	N/S realignment	19.05.2017	AC
U	Precinct 305 and road	30.01.2017	AC
T	Road cross sections	24.01.2017	AC
S	Homestead Dr and precinct 1	10.11.2016	AC
R	Revised Sports Park /School	28.06.2016	PS
A	Original	11.09.2015	KS/AC

Parish:	Undullah
County:	Stanley
Locality:	Undullah
Local Authority:	Logan City Council
Map Reference :	9442-21244
Scale:	1:7,500 at A1
Surveyed:	NA
Designed:	NA
Drawn:	AC
Checked:	AC
Plot Date:	20 Oct, 2020
Computer File Ref:	30729 GP07-AB Context Plan FS94 2014.dwg

Context Plan

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ACN 615 735 727
Veris Australia Pty Ltd

Drawing No 30729-GP07 Issue AB

Appendix D
Department of Natural Resources Soil and Land Information

Project description

Project name:	Soil and Land Resources of the Logan and Albert Rivers Catchment
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	Areas of Logan and Albert rivers catchments south of Greenbank-Park Ridge not covered by the Boonah (BNH) survey.

Site characteristics

Date described:	13/09/2006	Observation type:	Relatively undisturbed soil core
Described by:	LOIJ	Observation class:	Class I (detailed soil profile description)

Slope (%):	11	Morphological type:	Mid-slope
Slope type:	Abney level or clinometer and tape	Landform element:	Hillslope
Geology:	Gatton Sandstone: Lithic labile and feldspathic labile sandstone	Landform pattern:	Rises

Soil Name:	Pine Vale(1) (Pv)	Substrate lithology:	Sandstone
Runoff:	Moderately rapid	Depth to free water:	Not recorded
Permeability:	Moderately permeable (50-500 mm/day)	Erosion:	No type recorded - old data only
Drainage:	Imperfectly drained	Microrelief type:	Zero or none
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Hard setting	Horizontal interval (m):	N/A
Surface coarse fragments:	No coarse fragments	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.81405	152.91943	56	492065	6923393	Not recorded	Averaging GPS
GDA 2020	-27.81404	152.91944	56	492066	6923394		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Bleached-Mottled, Mesotrophic, Grey Chromosol; medium, non-gravelly, loamy, clayey, moderate.	No analytical data are available but confidence is fair.	Isbell (2002) The Australian Soil Classification Revised Edition.	N/A		

Vegetation

Community name	Tree, Corymbia citriodora	
Stratum	Species	Common name
Tallest	*Corymbia citriodora*	lemon-scented gum
	Acacia	A wattle

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.18	Greyish yellow-brown (10YR 4/2) moist	no mottles or other colour patterns mottles;	Fine sandy loam	Weak structure;	no coarse fragments;	No segregations;	Moderately moist, Very weak strength;	
2	A2e	0.18	0.39	Dull yellowish orange (10YR 6/3) moist	no mottles or other colour patterns mottles;	Fine sandy loam	Weak structure;	no coarse fragments;	No segregations;	Moderately moist, Very weak strength;	
3	B21	0.39	0.59	Greyish yellow-brown (10YR 6/2) moist	many (20-50%) medium (5-15 mm) distinct orange mottles;	Fine sandy light medium clay	Strong 10-20 mm Prismatic structure;	very few (<2%) subrounded quartz medium pebbles (6-20 mm);	No segregations;	Moderately moist, Weak strength;	
4	B22	0.59	0.82	Brownish grey (10YR 5/1) moist	common (10-20%) fine (<5 mm) distinct orange mottles;	Fine sandy light medium clay	Strong 5-10 mm Angular blocky structure;	no coarse fragments;	No segregations;	Moderately moist, Firm strength;	
5	C	0.82	0.85		no mottles or other colour patterns mottles;		Massive structure;	very abundant (>90%) sandstone not recorded;	No segregations;		

Field test	
pH by Raupach and Tucker method	
Depth (m)	Value
0.05	6
0.3	6.0
0.6	6.5
0.8	7.0

Field test	
Field EC 1:5 soil/water dS/m	
Depth (m)	Value
0.05	0.12
0.3	0.12
0.6	0.14
0.8	0.17

Notes			
Note level	Horizon name	Horizon no	Note
Observation			This landscape appears sandier than the Mundoolun Gatton Sandstones, particularly in the surface.
Observation			B2's felt slightly sodic, however permeability given from structure and low EC.
Observation			Depth stopped due to weathered rock
Observation			Site location, mid slope, slightly accumulative. Vegetation is mid dense Acacia scrub with 4-5m high spotted gums scattered throughout.
Observation			Similar to site 151 (which is very nearby), just a bit deeper, indicating the accumulation of material at this site and the loss of material at the site above.
Horizon	A1	1	Drainage 5
Horizon	A2e	2	Drainage 4
Horizon	B21	3	Drainage 3
Horizon	B22	4	Drainage 3
Horizon	B22	4	John suspects might be closer to drainage 2

Project description

Project name:	Soil and Land Resources of the Logan and Albert Rivers Catchment
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	Areas of Logan and Albert rivers catchments south of Greenbank-Park Ridge not covered by the Boonah (BNH) survey.

Site characteristics

Date described:	13/09/2006	Observation type:	Relatively undisturbed soil core
Described by:	LOIJ	Observation class:	Class I (detailed soil profile description)

Slope (%):	14	Morphological type:	Mid-slope
Slope type:	Abney level or clinometer and tape	Landform element:	Hillslope
Geology:	Gatton Sandstone: Lithic labile and feldspathic labile sandstone	Landform pattern:	Low hills

Soil Name:	Pine Vale(1) (Pv)	Substrate lithology:	Sandstone
Runoff:	Moderately rapid	Depth to free water:	Not recorded
Permeability:	Moderately permeable (50-500 mm/day)	Erosion:	No type recorded - old data only
Drainage:	Imperfectly drained	Microrelief type:	Zero or none
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Firm	Horizontal interval (m):	N/A
Surface coarse fragments:	No coarse fragments	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.80650	152.90981	56	491117	6924228	Not recorded	Averaging GPS
GDA 2020	-27.80650	152.90982	56	491118	6924229		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Bleached-Mottled, Dystrophic, Grey Kurosol; thick, non-gravelly, sandy, clayey, deep.	No analytical data are available but confidence is fair.	Isbell (2002) The Australian Soil Classification Revised Edition.	N/A		

Vegetation

Community name	Very tall woodland, Eucalyptus tereticornis	
Stratum	Species	Common name
Tallest 20.01-35 m	*Eucalyptus tereticornis*	blue gum, forest red gum
	Corymbia intermedia	pink bloodwood, red bloodwood

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.08	Greyish yellow-brown (10YR 4/2) moist	no mottles or other colour patterns mottles;	Loamy sand	Weak structure;	no coarse fragments;	No segregations;	Moderately moist, Very weak strength;	gradual
2	A21	0.08	0.35	Dull yellowish brown (10YR 5/3) moist	few (2-10%) fine (<5 mm) distinct brown mottles;	Loamy sand	Weak structure;	no coarse fragments;	No segregations;	Moderately moist, Very weak strength;	gradual
3	A22e	0.35	0.49	Dull yellowish orange (10YR 6/3) moist	few (2-10%) fine (<5 mm) distinct brown mottles;	Loamy sand	Weak structure;	no coarse fragments;	No segregations;	Moderately moist, Very weak strength;	clear
4	B2	0.49	1.1	Light grey (10YR 7/1) moist	many (20-50%) medium (5-15 mm) distinct orange mottles;	Fine sandy light medium clay	Strong 10-20 mm Prismatic structure;	no coarse fragments;	No segregations;	Moderately moist, Weak strength;	gradual
5	C	1.1	1.13		no mottles or other colour patterns mottles;				No segregations;	Dry, Weak strength;	

Field test	
pH by Raupach and Tucker method	
Depth (m)	Value
0.05	6.5
0.3	6.0
0.6	5.0
0.9	5.0
1.1	5.0

Notes			
Note level	Horizon name	Horizon no	Note
Observation			All textures non-sodic.
Horizon	A1	1	Drainage 5
Horizon	A21	2	Drainage 4
Horizon	A22e	3	Drainage 4
Horizon	B2	4	Drainage 3

Project description

Project name:	Soil and Land Resources of the Logan and Albert Rivers Catchment
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	Areas of Logan and Albert rivers catchments south of Greenbank-Park Ridge not covered by the Boonah (BNH) survey.

Site characteristics

Date described:	13/09/2006	Observation type:	Relatively undisturbed soil core
Described by:	LOIJ	Observation class:	Class I (detailed soil profile description)

Slope (%):	4	Morphological type:	Lower slope
Slope type:	Abney level or clinometer and tape	Landform element:	Hillslope
Geology:	Gatton Sandstone: Lithic labile and feldspathic labile sandstone	Landform pattern:	Low hills

Soil Name:	Stockleigh(1) (St)	Substrate lithology:	Sandstone
Runoff:	Moderately rapid	Depth to free water:	Not recorded
Permeability:	Moderately permeable (50-500 mm/day)	Erosion:	No type recorded - old data only
Drainage:	Imperfectly drained	Microrelief type:	Zero or none
Disturbance:	Extensive clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Hard setting	Horizontal interval (m):	N/A
Surface coarse fragments:	Very few (<2%), angular, sandstone, cobbles (60-200 mm)	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.80969	152.91643	56	491769	6923876	Not recorded	Averaging GPS
GDA 2020	-27.80968	152.91644	56	491770	6923877		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Mottled, Mesotrophic, Grey Chromosol; medium, non-gravelly, loamy, clayey, deep.	No analytical data are available but confidence is fair.	Isbell (2002) The Australian Soil Classification Revised Edition.	N/A		

Vegetation

Community name	Tall woodland, Eucalyptus tereticornis	
Stratum	Species	Common name
Tallest 12.01-20 m	*Eucalyptus tereticornis*	blue gum, forest red gum

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.11	Greyish yellow-brown (10YR 4/2) moist	no mottles or other colour patterns mottles;	Fine sandy loam	Moderate 2-5 mm Subangular blocky structure;	no coarse fragments;	No segregations;	Moderately moist, Very weak strength;	
2	B21	0.11	0.38	Brownish grey (10YR 4/1) moist	common (10-20%) fine (<5 mm) distinct brown mottles;	Fine sandy light medium clay	Strong 10-20 mm Prismatic structure;	no coarse fragments;	No segregations;	Moderately moist, Weak strength;	
3	B22	0.38	0.8	Dull yellowish orange (10YR 6/4) moist	common (10-20%) medium (5-15 mm) distinct orange mottles; few (2-10%) fine (<5 mm) distinct pale mottles;	Fine sandy light medium clay	Strong 10-20 mm Prismatic structure;	no coarse fragments;	No segregations;	Moderately moist, Weak strength;	
4	B23	0.8	1.25	Greyish yellow (2.5Y 7/2) moist	many (20-50%) medium (5-15 mm) distinct orange mottles;	Fine sandy light medium clay	Moderate 5-10 mm Angular blocky structure;	no coarse fragments;	No segregations;	Moderately moist, Weak strength;	
5	C	1.25	1.27		no mottles or other colour patterns mottles;				No segregations;		

Field test	
pH by Raupach and Tucker method	
Depth (m)	Value
0.05	5.5
0.3	6.0
0.6	6
0.9	5.0
1.2	5.0

Field test	
Field EC 1:5 soil/water dS/m	
Depth (m)	Value
0.05	0.07
0.3	0.09
0.6	0.18
0.9	0.34
1.2	0.41

Notes			
Note level	Horizon name	Horizon no	Note
Observation			B2 textures slightly sodic
Horizon	A1	1	Drainage 5
Horizon	B21	2	Drainage 4
Horizon	B22	3	Drainage 3
Horizon	B23	4	Drainage 3

Project description

Project name:	Soil and Land Resources of the Logan and Albert Rivers Catchment
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	Areas of Logan and Albert rivers catchments south of Greenbank-Park Ridge not covered by the Boonah (BNH) survey.

Site characteristics

Date described:	13/09/2006	Observation type:	Relatively undisturbed soil core
Described by:	LOIJ	Observation class:	Class I (detailed soil profile description)

Slope (%):	2	Morphological type:	Crest
Slope type:	Estimate	Landform element:	Hillcrest
Geology:	Gatton Sandstone: Lithic labile and feldspathic labile sandstone	Landform pattern:	Low hills

Soil Name:	Birnam(1) (Bi)	Substrate lithology:	Sandstone
Runoff:	Slow	Depth to free water:	Not recorded
Permeability:	Moderately permeable (50-500 mm/day)	Erosion:	No type recorded - old data only
Drainage:	Imperfectly drained	Microrelief type:	Zero or none
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Hard setting	Horizontal interval (m):	N/A
Surface coarse fragments:	Many (20-50%), angular, sandstone, boulders (600 mm-2 m)	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.80862	152.92759	56	492868	6923995	Not recorded	Averaging GPS
GDA 2020	-27.80861	152.92760	56	492869	6923996		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Mottled, Mesotrophic, Yellow Chromosol; medium, non-gravelly, loamy, clayey, moderate.	No analytical data are available but confidence is fair.	Isbell (2002) The Australian Soil Classification Revised Edition.	N/A		

Vegetation

Community name		
Very tall woodland, Eucalyptus melanophloia		
Stratum	Species	Common name
Tallest 20.01-35 m	*Eucalyptus melanophloia*	silver-leaved ironbark, silver ironbark
	Corymbia citriodora	lemon-scented gum

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.08	Greyish yellow-brown (10YR 4/2) moist	no mottles or other colour patterns mottles;	Fine sandy loam	Weak structure;	no coarse fragments;	No segregations;	Moderately moist, Very weak strength;	gradual
2	A2e	0.08	0.23	Dull yellowish orange (10YR 6/3) moist	no mottles or other colour patterns mottles;	Fine sandy loam	Weak structure;	no coarse fragments;	No segregations;	Moderately moist, Weak strength;	clear
3	B2	0.23	0.6	Dull yellowish orange (10YR 6/4) moist	common (10-20%) fine (<5 mm) distinct red mottles; few (2-10%) fine (<5 mm) distinct pale mottles;	Light medium clay	Strong 10-20 mm Prismatic structure;	no coarse fragments;	No segregations;	Moderately moist, Firm strength;	gradual
4	C	0.6	0.62		no mottles or other colour patterns mottles;				No segregations;		

Field test

pH by Raupach and Tucker method

Depth (m)	Value
0.05	6.0
0.3	6.0
0.6	6.0

Notes			
Note level	Horizon name	Horizon no	Note
Site			John says the rocks here look finer grained and more feldspathic than observed at Mundoolun.
Observation			Depth - fortunate to get over 0.5m.
Observation			B2 only slightly sodic.
Horizon	A1	1	Drainage 5
Horizon	A2e	2	Drainage 4
Horizon	B2	3	B2 feels slightly sodic
Horizon	B2	3	Drainage 3

Project description	
Project name:	Soil and Land Resources of the Logan and Albert Rivers Catchment
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	Areas of Logan and Albert rivers catchments south of Greenbank-Park Ridge not covered by the Boonah (BNH) survey.

Site characteristics			
Date described:	13/09/2006	Observation type:	Relatively undisturbed soil core
Described by:	LOIJ	Observation class:	Class I (detailed soil profile description)

Slope (%):	12	Morphological type:	Lower slope
Slope type:	Abney level or clinometer and tape	Landform element:	Hillslope
Geology:	Gatton Sandstone: Lithic labile and feldspathic labile sandstone	Landform pattern:	Rises

Soil Name:	Pine Vale(1) (Pv)	Substrate lithology:	Sandstone
Runoff:	Moderately rapid	Depth to free water:	Not recorded
Permeability:	Moderately permeable (50-500 mm/day)	Erosion:	No type recorded - old data only
Drainage:	Imperfectly drained	Microrelief type:	Zero or none
Disturbance:	Extensive clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Hard setting	Horizontal interval (m):	N/A
Surface coarse fragments:	No coarse fragments	Microrelief component sampled:	N/A

Site location							
Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.81618	152.92168	56	492287	6923157	Not recorded	Averaging GPS
GDA 2020	-27.81617	152.92169	56	492288	6923158		

Soil classification					
Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Bleached-Mottled, Eutrophic, Grey Chromosol; thick, non-gravelly, sandy, clayey, deep.	No analytical data are available but confidence is fair.	Isbell (2002) The Australian Soil Classification Revised Edition.	N/A		

Profile morphology											
No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.12	Greyish yellow-brown (10YR 4/2) moist	no mottles or other colour patterns mottles;	Loamy sand	Weak structure;	no coarse fragments;	No segregations;	Moist, Very weak strength;	gradual
2	A2e	0.12	0.35	Greyish yellow-brown (10YR 6/2) moist	no mottles or other colour patterns mottles;	Loamy sand	Weak structure;	no coarse fragments;	No segregations;	Wet, Very weak strength;	clear
3	B21	0.35	0.74	Greyish yellow (2.5Y 6/2) moist	common (10-20%) medium (5-15 mm) distinct orange mottles;	Fine sandy light medium clay	Strong 10-20 mm Prismatic structure;	no coarse fragments;	No segregations;	Moderately moist, Weak strength;	gradual
4	B22	0.74	1	Dark greyish yellow (2.5Y 5/2) moist	common (10-20%) medium (5-15 mm) distinct grey mottles;	Fine sandy light clay	Moderate 5-10 mm Angular blocky structure;	no coarse fragments;	No segregations;	Moderately moist, Firm strength;	

Field test	
pH by Raupach and Tucker method	
Depth (m)	Value
0.05	5.5
0.3	6.0
0.6	7.0
0.9	7.5

Field test	
Field EC 1:5 soil/water dS/m	
Depth (m)	Value
0.05	0.07
0.3	0.08
0.6	0.14
0.9	0.18

Notes			
Note level	Horizon name	Horizon no	Note
Observation			Depth - not sure if hit rock or not, might be a little deeper.
Observation			B2 textures only slightly sodic.
Horizon	A1	1	Depth 4
Horizon	A2e	2	Drainage 4
Horizon	B21	3	Drainage 3
Horizon	B22	4	Drainage 3

Queensland Government
Soil and Land Information
Site Listing Report (Internal)

Project LASER Site 100 Observation 1

SALI2078

Project description

Project name:	Logan Albert Soil Erodibility and Nutrient mapping project
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	

Site characteristics

Date described:	29/07/2019	Observation type:	Relatively undisturbed soil core
Described by:	WALT	Observation class:	Class IIIa (limited chemistry)

Slope (%):	8	Morphological type:	Lower slope
Slope type:	Abney level or clinometer and tape	Landform element:	Hillslope
Geology:	Gatton Sandstone: Lithic labile and feldspathic labile sandstone	Landform pattern:	Low hills

Soil Name:	Lowood(1) (Lw)	Substrate lithology:	Sandstone
Runoff:	Moderately rapid	Depth to free water:	Not recorded
Permeability:	Slowly permeable (5-50 mm/day)	Erosion:	Minor or present, active, gully erosion
Drainage:	Imperfectly drained	Microrelief type:	Not recorded
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Firm	Horizontal interval (m):	N/A
Surface coarse fragments:	No coarse fragments	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.82576	152.92363	56	492479	6922096	Not recorded	Single GPS
GDA 2020	-27.82575	152.92364	56	492480	6922097		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Eutrophic, Mottled-Mesonatric, Grey Sodosol; medium, non-gravelly, clay loamy, clayey, moderate.	All necessary analytical data is available	Isbell and NCST (2016) The Australian Soil Classification Second Edition.	N/A		

Vegetation

Community name	Tall woodland, Eucalyptus dominant	
Stratum	Species	Common name
Tallest	*Eucalyptus tereticornis*	blue gum, forest red gum
	Corymbia intermedia	pink bloodwood, red bloodwood
	Eucalyptus crebra	narrow-leaved ironbark
Mid	*Alphitonia excelsa*	red ash, soapbush, soap tree

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.25	Brown (10YR 4/3) moist		Sandy clay loam	Weak 5-10 mm Subangular blocky structure;	no coarse fragments;	No segregations;	Dry, Very weak strength;	clear
2	A2e	0.25	0.45	Dark yellowish brown (10YR 4/4) moist White (2.5YR 8/1) dry		Sandy loam	Massive structure;	no coarse fragments;	No segregations;	Dry, Very weak strength;	abrupt
3	B2t	0.45	0.75	Light brownish grey (10YR 6/2) moist	common (10-20%) very coarse (>30 mm) distinct brown mottles; common (10-20%) medium (5-15 mm) prominent orange mottles;	Fine sandy medium clay	Moderate 20-50 mm Prismatic structure; Moderate 5-10 mm Subangular blocky structure;	no coarse fragments;	No segregations;	Dry, Strong strength;	clear

4	B3	0.75	0.8	Light brownish grey (10YR 6/2) moist	many (20-50%) coarse (15-30 mm) prominent orange mottles;	Fine sandy light medium clay	Massive structure;	no coarse fragments;	No segregations;	Dry, Very firm strength;	

Field test

pH by Raupach and Tucker method

Depth (m)	Value
0.01	5.0
0.1	4.0
0.3	4.5
0.6	4.5
0.8	4.0

Field test

Field dispersion test as per LRO guidelines 2012

Depth (m)	Value
0.55	0
0.8	0

Field test

Field slaking test as per LRO guideline (2012)

Depth (m)	Value
0.55	0
0.8	0

Notes

Note level	Horizon name	Horizon no	Note
Observation			Changed from Pine Vale (Pv) SPC to Lowood (Lw) based on lab results.
Observation			30m NW of LARA site 165 (Pine Vale/Wyatt).

Laboratory test results

				Sample	1	2
				Upper depth (m)	0	0.5
				Lower depth (m)	0.1	0.6
Group	Method	Code	Units	Bulked Sample	N	N
Profile General	pH - 1:5 water	4A1			5	5.4
	EC - 1:5 water	3A1	dS/m		0.04	0.13
	Total OC - Dumas, volumetric	6B2a	%		1.31	0.34
	Organic Carbon, LECO furnace	6B5	%		1.18	0.35
	Total N - Kjeldahl, automated	7A2	%		0.089	0.042
	Total N - Dumas	7A5	%		0.07	0.17
	Coarse sand	2Z2_CS	%		53	34
	Fine sand	2Z2_FS	%		28	20
	Silt	2Z2_Silt	%		13	10
	Clay	2Z2_Clay	%		13	39
	Total P - Kjeldahl P (KP)	9A3a	%		<0.013	<0.013
	Moisture content - air-dry	2A1	%		<1.5	2.4
Acid Cations	Exch Ca - NH4Cl no wash	15A1_Ca	meq/100g		1.82	0.55
	Exch Mg - NH4Cl no wash	15A1_Mg	meq/100g		2.16	5.72
	Exch Na - NH4Cl no wash	15A1_Na	meq/100g		0.12	2.31
	Exch K - NH4Cl no wash	15A1_K	meq/100g		0.16	0.32
	Exchangeable Al – KCl	15G1_Al	meq/100g		1.7	6.41
	Exchange acidity (H + Al)	15G1_H	meq/100g		1.89	7.97
	ECEC	15J1	meq/100g		6.1	14.6
Other Cations	ESP	15N1	%		1.31	0.55
Other Analyses Completed	Al sat %	15O1	%		27.9	43.8
	Phosphorus buffer index + Col P	9I2			54	187
	Phosphorus buffer index unadj	9I4			53	187
	Total P - Kjeldahl P (KP)	9A3a	%		<0.013	<0.013
	P (BiCarb Extr)- automated	9B2	mg/kg		3	3

Project description	
Project name:	Logan Albert Soil Erodibility and Nutrient mapping project
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	

Site characteristics			
Date described:	29/07/2019	Observation type:	Relatively undisturbed soil core
Described by:	WALT	Observation class:	Class I (detailed soil profile description)

Slope (%):	6	Morphological type:	Simple Slope
Slope type:	Abney level or clinometer and tape	Landform element:	Hillslope
Geology:	Koukandowie Formation: Lithofeldspathic labile and sublabile to quartzose sandstone, siltstone, shal	Landform pattern:	Low hills

Soil Name:	Lowood(1) (Lw)	Substrate lithology:	Sandstone
Runoff:	Not recorded	Depth to free water:	Not recorded
Permeability:	Slowly permeable (5-50 mm/day)	Erosion:	Minor or present, active, gully erosion
Drainage:	Imperfectly drained	Microrelief type:	Not recorded
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Hard setting	Horizontal interval (m):	N/A
Surface coarse fragments:	No coarse fragments	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.82410	152.91938	56	492060	6922280	Not recorded	Single GPS
GDA 2020	-27.82409	152.91938	56	492061	6922281		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Bleached-Mottled, Dystrophic, Grey Kurosol; medium, non-gravelly, loamy, clayey, shallow.	Analytical data are incomplete but reasonable confidence	Isbell and NCST (2016) The Australian Soil Classification Second Edition.	N/A		

Vegetation

Community name	Tall open forest, Corymbia citriodora	
Stratum	Species	Common name
Tallest 12.01-20 m	*Corymbia citriodora*	lemon-scented gum
	Eucalyptus crebra	narrow-leaved ironbark

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.1	Brown (10YR 4/3) moist	no mottles or other colour patterns mottles;	Fine sandy loam	Massive structure;	no coarse fragments;	No segregations;	Dry, Very firm strength;	clear
2	A2e	0.1	0.25	Pale brown (10YR 6/3) moist White (2.5Y 8/1) dry	common (10-20%) fine (<5 mm) distinct dark mottles;	Fine sandy loam	Massive structure;	no coarse fragments;	No segregations;	Dry, Very firm strength;	clear
3	B2t	0.25	0.45	Greyish brown (10YR 5/2) moist	common (10-20%) coarse (15-30 mm) prominent orange mottles;	Fine sandy medium clay	Moderate 20-50 mm Prismatic structure; Moderate 5-10 mm Angular blocky structure;	no coarse fragments;	No segregations;	Dry, Strong strength;	gradual
4	C	0.45	0.6							Dry, Very firm strength;	

Field test

pH by Raupach and Tucker method

Depth (m)	Value
0.01	4.0
0.15	4.5
0.4	5.5
0.6	6.0

Notes			
Note level	Horizon name	Horizon no	Note
Observation			Near LARA 164 (Lowood SPC). More acidic than LARA 164, not obviously sodic. Check after lab results.

Project description	
Project name:	Logan Albert Soil Erodibility and Nutrient mapping project
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	

Site characteristics			
Date described:	29/07/2019	Observation type:	Relatively undisturbed soil core
Described by:	WALT	Observation class:	Class IVa (brief mapping observation, some morphological data)

Slope (%):	4	Morphological type:	Lower slope
Slope type:	Abney level or clinometer and tape	Landform element:	Hillslope
Geology:	Gatton Sandstone: Lithic labile and feldspathic labile sandstone	Landform pattern:	Low hills

Soil Name:	Pine Vale(1) (Pv)	Substrate lithology:	Sandstone
Runoff:	Not recorded	Depth to free water:	Not recorded
Permeability:	Not recorded	Erosion:	Not recorded
Drainage:	Not recorded	Microrelief type:	Not recorded
Disturbance:	Not recorded	Proportion gilgai:	N/A
Rock outcrop:	Not recorded	Vertical interval (m):	N/A
Surface condition:	Not recorded	Horizontal interval (m):	N/A
Surface coarse fragments:	Not recorded	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-27.81910	152.92114	56	492233	6922834	Not recorded	Single GPS
GDA 2020	-27.81909	152.92114	56	492234	6922835		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Grey Chromosol	No analytical data are available but confidence is fair.	Isbell and NCST (2016) The Australian Soil Classification Second Edition.	N/A		

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.1								
2	A2e	0.1	0.35								
3	B2t	0.35	0.5								
4	C	0.5	0.6								

Field test

pH by Raupach and Tucker method

Depth (m)	Value
0.45	6.0

Notes

Note level	Horizon name	Horizon no	Note
Observation			Pine Vale (Pc) SPC

Appendix E
IECA Basin Performance Report

BASIN PERFORMANCE REPORT

Site / basin identification: _____ Inspector: _____

Date / time: _____ Recent rainfall: _____

Water quality in basin: NTU: _____ pH: _____ Water level in basin: _____

Issue Item		Potential Issue / Action Required (Y/N)	Comments/Action Undertaken
Inflow channel	Channel/pipe overtopped		
	Scour in channel		
	Chemical not mixing with inflow runoff		
	Catchment bypassing channel		
	Lateral inflow to main basin cell		
	Other		
Chemical & dosing	Chemical not working		
	No dosing		
	Incorrect dose rate		
	Other		
Fore bay	Sediment re-suspension		
	Other		
Level spreader	Concentrated flow over level spreader		
	Scour on backside of level spreader		
	Other		

Issue Item		Potential Issue / Action Required (Y/N)	Comments/Action Undertaken
Settling pond	Flow short circuiting in main basin		
	Erosion on side of basin batters		
	Other		
In-line baffles	Flow concentrating to one side of baffle		
	Flow conveyed over the top of the baffle		
	Flow restricted through baffle too much		
	Flow passes through baffle too quickly		
	Other		
Decant system	Decant sinks below surface		
	Decant raised above water level		
	Decant dropped on one side		
	Decant blocked		
	Decants concentrating flow in basin		
	Other		
Emergency spillway	Concentrated flow on spillway		
	Spillway too low		
	Spillway too high		
	Other		
Other General Comments			

Refer to troubleshooting guide (Table B43) for details on potential remediation for issue items.

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