APPENDIX B4

Construction Soil and Water Quality Management Plan

Additional Crossing of the Clarence River at Grafton Project

SEPTEMBER 2016

Document control

File name	CSWQMP_Grafton_Rev4 080916
Report name	Additional Crossing of the Clarence River at Grafton Construction Soil and Water Quality Management Plan
Revision number	Rev4

Plan approved by:

[signed]	[signed]	[signed]
Name BRENDAN JOHNSON 15/9/16	Name SAM LEIGH 15-9-2016	Name Greg Nash 15/9/16
Contractor PM	Contractor EM	RMS representative

Revision history

Revision	Date	Description	Approval
0	23/06/2016	Draft for RMS and ER review	
1	12/07/2016	Revised in response to comments from RMS and the ER	
2	28/08/2016	Revised in response to comments from RMS. No further comments from the ER.	
3	06/09/2016	Revised in response to comments from RMS, EPA, CVC, DPI Water, DPI Fisheries and DP&E.	
4	08/09/2016	Amended Annexure E in response to comments from RMS, as follows: • Amended 'Purpose' to specifically refer to *temporary* stockpiles. • Amended 'Scope' to also refer to CFFMP, CNVMP and CHMP. • Amended the title of Section 3.2 and Section 3.3.	

Distribution of controlled copies

Copy no.	Issued to	Version
1		
2		
3		
4		
5		

Contents

Annexures

Tables

Figures

Glossary / Abbreviations

AHD	Australian Height Datum
ANZECC	The Australian and New Zealand Environment Conservation Council
ARI	Average recurrence interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARTC	The Australian Rail Track Corporation Ltd
ASS	Acid Sulfate Soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
Blue Book	OEH publication titled "Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) March 2004 (reprinted 2006) (the "Blue Book"). Volume 1 and Volume 2;
CCLMP	Construction Contaminated Land Management Plan
CEMP	Construction Environmental Management Plan
CFFMP	Construction Flora and Fauna Management Plan
CoA	Condition of Approval
CSWQMP	Construction Soil and Water Quality Management Plan
DEC	Department of Environment and Conservation
DECCW	Department of Environment, Climate Change and Water
DLWC	Department of Land and Water Conservation
DO	Dissolved oxygen
DoE	Department of the Environment
DPI	Department of Primary Industries
DPIF	Department of Primary Industries - Fisheries
DPIW	Department of Primary Industry – Water (formerly NSW Office of Water (NOW))
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (now DoE)
EIS	Environmental Impact Statement
EEC	Endangered Ecological Community
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environmental Protection Licence
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EWMS	Environmental Work Method Statements
FM Act	*Fisheries Management Act 1994*
FWCF	Freshwater Wetlands on Coastal Floodplain
GDE	Groundwater dependent ecosystem
LGA	Local Government Area
NHMRC	National Health and Medical Research Council
NOW	NSW Office of Water (now DPI – Water)
NSWF	NSW Fisheries
NWQMS	National Water Quality Management Strategy
OEH	Office of Environment and Heritage

PASS	Potential acid sulfate soils
PESCP	Progressive Erosion and Sediment Control Plan
POEO Act	*Protection of the Environment Operations Act 1997*
Project, the	Additional Crossing of the Clarence River at Grafton
RMS	Roads and Maritime Services
RTA	Roads and Traffic Authority (now RMS)
SCFF	Subtropical Coastal Floodplain Forest
SEPP	State Environmental Planning Policy
SSI	The state significant infrastructure as generally described in Schedule 1 (SSI-6103) of the Infrastructure Approval.
TEC	Threatened Ecological Community
VENM	Virgin Excavated Natural Material
Water Act	*Water Act 1912*
WM Act	*Water Management Act 2000*

1 Introduction

1.1 Context

This Construction Soil and Water Quality Management Plan (CSWQMP) forms part of the Construction Environmental Management Plan (CEMP) for the Additional Crossing of the Clarence River at Grafton Project (the Project).

This CSWQMP has been prepared to address the requirements of:

- the Infrastructure Approval;
- the environmental management measures listed in the Additional Crossing of the Clarence River at Grafton Environmental Impact Statement (EIS) (ARUP, 2014) and the Additional Crossing of the Clarence River at Grafton Submissions Report (RMS, 2014); and
- all applicable legislation.

1.2 Background

Section 8.10 of the *Additional Crossing of the Clarence River at Grafton* EIS (ARUP, 2014) assessed the construction impacts of the Project on geology, soils, contamination and water quality.

1.3 Environmental management document system

The Project Environmental Management document system is described in the Construction Environmental Management Plan (CEMP).

The CSWQMP is part of Fulton Hogan's environmental management framework for the Project. In accordance with the requirements of CoA D46(c), this CSWQMP has been developed in consultation with the Environmental Protection Authority (EPA), Department of Primary Industries (DPI) (Fisheries), NSW Office of Water (NOW) and Clarence Valley Council. Further details of the consultation are provided in Chapter 4 of this CSWQMP.

Management measures identified in this CSWQMP will be incorporated into the Fulton Hogan's site or activity specific Environmental Work Method Statements (EWMS) and Progressive Erosion and Sediment Control Plans (PESCP).

EWMSs will be developed and signed off by environment and management representatives prior to the commencement of the associated works. Construction personnel will be required to undertake works in accordance with the safeguards identified in the EWMSs.

PESCPs provide detailed site-specific erosion and sediment control measures. PESCPs will be developed by the Fulton Hogan's environment team in consultation with construction personnel and the Project Soil Conservationist. PESCPs will be updated or modified as required when there are changes in site conditions, flow paths or construction activities that affect ground conditions.

The combination of the CEMP, sub plans, strategies, procedures, EWMS and PESCPs identify the required environmental management actions for implementation by Fulton Hogan's personnel and sub-contractors.

The review and document control processes for this CSWQMP are described in Chapter 10 of the CEMP.

2 Purpose and objectives

2.1 Purpose

The purpose of this CSWQMP is to describe how Fulton Hogan proposes to manage and protect soil and water quality during the construction of the Project.

2.2 Objectives

The key objective of the CSWQMP is to ensure that impacts on soil and water quality during construction are minimised and within the scope permitted by the Planning Approval.

To achieve this objective, Fulton Hogan will undertake the following:

- ensure best management practice controls and procedures are implemented during construction activities to avoid or minimise erosion / sedimentation impacts and potential impacts to water quality in rivers, creeks and groundwater along the Project corridor;
- ensure appropriate measures are implemented to address the relevant CoAs outlined in Table 3-1 and the environmental management measures detailed in the EIS and the Submissions Report; and
- ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 of this CSWQMP.

2.3 Targets

The following targets have been established for the management of soil and water impacts during the construction of the Project:

- ensure full compliance with the relevant legislative requirements and the Infrastructure Approval;
- meet Blue Book water quality discharge parameters for all planned basin discharges (i.e. those within design capacity);
- manage downstream water quality impacts attributable to the Project (i.e. maintain waterway health by avoiding the introduction of nutrients, sediment and chemicals outside of that permitted by the ANZECC guidelines); and
- ensure training on best practice soil and water management is provided to all construction personnel through site inductions.

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation

Legislation relevant to soil and water management includes:

- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Environmental Planning and Assessment Regulation 2000;
- Protection of the Environment Operations Act 1997 (POEO Act);
- Water Management Act 2000 (WM Act);
- Fisheries Management Act 1994 (FM Act);
- Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act); and
- *Water Act 1912* (Water Act).

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix A1 of the CEMP.

3.1.2 Guidelines and standards

The main guidelines, specifications and policy documents relevant to this CSWQMP include:

- Acid Sulfate Soil Manual (ASSMAC 1998);
- *Acid Sulfate Soil and Rock* – Victorian EPA Publication 655.1 – July 2009;
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000);
- *National Water Quality Management Strategy* (NWQMS) (Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), 1994);
- Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites (NSW Office of Environment and Heritage, 2011)
- *Managing Land Contamination: Planning Guidelines: SEPP55 – Remediation of Land* (Department of Urban Affairs and Planning and NSW Environmental Protection Authority, 1998)
- Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC, NHMRC, 1992)
- National Environment Protection (Assessment of Site Contamination) Measure Schedule B (2) (National Environment Protection Council, 1999)
- Contaminated Land Management Guideline (Roads and Maritime, 2005).
- NSW Water Quality and River Flow Objectives (DECCW, 2006);
- Managing Urban Stormwater: Council Handbook (EPA, 1998a);
- Managing Urban Stormwater: Source Control (EPA, 1998b);
- Managing Urban Stormwater: Treatment Techniques (EPA, 1998c);
- Department of Environment and Conservation (DEC): Bunding & Spill Management. Insert to the Environment Protection Manual for Authorised Officers - Technical section "Bu" November 1997;
- *Managing Urban Stormwater: Soils and Construction.* Landcom, (4th Edition) March 2004 (reprinted 2006) (the “Blue Book”). Volume 1 and Volume 2;
- Volume 2A Installation of Services (DECCW 2008);

- Volume 2C Unsealed Roads (DECCW 2008);
- Volume 2D Main Roads Construction (DECCW 2008);
- DIPNR Roads and Salinity Guideline, 2003;
- DLWC, 1998. Constructed Wetlands Manual;
- Fairfull, S. and Witheridge, G. (2003) Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries, Cronulla, 16 pp.;
- NSW Fisheries, November 2003. Fishnote – Policy and Guidelines for Fish Friendly Waterway Crossings (Ref: NSWF – 1181).;
- Environmental Management of Construction Site Dewatering (RTA, 2011);
- RMS Pacific Highway Practice Note for Dewatering.
- RMS Grafton Bridge Specification D and C G36 and 38 (2015)
- RTA's Code of Practice for Water Management – Road Development and Management (1999);
- Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA, March 2004);
- Guidelines for the Management of Acid Sulphate materials: Acid Sulphate Soils, Acid Sulphate Rock and Monosulphidic Black Ooze (RTA 2005);
- RMS Environment Direction Management of Tannins from Vegetation Mulch;
- Stockpile Site Management Guideline, RMS 2011;
- Environmental Best Management Practice Guideline for Concreting Contractors (DEC, 2004;
- RMS Road Design Guideline: Section 8 Erosion and Sedimentation (RTA, 2003);
- RMS Guideline for Construction Phase Water Quality Monitoring (RTA, n.d.);
- RMS Erosion and Sedimentation Management Procedure (RTA, 2009);
- Procedures for Selecting Treatment Strategies to Control Road Runoff (RTA, 2003a);
- RMS *Water Policy* (RTA, 1997);
- RMS QA Specification G38 (RMS, 2011);
- Road Runoff and Drainage: Environmental Impacts and Management Options, AP-R180 (Austroads, 2001);
- Floodplain Development Manual (NSW Government, 2005);
- RMS Technical Guideline: Environmental Management of Construction Site Dewatering (RTA, 2011);
- Coastal Lakes: Independent Inquiry into Coastal Lakes and Statement of Joint Intent (Healthy Rivers Commission of NSW, 2002);
- The relevant targets within the *State Water Management Outcomes Plan* (NOW, 2003);
- *State Groundwater Policy Framework Document* (Department of Land and Water Conservation (DLWC), 1997);
- The NSW State Groundwater Quality Protection Policy (DLWC, 1998);
- (Draft) NSW State Groundwater Quantity Management Policy (DLWC, n.d.);
- NSW State Groundwater Dependent Ecosystems Policy (DLWC, 2002);
- *National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia* (Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and ANZECC, 1995);
- Guidelines for Treatment of Stormwater Runoff from Road Infrastructure, AP-R232 (Austroads, 2003);

- Guidelines for the Assessment and Management of Groundwater Contamination (NSW DEC, 2007); and
- Guidelines for Instream Works on Waterfront Land (NSW Office of Water, 2012).

3.2 Minister's Conditions of Approval

The CoAs relevant to this CSWQMP are listed in Table 3-1 below. A cross reference is also included to indicate where the condition is addressed in this CSWQMP or other Project management documents.

Table 3-1: Environmental management measures for soils, sediments, water and contaminated land impacts

CoA No.	Condition Requirements	Document Reference
	Soil, Water Quality and Hydrology	
B6	Scour protection measures shall be implemented prior to and during construction on the banks of the Clarence River in the vicinity of the bridge works to protect the riverbank from erosion and instability during construction and operation.	Detailed design Section 7 Table 7-2 mitigation measure ID CSWQMM1-CSWQMM8, CSWQMM43. Annexure A - Erosion and Sediment Control Plan
	Water Quality Management	
B9	The SSI shall be constructed and operated to comply with section 120 of the *Protection of the Environment Operations Act 1997*, which prohibits the pollution of waters.	G36 Section 3.1.1 Section 7 Annexure A - Erosion and Sediment Control Plan
B10	All water from the SSI shall be appropriately treated prior to discharge, to protect the quality of the receiving waters.	Section 7 Table 7-2 mitigation measure ID CSWQMM35, CSWQMM38, CSWQMM53, CSWQMM60. Annexure B - Water Quality Monitoring Program
	Land Contamination	
B11	In the event that remediation of contaminated soils is required, the Proponent shall engage a suitably qualified and experienced contaminated land consultant to prepare a validation report upon completion of the remediation. The validation report shall verify that the site has been remediated consistent with the remediation action plan for the Project and to a standard consistent with the clean-up criteria for the site.	G36 Section 7 Table 7-2 mitigation measure ID CSWQMM85. NA - No areas identified as

CoA No.	Condition Requirements	Document Reference
		requiring remediation. CEMP Appendix B9 – Construction Contaminated Land Management Plan
B12	The Proponent shall engage an accredited NSW Site Auditor to prepare a **Site Audit Report** and **Site Audit Statement** to determine the land use suitability. The Site Audit Report shall summarise the information reviewed by the auditor and provide the basis for the conclusions contained in the Site Audit Statement. The Statement and Report shall be submitted to the Secretary within seven days of the report being finalised and prior to the commencement of site preparation or excavation activities within areas identified as requiring remediation. A copy of the report shall also be submitted to Council for its information. Note : Terms used in this condition have the same meaning as in the *Contaminated Land Management Act 1997.*	G36 NA - No areas identified as requiring remediation. CEMP Appendix B9 – Construction Contaminated Land Management Plan
D18	Where available and practicable, and of appropriate chemical and biological quality, stormwater, recycled water or other water sources shall be used, where feasible and reasonable, in preference to potable water for construction activities, including concrete mixing and dust control.	G36, G38 Section 7 Table 7-2 mitigation measure ID CSWQMM68. CAQMP
	Soil and Water Management	
D19	Soil and water management measures consistent with *Managing Urban Stormwater - Soils and Construction Volumes 1 and 2, 4th Edition* (Landcom, 2004) shall be employed during the construction of the SSI to minimise soil erosion and the discharge of sediment and other pollutants to land and/or water.	G36, G38 Section 3.1.2 Section 7 Table 7-2 mitigation measure ID CSWQMM3, CSWQMM45. Annexure A - Erosion and Sediment Control Plan
D20	Works in riparian areas and on riverfront land shall be undertaken in accordance with NOW guidelines for controlled activities on waterfront land, as applicable.	Section 3.1.2 Section 7 Table 7-2 mitigation measure ID CSWQMM1-CSWQMM6, CSWQMM40-CSWQMM44 Annexure A - Erosion and Sediment Control Plan

CoA No.	Condition Requirements	Document Reference
D45(d)	(i) The CEMP/SWMP is to include measures to minimise hydrology impacts, including measures to stabilise bank structures as required;	All Section 7 mitigation measures, particularly Table 7-2 mitigation measure ID CSWQMM28, CSWQMM43. Annexure A - Erosion and Sediment Control Plan
	(iv) measures to monitor and manage spoil, fill and materials stockpile sites including details of how spoil, fill or material would be handled, stockpiled, reused and disposed in a Stockpile Management Protocol. The Protocol shall include details of the locational criteria that would guide the placement of temporary stockpiles, and management measures that would be implemented to avoid/minimise amenity impacts to surrounding residents and environmental risks (including surrounding water courses);	Section 6.2.1.4 Annexure E - Stockpile Management Protocol Section 7 Table 7-2 mitigation measure ID CSWQMM1, CSWQMM3, CSWQMM5, CSWQMM6, CSWQMM23, CSWQMM25, CSWQMM28. CWEMP for disposal options.
	(vi) measures for managing asbestos waste including its removal, handling, storage, transport and disposal;	G36 CEMP Appendix B9 – Construction Contaminated Land Management Plan CWEMP
	(vii) measures for reducing demand on water resources (including potential for reuse of treated water from sediment control basins);	Section 7 Table 7-2 mitigation measure ID CSWQMM68.
D46(c)	The Proponent shall prepare and implement a **Construction Soil and Water Quality Management Plan** to manage surface water impacts during construction of the SSI. The Plan shall be developed in consultation with the EPA, DPI (Fisheries), NOW and the Council and include, but not necessarily be limited to:	G36, G38 This CSWQMP Section 4
	(i) details of construction activities and their locations, which have the potential to impact on waterways and stormwater drainage;	Section 6.1 Annexure A - Erosion and Sediment Control Plan

CoA No.	Condition Requirements	Document Reference
	(ii) surface water impact assessment criteria consistent with Australian and New Zealand Environment Conservation Council (ANZECC) guidelines;	The surface water impact assessment was completed as part of the EIS (refer EIS Section 8.10). The findings, including reference to ANZECC guideline values, are summarised in Section 5.2.3 of this CSWQMP. Water quality criteria consistent with the Blue Book will be used to assess water quality impacts during construction. Refer to Chapter 7 Table 7-2 mitigation measure ID CSWQMM60.
	(iii) risk assessment of the potential surface and groundwater quality impacts posed by bridge construction;	Section 6 CEMP App A3
	(iv) management measures to be implemented to minimise surface water and groundwater impacts including details on waste water treatment devices, sediment basins, measures for managing pollutants at the source, spill management, and water quality monitoring;	Section 7
	(v) details of the management measures to be implemented during piling, construction of bridge pylons and the use and decommissioning of temporary work platforms on the Clarence River to minimise water quality impacts;	All Section 7 mitigation measures, particularly Table 7-2 mitigation measure ID ID CSWQMM1-8, CSWQMM40-CSWQMM44.
	(vi) details of how spoil and fill material required by the SSI will be sourced, handled, stockpiled, reused and managed, including locational criteria for guiding the placement of temporary stockpiles and measures to minimise potential impacts associated with stockpiling on waterways (such as erosion and sedimentation);	Section 6.2.1.4 Annexure E - Stockpile Management Protocol Section 7 Table 7-2 mitigation measure ID CSWQMM1, CSWQMM3, CSWQMM5, CSWQMM6, CSWQMM23,

CoA No.	Condition Requirements	Document Reference
		CSWQMM25, CSWQMM28. CWEMP for disposal options.
	(vii) a description of the erosion and sediment control measures to be implemented;	All Section 7 mitigation measures, particularly Table 7-2 mitigation measure ID CSWQMM1-CSWQMM8, CSWQMM24-CSWQMM39 Annexure A - Erosion and Sediment Control Plan
	(viii) details on the outcomes of the detailed site contamination investigations and proposed remediation measures, if remediation is required;	CEMP Appendix B9 – Construction Contaminated Land Management Plan No areas identified as requiring remediation.
	(ix) a procedure detailing the contingency measures to be implemented in the event of the discovery of previously unidentified contaminated soils, including the process for updating or preparing a remediation action plan;	Section 7 Table 7-2 mitigation measure ID CSWQMM85-CSWQMM86 CEMP Appendix B9 – Construction Contaminated Land Management Plan
	(x) an **Acid Sulfate Soils contingency plan**, consistent with the *Acid Sulfate Soils Manual* (Acid Sulfate Soils Management Advisory Committee, 1998) and *Acid Sulfate Soils Assessment Guidelines* (Ahern et al., 1998) to deal with the unexpected discovery of acid sulfate soils, including procedures for the investigation, handling, treatment and management of such soils and water seepage;	Section 7 Table 7-2 mitigation measure ID CSWQMM87 Annexure C – Acid Sulfate Soil Management Procedure
	(xi) a **tannin leachate management protocol** to manage the stockpiling of mulch and use of cleared vegetation and mulch filters for erosion and sediment control;	Section 7 Table 7-2 mitigation measure ID CSWQMM34 Annexure F - RMS Environmental Direction: Management of Tannins from Vegetation Mulch

CoA No.	Condition Requirements	Document Reference
	(xii) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be undertaken, the locations where monitoring would take place, how the results of the monitoring would be recorded and reported, and, if any exceedance of the criteria is detected how any non-compliance can be rectified; and	Section 8.3 Section 8.5 Section 8.8 Annexure B – Water Quality Monitoring Program
	(xiii) mechanisms for the monitoring, review and amendment of this plan.	Section 9 Annexure B – Water Quality Monitoring Program

4 Consultation

4.1 Consultation requirements under the Infrastructure Approval

In accordance with CoA D46(c), this CSWQMP has been developed in consultation with the:

- Environment Protection Authority (EPA)
- Department of Primary Industries (DPI) Fisheries
- DPI Water (formerly NOW), and
- Clarence Valley Council (CVC)

A summary of the consultation undertaken during the preparation of this CSWQMP is provided in Appendix A2 of the CEMP.

5 Existing environment

The following sections summarise the factors influencing soil and water within and adjacent to the Project corridor based on the information provided in the EIS.

5.1 Landscape and soil characteristics

5.1.1 Topography

The topography of the Project area gently rises on the southern side of the Clarence River to the east, south and west to an elevation of about 70 m Australian Height Datum (AHD). The northern side of the Clarence River is mostly flat.

5.1.2 Geology and soils

The Project area is underlain by the Grafton Formation, comprising sandstone, siltstone, claystone and minor coal. The geological map (*Grafton 1:250 000 Scale Geological Sheet 56-6* (Brunker and Chesnut, 1976)) indicates that Quaternary Alluvium overlies the Grafton Formation at the Project site. The Alluvium is described as stream alluvial deposits that are sandy to silty with minor gravels. Packham (1969) also states that boulder beds are present in the Clarence River near Grafton.

5.1.3 Soil landscape

Grafton soils consist of deep layered silty soils which vary in texture with well drained, brownish black sandy loams overlaying acidic dark brown sands at the riverbank, which extend out to more low plasticity, poorly drained clays with some fine sand overlaying heavy plastic clays. Erosion susceptibility within the Project area is considered to be relatively low.

Sections of the Project are known to have soft soils with soft to stiff consistency, high compressibility and are prone to settlement. Soft soils treatment is proposed as part of the construction method.

5.1.4 Acid sulfate soils

Acid sulphate soils are acidic soil horizons (layers) resulting from the aeration of soil materials rich in iron sulfides. Acid sulphate soils generally occur within:

- marine or estuarine sediments deposited during the Holocene period;
- soils less than 5 m above sea level;
- marine or estuarine settings/environments.

The *1:25,000 Scale Grafton Acid Sulfate Risk Soil Map* (1997) from the NSW Natural Resource Atlas database indicates that, within Grafton, the Project is located within an area of low probability of acid sulfate soil risk. In South Grafton, the works are mostly in an area of low probability. However, the area underlying the diversion of the existing Pacific Highway and the proposed flood mitigation area is potentially an area of high probability acid sulfate soil risk. The river channel where the bridge is to be constructed has a high probability of acid sulfate soils, as the soils are likely to contain estuarine bottom sediments within the river channel. Areas of high probability of acid sulfate soil risk are shown in Figure 5-1.

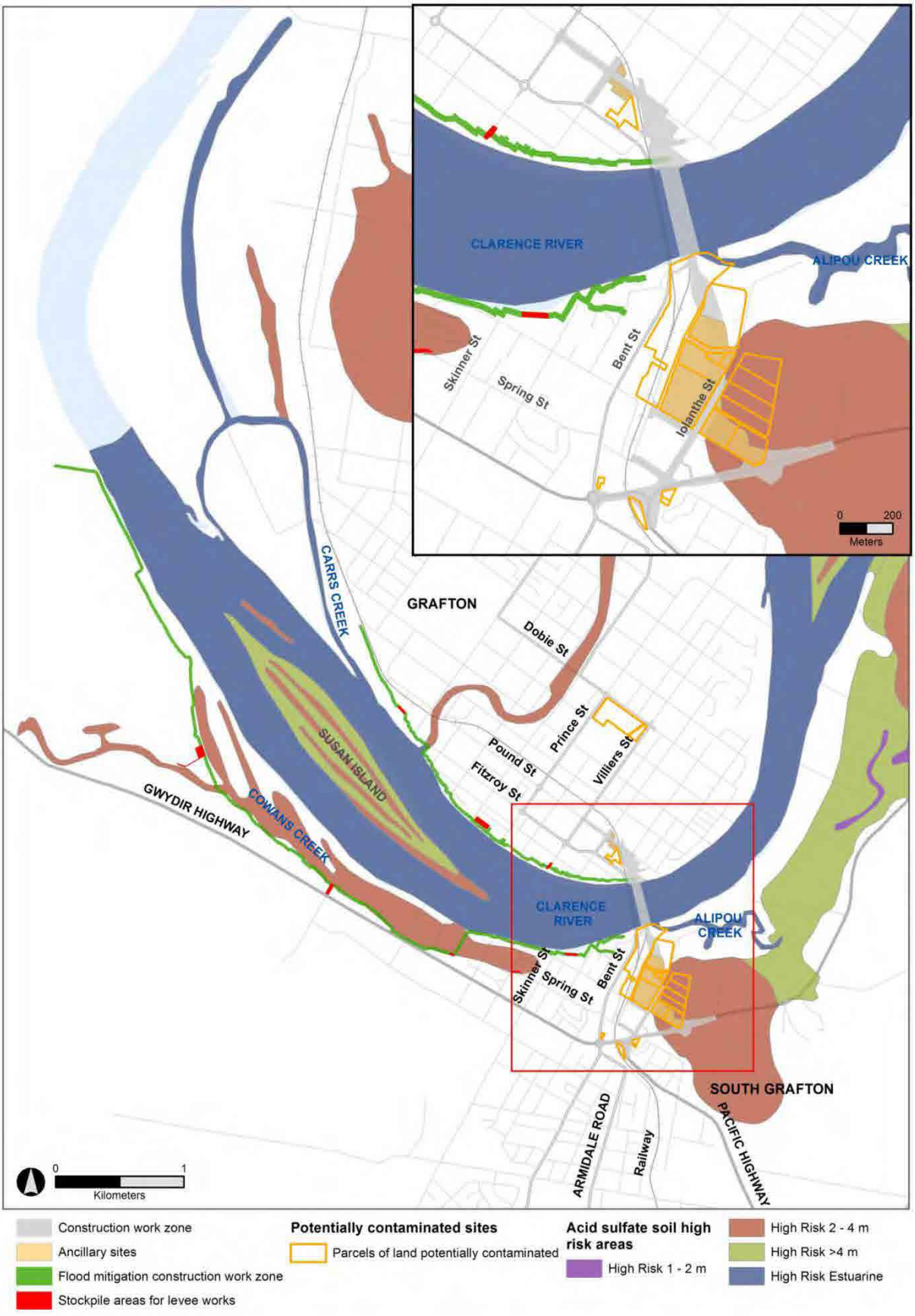


Figure 5-1: Potential contaminated land and acid sulfate soil high risk areas

5.1.5 Potential sources of contamination

A search of NSW EPA records for notices under Section 58 of the *Contaminated Land Management Act* found no records for sites with a written notice from the EPA for contamination within or in close proximity to the Project. Parcels of land that have the potential to be contaminated within or next to the Project area are listed in Table 5-1, shown in Figure 5-1 and further described below.

Table 5-1: Areas of potential contamination and acid sulfate soil risk within or next to the Project area

Description	Ownership	Issue	Contaminants of concern
Grafton (within the Project area)			
Lot 100 DP 851143	Grafton TAFE campus	Contaminated soils Combustible and flammable liquids stored on-site	TPH, benzene, toluene, ethyl benzene, xylenes
Grafton (next to the Project area)			
Lot 5 DP 1068698	Private	Agricultural land uses	Heavy metals, organic contaminants
Lot 1 DP 1160909	Grafton Showground	Agricultural land uses	Heavy metals, organic contaminants
Lot 7007 DP 92967	Grafton Showground	Agricultural land uses	Heavy metals, organic contaminants
South Grafton (within the Project area)			
Not available	ARTC	Known contaminated soils	Confirmed presence of arsenic,cadmium, copper, lead, zinc and mercury, TPH c10-c36 exceeding the soil investigation level (sil), total Polycyclic Aromatic Hydrocarbons (PAHs), benzo(a)pyrene and asbestos (from one test pit 1.5 m deep).
Lot 2 and Lot 3 DP 1101889	Private	Contaminated soils Truck diesel distribution area	Asbestos, heavy metals, TPH, benzene, toluene, ethyl benzene, xylenes
Lots 384/ 385 DP 751385	Private	Agricultural land uses Acid sulfate soil risk area	Asbestos, heavy metals, TPH, organic contaminants. High risk of acid sulfate soil.
Lot 379 and Lot 380 DP 751385	Private	Acid sulfate soil risk area	Asbestos, heavy metals, TPH. High risk of acid sulfate soil

Description	Ownership	Issue	Contaminants of concern
Lot 457 DP 823651	Private	Agricultural land uses	Heavy metals, organic contaminants
Lot 12 DP 858248	Public	Agricultural land uses	Heavy metals, organic contaminants
Lot 17 DP 858248	Private	Agricultural land uses	Heavy metals, organic contaminants
Lot 3 DP 586649	Private	Disused diesel/petrol tanks	TPH, benzene, toluene, ethyl benzene, xylenes
Pacific Highway on approach to South Grafton	Various	Acid sulfate soil risk area	High risk of acid sulfate soil
South Grafton (next to the Project area)			
Lot 1 DP 859759	Private	Contaminated soils Disused diesel/petrol tanks	TPH, benzene, toluene, ethyl benzene, xylenes
Lot 346 and 347 DP 751385	Private	Contaminated soils Disused diesel/petrol tanks	TPH, benzene, toluene, ethyl benzene, xylenes
Lots 381/ 382/383 DP 751385	Private	Agricultural land uses Acid sulfate soil risk area	Asbestos, heavy metals, TPH, organic contaminants High risk of acid sulfate soil

Grafton

There is potential for contamination within the Project area where there is, or has been, land uses such as automotive uses and agriculture.

Residential areas within the proposed corridor in Grafton are not identified as high risk of contamination, although there is potential for localised contamination such as heavy metals, asbestos fragments and disused storage tanks. Due to the age of most dwellings in Grafton, there is a risk of asbestos being present and fibres being released during any demolition.

The preliminary investigation did not identify any existing or former uses, or potentially contaminating events in the Clarence River that suggest contamination of the riverbed. Hence, there is a low risk of encountering contaminants on the section of Clarence River occupied by the below-water bridge foundations.

South Grafton

Potential for contamination on land occupied by the Project relates to existing and former industrial, automotive and agricultural land uses.

In particular, the ARTC land occupied by the former locomotive depot is known to be contaminated (Coffey, 2004). The site was used as a locomotive depot between the 1920s and late 1960s. Facilities such as railway lines and sidings, a turntable, a diesel refuelling facility, coal store, offices, workshops and garages were built during this time. Many of the

facilities were removed in the 1970s and the site ceased being used as a refuelling facility in the late 1980s. The site was leased to Manildra Sugars in 1989 and has been used for sugar loading operations since then.

Within the existing Grafton and South Grafton levees, the fill material is likely to comprise virgin excavated natural material (VENM) as well as fill material of unknown quality. There is a minor risk of encountering contaminated fill during the levee raising work. While no known cattle dip sites occur along the Project alignment, there is a possibility of encountering previously unknown cattle dips and associated contaminated soils.

Additional contaminated site investigations were undertaken by Cavvanba in October 2016 and January 2016. The report identified minor exceedances of human health and environmental criteria for metals in three locations and large volumes of fill material including varying inclusions of ash, metal rails, timber, brick, brick walls, concrete, plastic pipe, glass and tiles on ARTC land and commercial land allocated for the proposed construction compound.

5.2 Surface water

The Project is located within the Lower Clarence catchment area. The main watercourses within or near the Project are the Clarence River, Alipou Creek, Swan Creek and Carrs Creek (refer to Figure 5-2).

The Project would cross the Clarence River and be located immediately upstream of Alipou Creek. Refer to Figure 5-2. Hence, these two waterways were the focus of the surface water quality assessment completed as part of the EIS (p330).

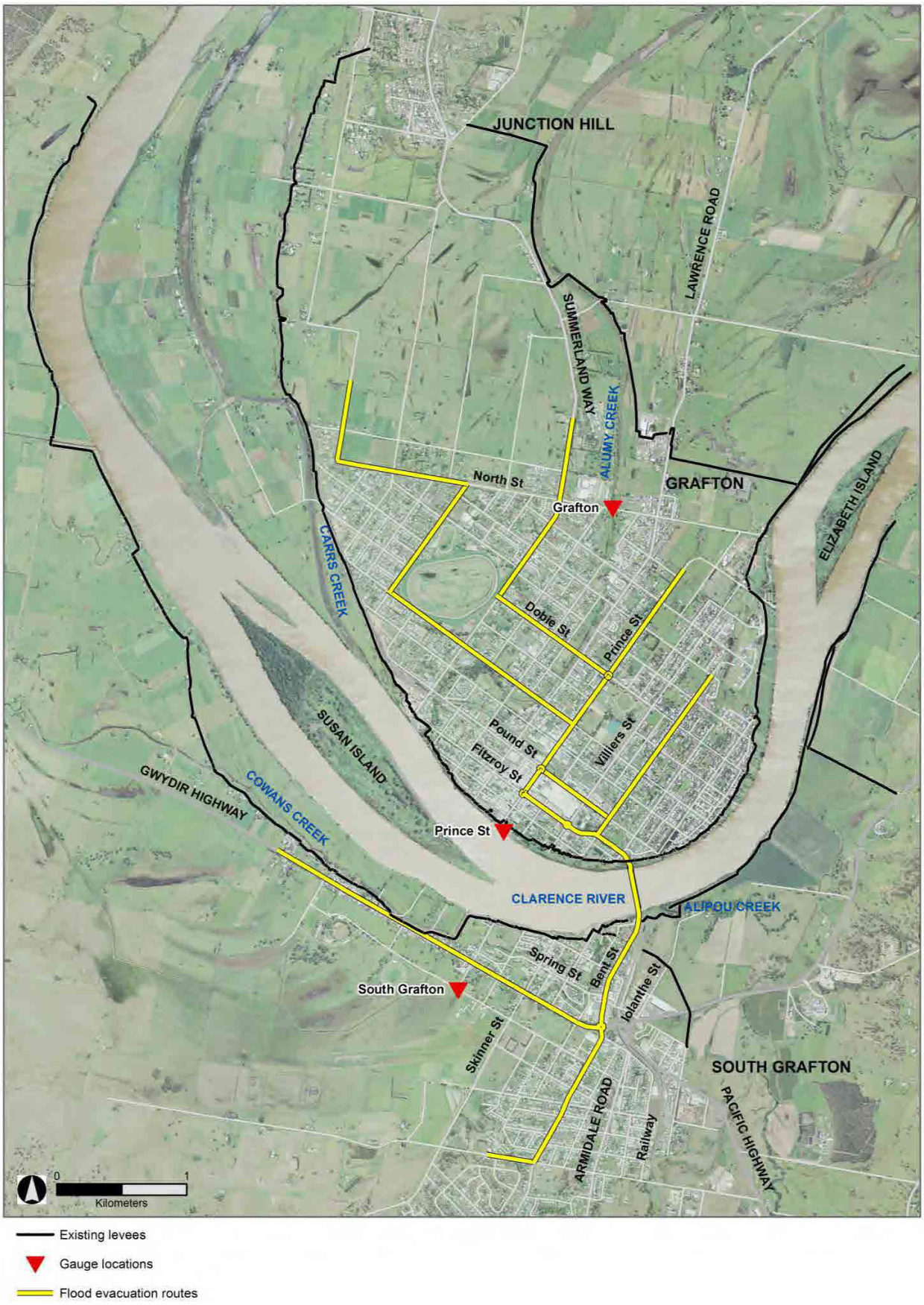


Figure 5-2: Main watercourses within or near the Project area

Source: EIS Main Report, Section 8.2.2, Figure 8-6, page 158.

5.2.1 Sensitive Receiving Environments

A sensitive receiving environment is defined as one that has a high conservation or community value or supports ecosystems or human uses of water that are particularly sensitive to pollution or degradation of water quality. Sensitive receiving environments relevant to the Project are described in Table 5-2.

Table 5-2: Sensitive Receiving Environments relevant to the Project

Location/ Site	Commentary
Nationally Important Wetlands and State Environmental Planning Policy No 14 Wetlands	There are no listed wetlands within or near the Project area. The Clarence River Estuary is the closest Nationally Important Wetland. It is located in Yamba, about 63 km downstream from the Project. Wetland number 292, listed under the *State Environmental Planning Policy No 14 Coastal Wetlands*, is located 8 km east of the Project area and is part of the Upper Coldstream Wetlands, associated with Coldstream River and Pillar Valley Creek.
National parks, marine parks, nature reserves and State conservation areas.	The nearest sensitive area is the Susan Island Natural Reserve located on the northernmost section of Susan Island on the Clarence River. It is located downstream from a section of the levee that will upgrades as part of the Project, but some 2.5 km upstream from the proposed bridge. The reserve is a known grey-headed flying-fox colony. There are no national parks, marine parks or nature reserves within or in close proximity to the Project. The nearest national park is the Fortis Creek National Park located about 30 km north-west of Grafton, while the nearest marine park is Solitary Islands Marine Park located off Corindi Beach.
Threatened ecological communities associated with aquatic ecosystems	There are two threatened ecological communities in the project area: • Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, located on the northern and southern Clarence River bank immediately east of the Project. The community is in poor condition with a high level of exotic species • Subcoastal Floodplain Forest of the NSW North Coast bioregion, limited to isolated patches of remnant vegetation. The canopy is mainly native with some exotic species, including garden escapees and noxious weeds in the mid storey and shrub strata.
Known and potential habitats for threatened fish	Silver perch and purple-spotted gudgeon are threatened fish species with a moderate likelihood of occurrence on the Clarence River at Grafton.

Location/ Site	Commentary
Key fish habitats as identified by the NSW Department of Primary Industry	Under the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013), the Clarence River and nearby tributaries the NSW are classified as CLASS 1 waterways within and next to the Project area. These waterways contain TYPE 2 moderately sensitive key fish habitat as they provide riverine brackish wetland habitats, and have a stable vegetated substrate.
Recreational swimming areas	The *NSW State of the Beaches 2010–2011: Far North Coast Region* report states that the Clarence River at Grafton has reported elevated enterococci levels during both dry and wet weather conditions, and its beach suitability is ranked as 'poor' and 'very poor'. Hence the Clarence River and Alipou Creek at Grafton are not considered suitable recreational swimming areas.
Areas that contribute to drinking water catchments	There are no areas that contribute to drinking water catchments within or near the Project. The closest water supply scheme is the Clarence Valley regional scheme which sources water from the Nymboida River catchment area, about 50 km upstream from Grafton.
Areas that are available or used for aquaculture and commercial fishing.	There are no areas available or used for aquaculture and commercial fishing within or near the Project. NSW Fisheries has reported two commercial fishing licences near fishing Susan Island, about 3 km upstream from the proposed bridge. The majority of commercial fishing licences operate in the Yamba, Maclean and Iluka areas. The closest aquaculture farm is at Palmers Island, about 50 km downstream from Grafton.

5.2.2 Water sharing plans

At the time this CSWQMP was written, the DPI Water was in the process of preparing a water sharing plan for the Clarence Alluvial Water Sources. The water sharing plan is anticipated to commence in mid-2016, as declared on the DPI Water website. Fulton Hogan will review the water sharing plan, once it becomes available, with the view of identifying its potential impact on the construction of the Project. If warranted, this CSWQMP will be updated accordingly to incorporate any relevant requirements of the plan. Water uses and basic landholder water rights

Recreational water uses mostly occur in the Clarence River and include boating, sailing, rowing and fishing. Various water events and water sport competitions are held in Grafton throughout the year.

There are three types of basic landholder rights in NSW under the *Water Management Act 2000*:

- **Domestic and stock rights**: Owners or occupiers of land which is overlaying an aquifer or river, estuary or lake frontage can take water without a licence for domestic (household) purposes or to water stock. Agricultural and livestock uses may occur on lands adjoining the Clarence River and Alipou Creek.
- **Native title rights**: Anyone who holds native title with respect to water, as determined under the *Commonwealth Native Title Act 1993*, can take and use water for a range of personal, domestic and non-commercial purposes. A search on the National Native Title

Tribunal TitleVision online tool on 18 April 2014 found no native titles in Grafton or South Grafton.

- **Harvestable rights** – allows landholders in most rural areas to collect a proportion of the runoff on their property and store it in one or more farm dams up to a certain size. Farm dams do not occur within the project area or Grafton and South Grafton urban areas but occur on rural land adjoining the Clarence River and Alipou Creek.

5.2.3 Surface water quality

A summary of the results of water quality sampling of the Clarence River taken between January and April 2014 is shown in Table 5-3. The water sampling locations are shown on Figure 5-3.

Table 5-3: Water quality sampling results for Clarence River

Location/ Site	Date	Conductivity (µS/cm)	Dissolved oxygen (% saturation)	pH	Turbidity (ntu)
BH 1305 (ARTC)	14/03/14	1,509	9	6.9	541
	28/3/14	2,358	18	7.0	600
	15/04/14	3,974	6	6.8	600
	23/05/14	2,974	15	7.0	600
BH 1308 (Kent/ Greaves)	14/03/14	8,000	7	6.8	4
	28/3/14	1,211	58	9.1	60
	15/04/14	8,000	6	6.5	21
	23/05/14	8,000	13	6.9	74
River (Sailing Club)	30/01/14	945	75	7.3	24
	14/03/14	6,152	99	7.6	52
	28/3/14	7,029	79	7.6	14
	15/04/14	171	78	7.1	59
	23/05/15	167	116	8.5	66
River (Corcoran Park)	30/01/14	2,961	73	7.5	17
	14/03/14	8,000	99	7.3	10
	28/3/14	8,000	77	7.4	9
	15/04/14	181	75	7.2	59
	23/05/15	185	112	8.3	24
River (Carrs Peninsula)	30/01/14	205	79	8.2	27
	14/03/14	2,046	97	7.4	20
	28/3/14	2,852	74	7.5	17
	15/04/14	114	82	7.0	87
	23/05/15	145	114	8.5	16
River (WharfSt)	30/01/14	1,550	67	7.6	2
	14/03/14	7,472	106	7.4	40
	28/3/14	8,000	77	7.3	6
	15/04/14	172	74	7.0	54
	23/05/15	155	110	8.5	15

These water quality samples were compared to ANZECC/ ARMCANZ guideline values for protection of aquatic ecosystems. The results for pH, turbidity and conductivity were above the guidelines and the results for dissolved oxygen were below the guideline values (EIS, p334).

Water quality monitoring results of the Clarence River at the sites shown in Figure 5-3 indicated elevated enterococci levels at all three sites during both dry and wet weather conditions (*The Beachwatch Partnership Program*, OEH, 2013). Based on the *National Health and Medical Research Council's Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008) the EIS (p334) found that:

- The Prince Street location scored a beach suitability grade of 'poor', indicating that this location is susceptible to faecal pollution and microbial water quality and is not always suitable for swimming. During dry weather conditions, swimming should be avoided if swimming locations have signs of pollution, such as discoloured water, odour or debris in the water. Swimming should be avoided at all times during and for up to three days following rainfall
- The Grafton Sailing Club and Corcoran Park sites scored a beach suitability grade of 'very poor', indicating that these locations are very susceptible to faecal pollution and microbial water quality and may often be unsuitable for swimming. It is generally recommended to avoid swimming at these sites.

Additional background water quality monitoring will be undertaken prior to construction. The Water Quality Monitoring Program to be implemented during pre-construction and construction is provided in Annexure B.

5.3 Groundwater

5.3.1 Groundwater conditions

The Project rests over the Clarence-Morton groundwater province, whgich is a porous rock aquifer system generally saline and therefore with limited potential uses (DECCW, 2010). Groundwater flow systems of the Clarence-Morton groundwater province are classified as 'intermediate,' indicating that groundwater may flow over distances ranging from 5 to 50 km.

Groundwater within the Project area is saline. The Clarence River Fact Sheet (Oceanwatch, 2014) states the tidal limit reaches over 100 km inland up to Copmanhurst, and this influences the groundwater resources at Grafton. Borehole BH1305 in South Grafton recorded conductivity values of up to 3974 µs/cm. These levels are not recommended for human consumption or irrigation but are acceptable for certain types of livestock. Groundwater from this borehole was also found to be turbid (above 540 NTU) and with a very strong odour.

5.3.2 Groundwater levels

Groundwater level observations obtained during geotechnical investigations carried out for the EIS identified groundwater levels at between 0.2 – 0.7 m AHD below the ground surface within ARTC land, South Grafton. On the corner of Kent Street and Greaves Street in Grafton, observed groundwater levels fluctuated between 0.1 and 0.3 m AHD below the ground surface.

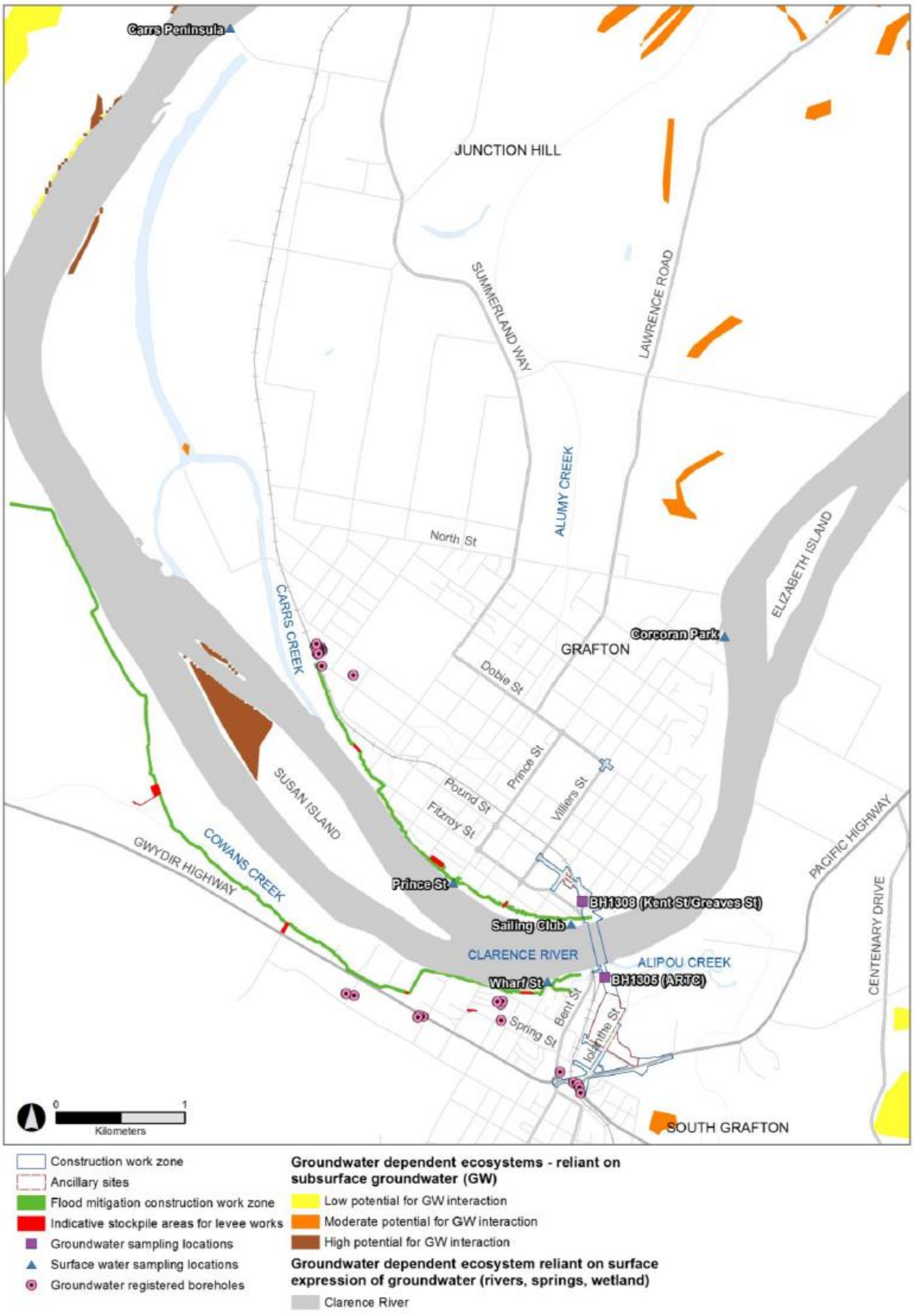


Figure 5-3: Water quality sampling sites and groundwater registered boreholes

Source: EIS Main Report, Section 8.10, Figure 8-39, page 328

5.3.3 Groundwater bores

No groundwater bores were identified within the Project area, based on a search of the NSW Natural Resources Atlas online tool (NSW Natural Resource Atlas, 2014). The closest registered boreholes to the Project area are listed in Table 5-4 and locations shown in Figure 5-3. The majority of the registered boreholes are used for monitoring purposes.

Table 5-4: Groundwater bores within the vicinity of the Project

Bore Number	Depth (m)	Ownership	Purpose
Grafton			
GW307339, GW307343, GW307340, GW307341, GW307342, GW307344, GW307345	5.7 to 7.2	Private	Monitoring
GW302258	6.6	Private	Domestic
GW304887	10 to 11	Public	Monitoring
GW302879, GW302880, GW302881, GW302882, GW302883, GW302884, GW302885, GW302886, GW302888, GW302887, GW302889, GW302890, GW302891, GW304886	9.5 to 11	Private	Monitoring
GW304885	10	Private	Monitoring
South Grafton			
GW305106, GW305827, GW305826, GW305829	5.1 to 6.1	Private	Monitoring
GW300861	11.5	Public	Domestic
GW307223, GW307222, GW307221	6.5 to 9	Private	Monitoring
GW307115, GW307116, GW307114	5.8 to 9.8	Private	Monitoring
GW068657	8.5	Private	Domestic stock
GW301785	7.5	Not Recorded	Monitoring
GW305828	5.1	Private	Monitoring

5.3.4 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems that have their species composition and natural ecological processes determined by groundwater (DLWC, 2002). The EIS identified the following GDEs within the Project area as shown in Figure 5-3:

- the Clarence River; and
- surrounding vegetation as a GDE reliant on subsurface groundwater.

As outlined in the CFFMP, there are two threatened ecological communities with the potential to be affected by impacts on groundwater (refer Table 5-2):

- Freshwater Wetlands on Coastal Floodplain (FWCF); and
- Subtropical Coastal Floodplain Forest Freshwater Wetlands (SCFF) on coastal floodplain.

The threatened ecological communities are further detailed in the CFFMP.

5.3.5 Groundwater Contamination

A groundwater investigation undertaken in the south-eastern part of the project site in the vicinity of the former refuelling facility (Cavvanba, February 2016) identified residual hydrocarbon contamination in groundwater. The report recommended to:

- report the site to the NSW EPA due to exceedances of the groundwater criteria and the potential of offsite migration; and
- depending on the outcome of the above mentioned notifications, ensure that any works which may disturb the subsurface are managed appropriately so as to not exacerbate the groundwater issue.

Subsequent to the abovementioned investigation a report titled "Contamination Strategy – Construction Purposes, Former Rail Land, South Grafton" was prepared by Cavvanba Consulting in April 2016. The requirements and recommendations of this report are addressed in the CEMP Appendix B9 Construction Contaminated Land Management Plan (CCLMP).

5.4 Climate

Based on Bureau of Meteorology data for the Grafton Airport monitoring station, the Project area experiences a total mean annual rainfall of 1,142.9 mm, with the highest mean monthly rainfall occurring between November to March (115.3 to 165.8 mm per month).

Data from the Bureau of Meteorology indicates that the warmest months are November to March (mean maximum temperatures of about 28 to 30°C) and the coldest months are June to August (mean maximum temperatures of about 20 to 22°C).

Climate data for the Grafton Airport monitoring station is summarised in Table 5-5.

Table 5-5: Summary of BoM climate data for BoM Grafton Airport monitoring station

Climate Parameter	Average monthly minimum	Average monthly maximum	Average annual
Rainfall (mm)	35.0 (July)	165.8 (February)	1142.9
Maximum temperature (°C)	20.4 (June, July)	29.7 (January)	25.6
Minimum temperature (°C)	5.0 (July)	19.0 (January)	12.6
Wind speed (km/h)			7.6 - 8.6

5.4.1 Rainfall erosivity factor

The rainfall erosivity factor is a measure of the ability of rainfall to cause erosion (referred as "R" in the Revised Universal Soil Loss Equitation RUSLE). The rainfall erosivity factor is used to determine the soil loss in tonnes per hectare over one year, and is used in calculations when sizing construction sediment basins.

The Project has a Rainfall Erosivity Factor of 3210 SI (refer Soil Loss Calculations in Annexure A – Erosion and Sediment Control Plan).

6 Environmental aspects and impacts

6.1 Construction activities

Key construction activities and their locations that could result in adverse impacts on waterways and stormwater drainage are detailed in Table 6-1.

Table 6-1: Construction activities and their locations with potential to impact on waterways and stormwater drainage

Construction Activity	Key Locations
• Site establishment, including general site clearing; construction of temporary access roads/access points; construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required); temporary upgrade work on existing local roads and intersections.	• Entire project area
• Vegetation clearing and topsoil stripping	• Entire project area
• Bulk earthworks	• Entire project area
• Pre-loading on localised areas of soft soils	• Southern abutment
• Levee raising	• Flood levee works area in Grafton and South Grafton
• Construction of retaining walls and embankments	• Retaining wall at Ch 1450 • Fill embankments on the Grafton and South Grafton bridge approach
• Culvert and drainage works	• New pavement drainage for the length of the works • Culverts at Ch 400, Ch 800 and Ch 1570
• Material stockpiles	• Ancillary facilities • As identified during construction in accordance with the *Stockpile Management Protocol* included in Annexure E of this CSWQMP
• Removal/ modification of existing built features (e.g. paved surfaces)	• Houses in North Grafton • Pavement in Spring Street, Through Street, Pound Street, Greaves Street and Clarence Street.
• River-based construction	• Clarence River
• Water use	• Entire project area
• Compound operation including operation of concrete batching plant, fuel and chemical storage, refuelling and chemical handling;	• Adjacent to Butters Lane

Construction Activity	Key Locations
• Landscaping and tree planting	• The length of the project
• Noxious weed treatment including herbicide spraying	• Where required

Refer also to the Environmental Aspects and Impacts Register included in Appendix A3 of the CEMP.

6.2 Impacts

Potential impacts on soil and water attributable to construction of the Project are identified in the following sections. Chapter 7 of the CSWQMP provides a suite of mitigation measures that will be implemented to avoid or minimise the impacts identified below.

6.2.1 Soils

6.2.1.1 Soil erosion and sedimentation generating activities

The construction activities identified in Table 6-2 would result in exposure of soils and subsoils, creating an elevated risk of soil erosion and sedimentation.

Table 6-2: Construction activities with potential to cause soil erosion and disturbance of acid sulfate soils

Component	Activity
Project preliminaries and site establishment	• General site clearing • Construction of temporary access roads/access points • Construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required) • Clearing of vegetation and processing of materials • Temporary upgrade work on existing local roads and intersections.
Levee raising work	• Stripping of topsoil • Placement and compaction of earthwork.
Roadwork and road surfacing	• Stripping of topsoil • Placement and compaction of earthwork • Road widening • Diversion of utilities • Installation of traffic signals, roadside furniture and lighting • Construction of any retaining walls and subsurface drainage • Construction of pedestrian and cycle path • Progressive landscaping and tree planting.
Drainage	• Construction of drainage, including culvert structures, grass-lined open channels, and kerbs and gutters • Construction of temporary sedimentation basins.
Bulk earthwork	• Stripping of topsoil and stockpiling for later reuse in landscaping • Materials haulage

Component	Activity
	• Soft soils treatment • Embankment foundation treatment • Construction of fill embankments • Stockpiling
Bridge work	• Removal of viaduct structures below ground during the replacement of ARTC rail viaduct at Pound Street. • Installation of scour protection along the bridge piers and abutments.

6.2.1.2 Acid sulfate soil disturbance

The following construction activities have the greatest risk of disturbing acid sulfate soils (ASS):

- site establishment;
- levee raising;
- drainage construction;
- bulk earthworks;
- river-based construction; and
- construction of bridge foundations.

These activities could disturb and expose acid sulfate soils to oxygen. Pollutants could be readily released into the surrounding environment, polluting surface water and groundwater.

The risks associated with disturbing acid sulfate soils and potential acid sulfate soils (refer Table 6-2) can be adequately managed and mitigated by implementing the relevant measures and procedures in the *Acid Sulfate Soils Manual* (Acid Sulfate Soils Management Advisory Committee, 1998), and Roads and Maritime *Guidelines for Managing Acid Sulfate Materials 2005*.

6.2.1.3 Soft soils settlement treatment

Soft soil areas would be treated to achieve adequate levels of soil settlement and consolidation before construction can begin. Fulton Hogan will use surcharge pre-loading as a treatment method during construction.

6.2.1.4 Spoil and fill material management

Construction of the project will require spoil and general fill management as described below.

Spoil

The excavation of existing ground will create spoil material that may need to be stockpiled. Some of it would be reused as general fill for other parts of the project where possible (refer CWEMP Table 7-2 CWEMM17); the rest would be unsuitable spoil material and would be appropriately disposed (refer CWEMP Section 6.6). Spoil stockpile areas will be located within the ancillary facilities identified in CEMP Section 2.4, as well as other areas in accordance with the *Stockpile Management Protocol* contained in Annexure E.

The project will not generate significant amounts of spoil as there are no large cuttings on the Project. The Project will have a net fill requirement.

General fill material

General fill material will be required for the Project, including the construction of fill embankments. General fill material will likely be sourced from the local area unless there is an issue with local supply and resources further afield need to be investigated. The general fill material will generally be imported and placed directly within the proposed fill embankment footprint to minimise the need for double handling. Should the sequence of construction require stockpiling of general fill, stockpile areas will be located within the ancillary facilities identified in CEMP Section 2.4, as well as other areas in accordance with the *Stockpile Management Protocol* contained in Annexure E.

6.2.2 Surface water quality

6.2.2.1 Impact on sensitive receiving environments

If unmanaged, construction activities could increase levels of turbidity and sediment deposition, decrease dissolved oxygen, and change pH levels in downstream waters. These changes could have an adverse impact on the health of aquatic environments, particularly in sensitive receiving environments.

The impacts of the Project on the threatened ecological communities and threatened fish species will not be significant provided that measures to substantially reduce the amounts of sediments entering the Clarence River are implemented.

6.2.2.2 Impact on water users and basic landholder rights

Project construction is unlikely to change the existing water quality of the Clarence River and other waterways provided that standard erosion and sediment control measures are implemented. Construction activities would not change the ability of landholders to take and use water from Alipou Creek, the Clarence River or any other watercourse.

6.2.2.3 Impacts of ancillary sites on surface water quality

The following activities at ancillary sites have the potential to impact on water quality:

- storage of chemicals and other hazardous materials;
- earthworks, which could disturb acid sulfate soils high risk areas in South Grafton (refer to Table 5-1);
- concrete batching;
- handling of construction materials;
- vehicle washdown and refuelling;
- vehicle, plant and equipment movements; and
- stockpiling operations.

If unmanaged, construction activities at ancillary sites could result in sediments and particles being washed off-site into drainage lines and waterways, and increasing levels of turbidity.

6.2.2.4 Surface water quality risk factors and impacts

The risk factors and impacts on surface water quality as a result of the construction of the Project are presented in Table 6-3.

Table 6-3: Surface water quality risk factors and impacts

Risk Factor	Impact

Risk Factor	Impact
River-based construction activities could result in changes to the Clarence River hydrologic flow regimes.	Temporary river-based construction structures such as barges, and activities such as piling work, would be confined to the areas occupied by the bridge foundations. The footprint of these areas is modest in relation to the river width. It is unlikely that river-based construction activities would result in changes to the flow or river levels.
River-based construction activities such as installation of bridge foundations, bridge superstructure and piers. These may disturb riverbed sediments.	If unmanaged, disturbed sediment may increase river turbidity.
Dispersal of sediments and water pollutants from land-based construction activities. Construction activities outlined in Section 6.1 may result in soil erosion, siltation and off-site movement of eroded sediments by wind and/or stormwater to receiving waterways.	If unmanaged, the dispersal of sediments and water pollutants could result in turbidity, increased nutrients, metals and other pollutants in the waterways.
Removal of riparian vegetation to enable bridge launching, construction of abutments and scour protection.	If unmanaged, the removal of riparian vegetation could reduce the stability of the Clarence River bank, and result in soil and streambank erosion and increased sediment loads into the Clarence River and Alipou Creek.
Exposure of acid sulfate soils as a result of earthwork	If untreated, the exposure of acid sulfate soils may result in generation of sulfuric acid and subsequent acidification of waterways and groundwater sources and mobilisation of heavy metals in the environment.
Disturbance of contaminated land.	If unmanaged, disturbed contaminated land may result in contamination of downstream waters, which could impact on aquatic and vegetation community habitats.
Accidental fuel and chemical spills, and contaminated runoff infiltration to groundwater.	If uncontained, accidental leaks or spills may pollute waterways and groundwater. The process of runoff infiltration is generally effective in filtering polluting particles and sediment. Hence, the risk of contamination to groundwater from any pollutants bound in particulate form in surface water, such as heavy metals, is generally low. Similarly, low-density pollutants such as oils, tars and petroleum products would be preferentially retained in the soil profile and would not penetrate to the groundwater table. However, soluble pollutants, such as acids and alkalis, salts and nitrates, and soluble hydrocarbons, would be able to infiltrate through soils into the groundwater and would pose a risk to that groundwater source. Under certain pH conditions, metals may also become soluble and infiltrate groundwater. In these areas, chemical treatments may be necessary to help remediate spills.

6.2.3 Groundwater

6.2.3.1 Impacts on groundwater levels

The Project construction requires two sections of shallow cutting. One cutting would be located on Greaves Street beneath the proposed bridge northern approach and the second would be located on Pound Street beneath the existing railway viaduct. The cutting on Greaves Street would be approximately 1.2 m below existing ground level and the cutting on Pound Street would be approximately 0.2 m below existing ground level. The final profile of cutting sections will be shallow and therefore low risk in terms of intercepting groundwater levels or changing existing groundwater flows.

The construction of embankments has the potential to preferentially direct surface runoff and concentrate recharge to groundwater however, these impacts would be confined to the bridge approaches where the largest embankments are proposed.

Areas of soft soil are known to occur within the Project area and soft soil treatment compaction may restrict near-surface groundwater flows, resulting in discharge and waterlogging.

6.2.3.2 Impacts on groundwater quality

Groundwater pollution may potentially occur due to accidental spills during construction of the Project or if construction activities are not adequately managed.

6.2.3.3 Impact on groundwater dependent ecosystems

The GDEs within the Project area (refer Section 5.3.4 are partly supported by shallow groundwater systems that effectively arrest the infiltration of surface waters. Potential impacts on groundwater recharge rates from general road construction are generally greatest in areas where significant cuttings are required as they have the potential to intersect the water table and affect groundwater levels downstream. Given the limited extent of cutting proposed for the Project, the risk of blocking or diverting groundwater flows that support these GDEs is low.

6.2.3.4 Impact on licensed groundwater users and basic landholder rights

The Project construction is unlikely to impact the access, use or yield of registered groundwater boreholes or to change the level of access to underlying aquifers beneath lands with domestic and stock rights.

6.2.4 Contamination

The disturbance of potentially contaminated land identified in Figure 5-1 and Table 5-1 may have the following impacts:

- mobilisation of surface and subsurface contaminants, with the potential to impact surface water, groundwater and soils;
- migration of contaminants into the surrounding area, with the potential to impact surface water, groundwater and soils via leaching, overland flow and/or subsurface flow;
- mobilisation of groundwater and/or surface water contamination;
- exposure of contaminants to ecological receivers, which may impact flora and fauna;
- exposure of contaminated soils and/or groundwater to people.

Any existing contamination present within the soils or groundwater underlying the Project area and associated ancillary facilities has the potential to be exposed or disturbed by construction activities. The highest risk activities would be:

- bulk earthwork
- demolition of dwellings, old railway tracks and other structures (due to the potential presence of asbestos).

The Project is unlikely to increase the risks associated with any site contamination and the placement of virgin excavated natural material fill will also act as a barrier to future exposure and disturbance of contamination.

7 Environmental management measures

A range of environmental requirements and control measures are identified in the EIS, Submissions Report, Conditions of Approval, RMS documents and from recent RMS experience on similar bridge construction Projects. General and specific measures to address impacts on soil and water are outlined in Table 7-1 and Table 7-2.

7.1 Protection of water quality

Temporary sediment control measures will be installed to protect water quality. Controls and management measures outlined in this section are consistent with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). The details of location, design and maintenance of erosion and sediment control measures are provided in Annexure A Erosion and Sediment Control Plan, Table 7-1 and Table 7-2.

7.1.1 Land-based construction activities

A significant part of construction involves extending and upgrading existing roads and raising existing levees. This work does not require large amounts of clearing, therefore standard practices for the control of erosion and sedimentation will be adopted to manage sediment runoff. Erosion and sediment control measures are to be implemented in accordance with the Landcom/Department of Housing *Managing Urban Stormwater, Soils and Construction Guidelines* (the Blue Book)) and maintained to:

- prevent sediment moving off-site and sediment laden water entering any watercourse, drainage lines, or drain inlets;
- reduce water velocity and capture sediment on-site;
- minimise the amount of material transported from site to surrounding pavement surfaces
- divert clean water around the site.

The Blue Book requires the installation of a sediment basin on site if the soil loss is greater then 200t/yr (150m3/yr). The soil loss for the project site is greater than 200t/yr (refer Soil Loss Calculations in Annexure A), therefore sediment basins would normally be required, however, sediment basins will not be feasible for some locations on this project due to space and topographical constraints and the proximity to live traffic or waterways.

In these instances alternative sediment controls, e.g. rock filter bunds, sediment fences or sumps, will be installed downslope of works or dirty water storage will be provided in boxed out work areas to whatever volume is reasonable and feasible. These controls will also be supplemented with enhanced erosion controls. Trapped water will be treated in-situ or transferred to dewatering basins or sediment basins.

For more details on the location and design of erosion and sediment controls refer Annexure A *Erosion and Sediment Control Plan*. More detailed controls would be outlined in the Progressive ESCPs.

7.1.2 River-based construction activities

River-based construction activities will be carried out in accordance with the principles of the Blue Book and include:

- measures to ensure no release of dirty water into drainage lines and/or waterways
- visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) on a regular basis to identify any potential spills or deficient controls
- water quality control measures prevent materials (e.g. concrete, grout, sediment etc) entering waterways.

7.1.3 Temporary Work Platforms

Temporary working platforms may be constructed. These platforms would be located within the construction work zone and would extend from the existing banks into the river to enable stable and safe access to construction barges, and piling areas as required. Any temporary working platforms would be designed in accordance with the following principles:

- be constructed of hard, sound, durable rock free of fine particles and not contaminated with foreign materials
- be designed to allow for effective and regular clean-up of sediment and spill management
- be designed to prevent small rock or fine capping materials from being washed out of the platform
- be designed and operated in a manner that minimises the re-suspension of sediments or substrates
- remain in the waterway for the minimum time possible
- be protected with large rock armouring as required to ensure durability during a 10 year average rainfall interval (ARI) flood event as a minimum
- be protected by anti-pollution booms and heavy duty silt curtains which are designed, installed/anchored and maintained specific to the waterway. Antipollution booms and heavy duty silt curtains would be installed before the commencement of any work that may generate sedimentation
- facilitate appropriate water flow to safely convey water and reduce impacts in high flow events, including but not limited to downstream bank and bed scouring and associated deposition
- include appropriate fish passage treatments.

Design of temporary working platforms will address:

- tidal range, variation and flow velocity;
- river flow velocity during non-flood events;
- flooding characteristics including afflux constraints (e.g. proximity of sensitive receivers), catchment size, flow velocity during a 2-year, 10-year and 20-year ARI flood events, associated potential scour impacts and flood evacuation procedures;
- river morphology including bed shape, depth, major flow channels and substrate type;
- navigational requirements including visibility, speeds and navigational channels;
- commercial and recreational uses of the waterway including fishing, water skiing or other leisure activities;
- procurement and delivery of working platform materials and components including mobilisation, proximity to existing river structures, transportation/access for barges, access to clean rock (i.e. hard, sound, durable rock free of fine particles and not contaminated with foreign materials);
- maintenance works and associated management (e.g. refuelling, routine maintenance and spill management);
- rehabilitation requirements associated with decommissioning; and
- applicability of industry innovations and/or sustainability initiatives (e.g. reuse of materials).

Any temporary working platforms will be developed and designed in consultation with the appropriate regulatory agencies to ensure that potential impacts from the installation, operation and decommissioning of the working platforms are managed to minimise impacts on the surrounding waterways.

7.1.4 Construction work/plant on barges moored in the river

Construction work/plant on barges will be carried out in accordance with the principles of the Blue Book and include:

- measures to ensure no release of dirty water into waterways, include use of Reverse Circulation Drilling system that uses barge mounted settlement tanks for handling of pile spoil and water. Water to be contained within tanks and removed from barge and transported to approved discharge location
- containment of hydraulic systems, oils and lubricants (i.e. bunds or double sheathed hoses)
- visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) on a regular basis to identify any potential spills or deficient controls
- maintaining a hardstand area at the barge loading area and clearing debris from items prior to being loaded on to barges

A *Barge Works* EWMS (refer Table 7-2 mitigation measure ID CSWQMM41) will be issued to the relevant agencies for review and comment in February 2017, and well before the planned commencement of bridge work in the Clarence River in May 2017.

7.1.5 Construction work on the bridge

Construction activities on the new bridge will be carried out in accordance with the principles of the Blue Book and include:

- measures to ensure no release of dirty water into drainage lines and/or the Clarence River
- pre-casting of pile cap and bridge segments
- water quality control measures to prevent materials (e.g. concrete, grout, sediment, fuel etc.) entering the Clarence River, including;
    - design and maintenance of hoses and containment systems
    - maintaining bridge deck clear of loose materials that may wash or be blown from the deck
    - use of containment mesh whilst applying epoxy to bridge segment joints
    - refuelling of plant in bunded area
    - installation of perimeter handrail and parapets progressively to provide edge protection
    - certified design of pier formwork system and inspection by qualified engineer prior to placement of concrete. Sealing of formwork to prevent loss of concrete slurry
- visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) on a regular basis to identify any potential spills or deficient controls.

A *Works in Waterways* EWMS (refer Table 7-2 mitigation measure ID CSWQMM41) will be issued to the relevant agencies for review and comment in February 2017, and well before the planned commencement of bridge work in the Clarence River in May 2017.

Table 7-1: Environmental management measures for soils, sediments, water and contaminated land impacts

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
SOILS, SEDIMENTS, WATER AND CONTAMINATED LAND					
Acid sulfate soils disturbance					
SW1	Acid-resistant construction materials will be used where possible in areas known to contain acid sulfate soils.	EIS Section 10 Submissions Report S4	Pre-construction, Construction	Fulton Hogan	Detailed design
Construction soils and water management plan					
SW3	As part of the construction environmental management plan, a SWMP will be prepared in line with current Roads and Maritime specifications. The SWMP will include (but not limited to):	EIS Section 10 Submissions Report S4	Pre-construction	Fulton Hogan	This CSWQMP
	• A risk assessment of the potential impacts on water quality and hydrological processes				Table 6-3 CEMP App A3
	• Details of erosion and sediment controls to be implemented, including erosion and sediment control plans developed for the Project				Annexure A - Erosion and Sediment Control Plan
	• Details of inspection frequency for control measures				Section 8.3
	• Monitoring and maintenance of environmental control measures				Section 8.3
	• Environmental work method statements for high risk activities such as dewatering and works within waterways				Section 1.3 Table 7-2 mitigation measure ID CSWQMM41, CSWQMM54
	• Procedures to manage stockpiles generated during				Annexure E - Stockpile Management Protocol

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
	construction				
	• Tannin leachate management measures				Annexure F – RMS Environmental Direction: Management of Tannins from Vegetation Mulch
	• Acid sulfate management measures				Annexure C - Acid Sulfate Soil Management Procedure
	• Detailed consideration of measures to prevent (where possible) or minimise any water quality impacts				Annexure A - Erosion and Sediment Control Plan
	• Measures to manage known and unexpected contamination during the construction stage				CCLMP - Unexpected Discovery of Contaminated Land Procedure
	• Consideration of water dissipation due to wick drains.				Detailed design
Soil erosion and sediment control					
SW4	Erosion and sediment control measures will be implemented in accordance with the Landcom/Department of Housing *Managing Urban Stormwater, Soils and Construction Guidelines* (the Blue Book) and maintained to: • Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • Reduce water velocity and capture sediment on-site • Minimise the amount of material transported from site to surrounding pavement surfaces • Divert clean water around the site.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure A - Erosion and Sediment Control Plan

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
SW5	Erosion and sedimentation controls will be checked and maintained on a regular basis (including clearing of sediment from behind barriers) and records kept and provided on request.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure A - Erosion and Sediment Control Plan
SW6	Erosion and sediment control measures will not be removed until the works are complete and areas are stabilised.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure A - Erosion and Sediment Control Plan
SW7	Work areas will be stabilised progressively during the works.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure A - Erosion and Sediment Control Plan
SW8	Water from site will be used for construction purposes, such as dust suppression, where feasible and reasonable.	EIS Section 10 Submissions Report S4	Construction	Contractor	CAQMP
Acid sulfate soils disturbance					
SW9	Where excavation is to be carried out in areas anticipated to contain acid sulfate soils, work will proceed according to the soils and water management plan (acid sulfate soils section). Specific controls to be implemented will include: • Capping exposed surfaces with clean fill to prevent oxidation • Placing excavated acid sulfate soils separately in a lined, bunded and covered area • Neutralising acid sulfate soils for reuse (where appropriate) by using additives such as lime • Disposing of acid sulfate soils where necessary in accordance with the relevant guidelines set out in the *Acid Sulfate Soils Assessment Guidelines* (Ahern et al, 1998).	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure C- Acid Sulfate Soil Management Procedure

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
SW10	If acid sulfate soils are disturbed, any acid produced will be neutralised and acid waste prevented from leaving the site in accordance with the applicable guidelines.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure C- Acid Sulfate Soil Management Procedure
Protection of water quality during construction					
SW11	Construction work in proximity to waterways will be undertaken in accordance with best practice and the NOW guidelines for controlled activities where feasible and reasonable. Construction water quality management measures to protect nearby waterways from construction activities will be included in SWMP developed for the Project. This SWMP will include (but not limited to) the following measures: • Appropriate controls to minimise risk of release of dirty water into drainage lines and/or waterways • Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be carried out on a regular basis to identify any potential spills or deficient erosion and sediment controls • Water quality control measures to prevent any materials (e.g. concrete, grout, sediment etc.) entering waterways.	EIS Section 10 Submissions Report S4	Pre-construction	Contractor	Annexure A - Erosion and Sediment Control Plan
Temporary working platforms					
SW12	Before commencement of works within the river, a workshop will be held with relevant government agencies including representatives from EPA, NSW Office of Water, Department of Primary Industries Fisheries, Roads and Maritime and the construction contractor to discuss potential options for temporary working platforms.	EIS Section 10 Submissions Report S4	Pre-construction	Contractor and RMS	ERG Meeting Minutes 14/07/2016 Table 7-2 mitigation measure ID CSWQMM40

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
	Any temporary working platforms will be managed in accordance with the principals detailed in Section 6.6.1 of the EIS.				
Exposed areas					
SW13	Exposed areas will be progressively rehabilitated. Methods will include permanent revegetation, or temporary protection with spray mulching or cover crops.	EIS Section 10 Submissions Report S4	Construction	Contractor	Section 7 – Mitigation Measures
Stockpile site management					
SW14	Topsoil, earthworks and other excess spoil material will be stockpiled in accordance with the principles outlined in *Stockpile Management Guidelines* (Roads and Maritime, 2011).	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure E- Stockpile Management Protocol
SW15	Stockpiles will be placed within a designated ancillary site or stockpile area in accordance with the following principles: • Not require removal of areas of native vegetation (where feasible and reasonable) • Not be located under the 'dripline' of trees • Be located outside known areas of weed infestation • Be located such that waterways and drainage lines are not directly impacted.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure E - Stockpile Management Protocol
SW16	Where practicable, stockpiles will be located away from areas subject to concentrated overland flow. Stockpiles located on a floodplain will be managed so as to minimise loss of material in flood or rainfall events.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure E- Stockpile Management Protocol

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
SW17	All construction stockpiles will comply with the requirements of the *Protection of the Environment Operations Act 1997* and *Waste Avoidance and Resource Recovery Strategy 2007* for any waste activities that involve the generation, storage and/or disposal of waste. The NSW Resource Recovery Exemptions will also be applied to the storage and management of stockpiled material.	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure E- Stockpile Management Protocol CWEMP
SW18	Stockpiles containing potential acid sulfate soils will be managed in accordance with the *Acid Sulfate Soils Manual* (Acid Sulfate Soils Management Advisory Committee, 1998).	EIS Section 10 Submissions Report S4	Construction	Contractor	Annexure E- Stockpile Management Protocol Annexure C- Acid Sulfate Soil Management Procedure
Emergency spill response during construction					
SW19	Emergency spill response measures will be developed and incorporated into the soils and water management plan as part of the construction environmental management plan. This plan will detail measures for the prevention, containment and clean-up of accidental spills of fuels and chemicals.	EIS Section 10 Submissions Report S4	Pre-construction	Contractor	Section 7 – Mitigation Measures
Chemical use and storage					
SW20	The storage, handling and use of the chemicals and fuels will be in accordance with the *Work Health and Safety Act 2000* and *Workcover's Storage and Handling of Dangerous Goods Code of Practice* (WorkCover, 2005).	EIS Section 10 Submissions Report S4	Construction	Contractor	Section 7 – Mitigation Measures Fulton Hogan Work Health Safety Management Plan.

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
Chemical use and storage					
SW21	Physical controls to address the potential risks associated with the use and storage of chemicals on-site will include: • Bunded storage facilities for chemicals and fuels • Bunded areas for refuelling and washdown • Effective spill kits at all construction sites.	EIS Section 10 Submissions Report S4	Construction	Contractor	Section 7 – Mitigation Measures
DISTURBANCE OF CONTAMINATED SOILS					
Detailed site investigation					
CS1	A detailed site investigation will be prepared for the areas of potential contamination identified in the EIS in accordance with *Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011). The site investigation will provide detailed information on the type, extent and level of contamination and assess: • Contaminant dispersal in air, surface water, groundwater, soil and dust • The potential effects of contaminants on public health, the environment and the Project structures • Off-site impacts on soil, sediment and biota (where applicable) The adequacy and completeness of all information available to be used in making decisions on remediation.	EIS Section 10 Submissions Report S4	Pre-construction	RMS	Contaminated Site Investigation Report - Summerland Way – Additional Crossing of the Clarence River at Grafton, NSW prepared by Cavvanba Consulting in October 2015 did not indicate that a Remedial Action Plan is required. RMS has prepared a Contamination strategy for ARTC – refer Appendix B9 Construction Contaminated Land Management Plan.
Site remedial action plan					
CS2	If the results of the detailed site investigation indicate a remedial action plan needs to be prepared and implemented, this plan will be prepared in consultation with Department of Planning and Environment and	EIS Section 10 Submissions Report S4	Pre-construction	RMS	As above.

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where addressed
	Office of Environment and Heritage. The plan will be prepared in accordance with *Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011).				
Asbestos on demolished structures					
CS3	An asbestos survey will be conducted for structures to be demolished as part of the Project. An asbestos certified disposal service will be engaged for properties identified as having asbestos materials.	EIS Section 10 Submissions Report S4	Pre-construction	Contractor and RMS	Asbestos waste will be handled in accordance with the Fulton Hogan Work Health Safety Management Plan. If asbestos waste is encountered, SafeWork NSW licensed asbestos removalists will be engaged to handle, manage and remove the waste. CWEMP – for disposal options.

7.2 Construction water

The amount of water that would be required during construction is unknown at this stage. The amount would depend on material sources and methodologies applied by Fulton Hogan. It is proposed that water would be obtained from Grafton's water supply network.

Construction water will be used for dust suppression, earthwork compaction and planted vegetation maintenance.

The volume of water required will depend on a number of factors including rainfall, wind direction and intensity, soil type and area of ground disturbance at any one time.

7.3 Additional Mitigation Measures

Additional mitigation measures to address impacts on soil and water quality are provided in Table 7-2.

Table 7-2: Additional mitigation measures for soils, sediments, water and contaminated land impacts

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
GENERAL				
CSWQMM1	Engage a soil conservationist selected from the RMS' Registered Category of 'Soil Conservation Consultancy Services', must be appointed and retained by you until Contract Completion. All erosion, sediment and water pollution Plans, controls and measures will be reviewed by soil conservationist prior to installation. The soil conservationist will also assist in project training in regards to project erosion and sediment control issues.	✓	✓	Environmental Manager
CSWQMM2	Install erosion and sediment controls in all construction areas where soil disturbance is going to occur, prior to soil disturbance occurring.		✓	Environmental Manager Project Engineers Foreman
CSWQMM3	Design and install all erosion and sediment controls in accordance with the *Erosion and sediment control plan* (ESCP) included in Annexure A of this plan. The plan has been prepared in accordance with the Blue Book (Landcom, 2004 and DECC, 2008) and includes relevant standard drawings and details from these texts.		✓	Environmental Manager Project Engineers Foreman
CSWQMM4	Consult relevant government agencies in relation to control measures in watercourses and creeks and the design of waterway crossings (e.g. DPI Water, DPI Fisheries, Office of Environment and Heritage).	✓	✓	Environmental Manager
CSWQMM5	In addition to the overarching ESCP (refer Annexure A) prepare Progressive Erosion and Sediment Control Plans (PESCPs) prior to commencing each stage or parcel of work. Prepare, review and issue the PESCPs in accordance with the Project Document and Data Control Procedure to ensure their currency and relevance at all times.		✓	Environmental Manager Project Engineers
CSWQMM6	Implement appropriate erosion and sediment control measures for each particular section of works in accordance with the PESCP, prior to the commencement of any clearing, stripping or earthworks.		✓	Project Engineers Foreman

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
CSWQMM7	Install certain structures and controls (i.e. sediment basins, pipes and culverts) early (i.e. prior to clearing and stripping) to promote successful erosion and sediment control during construction (principally, during clearing, stripping and earthworks).		✓	Project Engineers Foreman
CSWQMM8	Implement relevant documentation and systems for recording erosion and sediment control activities in accordance with the procedure for site environmental inspections outlined in the CEMP.		✓	Environmental Manager
MINIMISING DISTURBANCE				
CSWQMM9	Establish clearing limits and work boundaries that are well defined using barrier tape (or equivalent) prior to any construction, clearing or stripping works commencing.		✓	Environmental Manager Project Engineers Foreman
CSWQMM10	Minimise the extent of clearing and retain as much groundcover as possible.		✓	Project Engineers Foreman
CSWQMM11	Clearly mark all vegetation that is to be retained.		✓	Environmental Manager Project Engineers Foreman
CSWQMM12	Clear land progressively and clear the areas associated with the current section/stage of works only.		✓	Project Engineers Foreman
CSWQMM13	Initially clear and grubb leaving the soil surface in a reasonably rough condition with some surface vegetative cover.		✓	Project Engineers Foreman
DRAINAGE CONTROL				
CSWQMM14	Maximise the separation of 'clean' (offsite) run-on water from 'dirty' (onsite) (e.g. turbid) construction area runoff as much as possible.	✓	✓	Environmental Manager Project Engineers Foreman
CSWQMM15	Construct drainage structures early in the project including: - sediment basins and traps - catch drains, and - culverts/ pipes and associated inlet and outlet protection (e.g. dissipaters).		✓	Project Engineers Foreman
CSWQMM16	Maximise the diversion of turbid construction runoff into sediment basins.		✓	Project Engineers Foreman
CSWQMM17	Control runoff during the construction of embankments (e.g. fill shaping and the construction of temporary dykes and batter drains).		✓	Project Engineers Foreman
CSWQMM18	Divert formation runoff into pits and the stormwater drainage system as soon as practical to reduce surface flow lengths.		✓	Project Engineers Foreman

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
CSWQMM19	Divert offsite run-on water around the works site as much as possible. Use permanent cut-off drains to achieve this as much as possible.		✓	Project Engineers Foreman
CSWQMM20	Maintain slope lengths at appropriate lengths (refer to the standard drawings in the Primary ESCP) to reduce water velocity and minimise erosion. Use catch drains to collect and divert runoff from the slopes.		✓	Project Engineers Foreman
CSWQMM21	Use geotextile linings or other surface protection methods to provide temporary surface protection in areas where appropriate (e.g. batter drains, culvert construction).		✓	Project Engineers Foreman
CSWQMM22	Use check dams within diversion drains where required to reduce water velocity and minimise erosion within the drains.		✓	Project Engineers Foreman
CSWQMM23	Locate stockpiles in accordance with the *Stockpile Management Protocol* included in Annexure E of this CSWQMP.		✓	Project Engineers Foreman
EROSION AND SEDIMENT CONTROL				
CSWQMM24	Progressively stabilise exposed ground surfaces.		✓	Project Engineers Foreman
CSWQMM25	Progressively revegetate batters and other disturbed areas, such as stockpiles, with temporary cover crop species. Use Rye Corn during the months of April to August or Japanese Millet during the months of September to March as required by R178.		✓	Project Engineers Foreman
CSWQMM26	Immediately commence stabilisation of waterways, including their beds and banks, after the completion of any works within these areas. All stabilised areas to mimic a naturalised creek system and the disturbed areas to be planted with native species.		✓	Project Engineers Foreman
CSWQMM27	Control dust through progressive revegetation techniques and by watering unsealed areas.		✓	Project Engineers Foreman
CSWQMM28	Use temporary ground covers such as soil stabilisers (e.g. Gluon polymer emulsion), hydroseed or hydromulch as much as possible to stabilise batters, stockpiles and large surface areas.		✓	Project Engineers Foreman
CSWQMM29	Construct sediment control measures as close to the potential source of sediment as possible.		✓	Environmental Manager Project Engineers Foreman
CSWQMM30	Ensure sediment basin management of turbid water immediately after rain as required with one or a combination of: - flocculation with gypsum (or approved alternative flocculant), and - pump-out for construction purposes or dust control.		✓	Environmental Manager Project Engineers Foreman
CSWQMM31	Do not release water from sediment basins prior to achieving acceptable water-quality standards (refer to mitigation measure ID CSWQMM60 for water quality criteria).		✓	Environmental Manager Project Engineers

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
				Foreman
CSWQMM32	Control the tracking of mud and soil material onto local roads using shakers, rubble pads or washdown areas.		✓	Foreman
CSWQMM33	Provide sediment fencing or equivalent downslope of disturbed areas that can't be directed into a designated sediment basin, trap or bund unless completely impractical (e.g. works within watercourses). Implement alternative controls (i.e. silt curtains and enhanced erosion controls) in these locations.		✓	Environmental Manager Project Engineers Foreman
CSWQMM34	Use mulch bunds, earth bunds or straw bales as alternatives to sediment fencing where appropriate. However, do not use mulch in concentrated flow areas or where it has the potential to result in tannin leachate into waterways. Refer to Annexure F *RMS Environmental Direction: Management of Tannins from Vegetation Mulch*.		✓	Environmental Manager Project Engineers Foreman
CSWQMM35	Treat water accumulating within any excavation, trap or low point on site that cannot be re-used in construction or dust suppression, as per the requirements for sediment basins before discharge from site. Refer to mitigation measure ID CSWQMM60 for water quality criteria.		✓	Environmental Manager Project Engineers Foreman
CSWQMM36	Install sediment controls around stormwater inlet pits where appropriate and where they won't cause or exacerbate flooding. Consider traffic management and safety if installing such devices on live traffic roads.		✓	Environmental Manager Project Engineers Foreman
CSWQMM37	Remove sediment controls only after works are complete and 70% stabilisation of disturbed surfaces is achieved.		✓	Environmental Manager Project Engineers Foreman
CSWQMM38	Test sediment basins and, if required, treat, prior to discharge within 5 days of a rainfall event that causes runoff (refer to mitigation measure ID CSWQMM60 for water quality criteria). Alternatively, pump sediment basins out for construction or dust control purposes to ensure the required capacities remain available for future rainfall.		✓	Environmental Manager Project Engineers Foreman
CSWQMM39	Carry out dust suppression whenever necessary to minimise sediments becoming air borne due to wind erosion.		✓	Foreman
WORKS IN AND AROUND WATERWAYS				
CSWQMM40	Before commencement of works within the Clarence River, discuss potential options for temporary working platforms with the ER, RMS, EPA, OEH, NSW Office of Water and Department of Primary Industries (Fisheries).		✓	Environmental Manager
CSWQMM41	Undertake all works in and around waterways in accordance with an area-specific *Works in Waterways* EWMS and a *Barge Works* EWMS (where relevant). Both of these EWMS will undergo agency review and comment.		✓	Environmental Manager Project Engineers Foreman
CSWQMM42	Complete any vegetation clearing and removal of topsoil near the waterways in accordance with an area-specific Clearing and Grubbing EWMS; minimise removal of native riparian vegetation, where practical.		✓	Environmental Manager Project Engineers Foreman

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
CSWQMM43	Implement scour protection measures, using clean aggregate, small rock or other similar stable material, on the banks of the Clarence River in the vicinity of the bridge works to protect the riverbank from erosion and instability as required.		✓	Project Engineers Foreman
CSWQMM44	Undertake permanent replanting with local native species in accordance with the Urban Design and Landscape Management Plan, as soon as practicable.		✓	Project Engineers Foreman
MANAGEMENT OF SEDIMENT BASINS				
CSWQMM45	Design all sediment basins in accordance with the requirements of RMS Specifications G36 and G36 and in accordance with the Blue Book (Landcom, 2004 and DECC, 2008).		✓	Environmental Manager Project Engineers Foreman
CSWQMM46	Provide suitable access into sediment basin locations to allow for safe removal of sediment and maintenance operations.		✓	Environmental Manager Project Engineers Foreman
CSWQMM47	Inspect all sedimentation basins at least weekly and following any rainfall event causing runoff.		✓	Environmental Manager Project Engineers Foreman
CSWQMM48	Immediately schedule de-silting and water treatment if sediment accumulates to a level above 30% of the sediment storage zone marker.		✓	Environmental Manager Project Engineers Foreman
CSWQMM49	Apply flocculant to settle sediments within 24 hours of the conclusion of the last rainfall event causing runoff.		✓	Environmental Manager Project Engineers Foreman
CSWQMM50	Include the following items on sediment basins: - a spillway constructed and stabilised to the 100-year ARI event - a marker peg (or equivalent) showing the boundary between the Sediment (Storage) and Water (Settling) zones of the basin - a sediment basin ID - lined inlets to minimise scour, and - measures to minimise the safety risk for site workers.		✓	Environmental Manager Project Engineers Foreman
CSWQMM51	Adequately compact and stabilise sediment basin walls with appropriate protective ground cover. Provide freeboard of at least 600mm from the spillway invert to the top of any earth wall.		✓	Environmental Manager Project Engineers Foreman
CSWQMM52	Source water for compaction and dust suppression preferentially from sediment basins.		✓	Environmental Manager Project Engineers

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
				Foreman
CSWQMM53	Treat water in sediment basins and discharge within 5 day of a rainfall event that causes runoff. Refer to mitigation measure ID CSWQMM60 for water quality criteria.		✓	Environmental Manager Project Engineers Foreman
CSWQMM54	Undertake all dewatering on site in accordance with the Blue Book and RMS guideline titled *Environmental Management of Construction Site Dewatering*. Prepare and implement a *Dewatering EWMS* to ensure that the waters being discharged meet the water quality criteria specified under mitigation measure ID CSWQMM60.		✓	Environmental Manager Project Engineers Foreman
CSWQMM55	Issue a *Dewatering Permit* prior to any dewatering on site.		✓	Environmental Manager Project Engineers Foreman
STABILISATION OF DISTURBED AREAS				
CSWQMM56	Where using cover crop species to progressively revegetate disturbed areas, use Rye Corn during the months of April to August or Japanese Millet during the months of September to March.		✓	Project Engineers Foreman
CSWQMM57	Commence stabilisation of waterways, including their beds and banks, immediately after the completion of any works within these areas.		✓	Project Engineers Foreman
CSWQMM58	Control dust through progressive revegetation techniques and by watering unsealed areas.		✓	Project Engineers Foreman
CSWQMM59	Use temporary ground covers such as soil stabilisers (e.g. Gluon polymer emulsion), hydroseed or hydromulch as much as possible to stabilise batters, stockpiles and large surface areas.		✓	Project Engineers Foreman
SURFACE WATER QUALITY MANAGEMENT				
CSWQMM60	Consider the receiving water quality prior to discharging site water. The discharge must meet or be better than the background water quality. Test and, if required, treat water before it is released from any discharge points (e.g. from sediment basins). Then re-test (and, if required, re-treat) the water. Do not release until the following water quality criteria are met: - pH 6.5-8.5 - Total suspended solids (TSS) < 50mg/L - No visible oil or grease. Promptly distribute the results of water quality monitoring to relevant project staff for action and further investigate any exceedances. Where a discharge occurs solely as a result of rainfall exceeding the 5-day 85th percentile rainfall depth value of 37.2mm, the abovementioned pH and TSS criteria do not apply.		✓	Environmental Manager
CSWQMM61	Once pre-construction water quality monitoring has been completed, Fulton Hogan may develop: - a statistical correlation to identify the relationship between		✓	Environmental Manager

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
	turbidity (NTU) and TSS, and - a statistical correlation methodology to detail the method to enable ongoing verification of the relationship between NTU and TSS. Both the statistical correlation and statistical correlation methodology will be submitted to EPA and RMS for approval prior to their use.			
CSWQMM62	If water is to be re-used for dust suppression or construction purposes, the above criteria do not apply providing water does not leave the site (either directly or indirectly via runoff).		✓	Environmental Manager
CSWQMM63	Provide and maintain access to the sediment basins to permit: - clear identification of each sediment basin and discharge point - easy collection of samples - collection of representative samples of water discharged from the sediment basin(s), and - access to the sampling point(s) at all times by an authorised officer of the EPA.		✓	Environmental Manager
CSWQMM64	Complete pre-construction and construction water quality monitoring in accordance with the *Water Quality Monitoring Program* attached at Annexure B.		✓	Environmental Manager
CSWQMM65	Record and retain the results of any monitoring: - in a legible form, or in a form that can readily be reduced to a legible form - for at least 4 years after the monitoring or recording event to which they relate took place, and - so that they can be produced in a legible form to any authorised officer of the EPA who asks to see them.		✓	Environmental Manager
CSWQMM66	Check weather forecasts daily and implement the *Heavy Rainfall Event Procedure* (included in Annexure D of this CSWQMP) where required.		✓	Environmental Manager
CSWQMM67	Manage vegetation stockpiles to minimise the impact of tannins leaching into the surrounding environment in accordance with *RMS Environmental Direction: Management of Tannins from Vegetation Mulch* included in Annexure F of this CSWQMP.		✓	Environmental Manager Project Engineers Foreman
CSWQMM68	Where available and practicable, and of appropriate chemical and biological quality, use stormwater, recycled water or other water sources where feasible and reasonable, in preference to potable water for construction activities, including concrete mixing and dust control.		✓	Environmental Manager Project Engineers Foreman
MANAGEMENT OF OTHER ACTIVITIES WITH POTENTIAL WATER QUALITY IMPACT				
Concreting and saw cutting				
CSWQMM69	Wash concrete mixers, pumps, concrete tools and other equipment at specially designated washout areas that are constructed in a manner that will prevent storm water surface run-off from being contaminated.		✓	Environmental Manager Foreman
CSWQMM70	Locate washout areas within an area that is not subject to natural surface storm water run-off and away from drainage lines. Post signs to advise workers of their locations.		✓	Environmental Manager Foreman

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
CSWQMM71	Construct the washout areas with an impermeable type material capable of retaining any contaminated water and concrete residue.		✓	Environmental Manager Foreman
CSWQMM72	Monitor the washout areas to ensure that they are not getting over full and that the washing activity is not contaminating the surrounding area.		✓	Environmental Manager Foreman
CSWQMM73	As part of the project induction program, advise all personnel performing concreting or saw cutting activities of the concrete washout areas and their obligations to: - clean their plant, tools and equipment within the designated area - maintain the area in a clean condition, and - ensure that contaminated water associated with their activities is appropriately controlled and prevented from reaching natural storm water surface drainage areas.		✓	Environmental Manager
Spray sealing and asphalt paving				
CSWQMM74	Properly maintain and regularly check spray sealing and asphalt paving plant, equipment and associated tools to minimise the risk of spills.		✓	Foreman
CSWQMM75	Promptly contain and collect any spills of fuel or bitumen materials using spill kits. Maintain spill kits and fire extinguishers at all times in the spray trucks, tankers and associated plant.		✓	Foreman
CSWQMM76	Promptly report all spills to the Environmental Manager.		✓	Environmental Manager Foreman
CSWQMM77	Allocate designated equipment washdown and cleaning areas for major asphalt works with appropriate environmental controls in place (e.g. bunds) to prevent washout water from reaching the receiving environment.		✓	Foreman
Storage and handling of fuels and chemicals				
CSWQMM78	Where practicable, do not locate storage areas within 50 metres of natural surface drainage areas, storm drainage systems or poorly drained or flood prone areas or any area with a slope steeper than 10%.		✓	Project Engineers Foreman
CSWQMM79	Keep liquid chemicals and fuels in bunded storage areas or sheds that have the capacity to contain spills from leaky containers or from an incident involving a decanting activity. Ensure the bunded capacity is at least 120% of the total capacity of all containers stored inside the bunded area or shed.		✓	Foreman
CSWQMM80	Where practicable, locate designated bunded plant refuelling areas, plant service/maintenance areas and concrete/plant wash down areas at least 5 meters from native vegetation and at least 50m from the following: - a natural surface drainage area, and - a built drainage structure such as a storm water pipe or box culvert.		✓	Foreman
CSWQMM81	During site induction, advise all personnel of the following: - The location of bunded storage areas, liquid absorbent materials and other spill containment materials and kits. - Storage of large quantities of fuel for construction plant is		✓	Environmental Manager

ID	Mitigation Measure	Timing		Responsibility
		PC[1]	C[2]	
	not permitted. Licensed fuel trucks carrying emergency fuel spill kits must be used to service plant and equipment. - All drums and decanted containers must be labelled and stored within bunded areas whenever they are not in use. Whenever practical, all unattended drums/containers must be returned to the bunded storage area.			
Temporary batching plants				
CSWQMM82	Locate temporary batching plants (if required) in accordance with the Ancillary facilities assessment included in Appendix A5 of the CEMP.	✓	✓	Environmental Manager
CSWQMM83	Establish and operate concrete batching plants (if required) in accordance with a site specific Concrete batching establishment and operation EWMS.		✓	Environmental Manager Project Engineers Foreman
Effluent				
CSWQMM84	Portable toilet block systems will be regularly serviced. All effluent facilities will be positioned with consideration of vicinity of water courses, sensitive flora/fauna habitats and residents.		✓	Environmental Manager Project Engineers Foreman
MANAGEMENT OF CONTAMINATED MATERIALS				
CSWQMM85	In the event that unexpected contamination is identified implement the *Unexpected discovery of contaminated land procedure* included in the CCLMP.		✓	Environmental Manager
CSWQMM86	Develop a remedial action plan, and a validation report upon completion of the remediation, if contamination is found to pose unacceptable risks to human health or the environment, in accordance with the OEH Guidelines for Consultants Reporting on Contaminated Sites. Undertake remediation works in consultation with the EPA.		✓	Environmental Manager
CSWQMM87	Should the presence of ASS be confirmed, follow the *Acid Sulfate Soil Management Procedure* included in Annexure C of this CSWQMP.		✓	Environmental Manager Project Engineers Foreman
CSWQMM88	Should any groundwater be encountered and need to be disposed of during construction, disposal would be undertaken in accordance with the RMS *Technical Guideline – Environmental management of construction site dewatering.*	✓	✓	Environmental Manager Project Engineers Foreman

8 Compliance management

8.1 Roles and responsibilities

Fulton Hogan's Project Team organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 7 of this CSWQMP.

8.2 Training

All employees, contractors and utility staff working on site will undergo site induction training relating to soil and water management issues. The induction training will address elements related to soil and water quality management including:

- existence and requirements of this sub-plan;
- relevant legislation;
- roles and responsibilities for soil and water quality management;
- the location of ASS or PASS;
- water quality management and protection measures;
- groundwater issues; and
- procedure to be implemented in the event of an unexpected discovery of contaminated land.

Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in soil and water management. Examples of training topics include:

- ERSED control installation methodology;
- sediment basin construction, operation and maintenance;
- working near Clarence River and other waterways;
- working near or in drainage lines and creeks;
- preparedness for high rainfall events;
- preparedness for flood events;
- emergency response measures in high rainfall and flood events;
- lessons learnt from incidents and other events e.g. high rainfall / flooding;
- mulch and tannin management;
- spill response;
- stockpile location criteria; and
- identification of potentially contaminated spoil and fill material.

Further details regarding staff induction and training are outlined in Chapter 5 of the CEMP.

8.3 Monitoring and inspection

Regular monitoring and inspections will be undertaken prior to, during and following construction. The following monitoring and inspections will be undertaken:

- the requirements of the Water Quality Monitoring Program (provided in Annexure B) in accordance with CoA D46(c)(iv), including monitoring of water quality of areas downstream of PASS risk, regular visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) to identify any potential spills or deficient controls;

- monitoring and management of spoil, fill and materials stockpile sites including details of how spoil, fill or material would be handled, stockpiled, reused and disposed;
- monitoring of the effectiveness of erosion and sediment control actions and measures during the works, The type, timing, frequency, assessment criteria and associated reporting requirements for water quality are detailed in the Water Quality Monitoring Program attached at Annexure B.

8.3.1 Weather monitoring

Rainfall will be measured and recorded in millimetres per 24-hour period at the same time each day from the time that the site office associated with the activities is established.

In addition, the Bureau of Meteorology's (BOM) website will be checked at least daily, or more frequently if wet weather is predicted, and regular weather updates will be broadcasted to project team by the Environmental Manager.

8.4 Licenses and permits

An EPL will be obtained for the scheduled activity "railway systems activities" in approximately 2018 before these activities are undertaken.

Should the need for other licenses or permits be identified Fulton Hogan will obtain these prior to and during construction as required.

8.5 Non-conformances

Non-conformances will be dealt with and documented in accordance with Section 8.6 of the CEMP.

8.6 Complaints

Complaints will be recorded and addressed in accordance with Section 6.3 of the CEMP and the Community Communication Strategy (CCS).

8.7 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this CSWQMP, CoA and other relevant approvals, licenses and guidelines. Audit requirements are detailed in Section 8.3 of the CEMP.

8.8 Reporting

Reporting requirements and responsibilities are documented in the Water Quality Monitoring Program, and Section 8.2 and Section 8.5 of the CEMP.

9 Review and improvement

9.1 Continuous improvement

Continuous improvement of this CSWQMP will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- identify areas of opportunity for improvement of environmental management and performance;
- determine the cause or causes of non-conformances and deficiencies;
- develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies;
- verify the effectiveness of the corrective and preventative actions;
- document any changes in procedures resulting from process improvement; and
- make comparisons with objectives and targets.

9.2 CSWQMP update and amendment

The processes described in Section 8 and Section 9 of the CEMP may result in the need to update or revise this CSWQMP. This will occur as needed.

Any revisions to this CSWQMP will be in accordance with the process outlined in Section 1.6 of the CEMP and as required, be provided to RMS, ER and other relevant stakeholders for review and comment and forwarded to the Secretary of DP&E for approval.

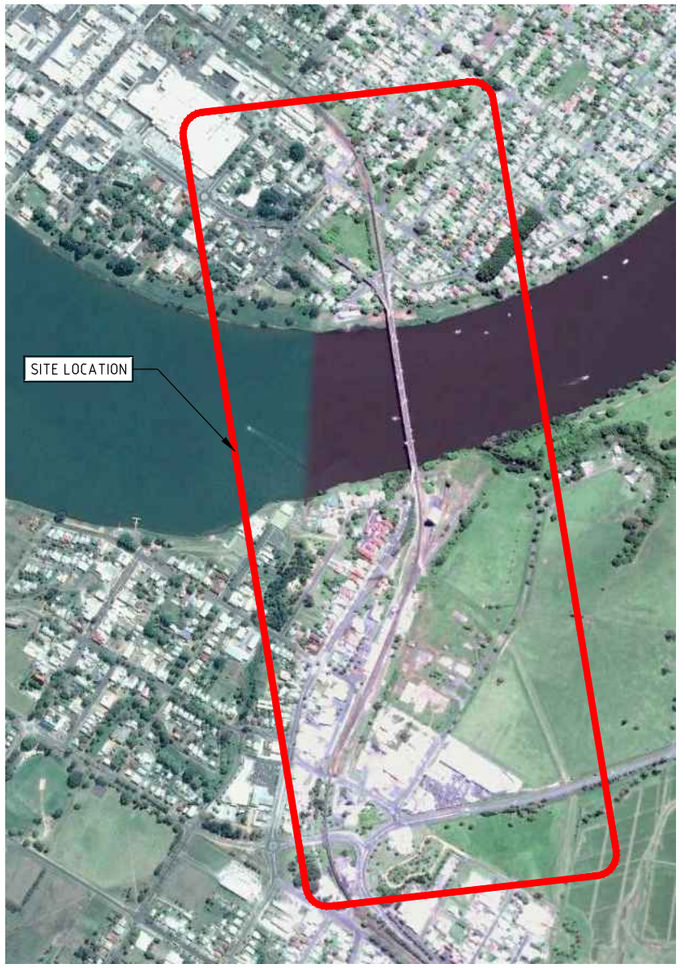
A copy of the updated CSWQMP and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 10.2 of the CEMP.

Annexure A
Erosion and Sediment Control Plan

MR83 – SUMMERLAND WAY
ADDITIONAL CROSSING
OF CLARENCE RIVER AT GRAFTON

PRIMARY EROSION AND SEDIMENT CONTROL PLAN

FINAL



DRAWING SCHEDULE

DRAWING NUMBER	DRAWING TITLE
15000333_P02_ESCP000	PRIMARY ESCP - COVER SHEET, LOCALITY PLAN AND DRAWING SCHEDULE
15000333_P02_ESCP001	PRIMARY ESCP - OVER-ARCHING REQUIREMENTS
15000333_P02_ESCP002	PRIMARY ESCP - OVER-ARCHING REQUIREMENTS CONTINUED
15000333_P02_ESCP003	PRIMARY ESCP - TABLE 1 AND TYPICAL WORK SCENARIO DETAILS
15000333_P02_ESCP004	PRIMARY ESCP - PHOTO EXAMPLES AND DETAILS
15000333_P02_ESCP005	PRIMARY ESCP - PHOTO EXAMPLES AND DETAILS
15000333_P02_ESCP006	PRIMARY ESCP - PHOTO EXAMPLES AND DETAILS
15000333_P02_ESCP007	PRIMARY ESCP - STANDARD DRAWINGS
15000333_P02_ESCP008	PRIMARY ESCP - STANDARD DRAWINGS
15000333_P02_ESCP101	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 1 OF 11
15000333_P02_ESCP102	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 2 OF 11
15000333_P02_ESCP103	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 3 OF 11
15000333_P02_ESCP104	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 4 OF 11
15000333_P02_ESCP105	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 5 OF 11
15000333_P02_ESCP106	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 6 OF 11
15000333_P02_ESCP107	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 7 OF 11
15000333_P02_ESCP108	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 8OF 11
15000333_P02_ESCP109	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 9 OF 11
15000333_P02_ESCP110	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 10 OF 11
15000333_P02_ESCP111	PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 11 OF 11

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N.T.S.

FINAL

North

CLIENT

Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
MR83 – SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

DRAWING TITLE
PRIMARY ESCP
COVER SHEET, LOCALITY PLAN
AND DRAWING SCHEDULE

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP000	00

Plot Date: Tuesday, 6 September 2016 10:47:53 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg

OVER-ARCHING REQUIREMENTS

EROSION AND SEDIMENT CONTROL DESIGN

The details shown on this drawing are Primary stage erosion and sediment control requirements only. Progressive Erosion and Sediment Control Plans (PESCPs) are required prior to the construction of each stage and section of works to detail controls and and specify staging requirements.

This Erosion and Sediment Control Plan (ESCP) has been prepared in accordance with Blue Book Volume 1 (Landcom, 2004) and Volume 2D – Main Road Construction (DECC,2008) and project approval conditions.

An erosion hazard assessment has been completed for all areas within the proposed work zone. The predicted soil loss across all site areas has been determined in accordance with the following:

A = R x K x LS x C x P

Where

A = Annual soil loss due to erosion (t/ha/yr)
R = Rainfall erosivity factor
K = Soil erodibility factor
LS = Topographic factor derived from slope length (SL) and slope gradient (S)
C = Cover and management factor
P = Erosion control practice factor

The following values have been used:

R : 3210
K : 0.051 (Based on an analysis of the nearby Cowper Soil Landscape)
SL : – 80m for general slopes
– 14m for batter slopes
S : Varies:
– 4% assumed as average maximum for general surfaces
– 50% assumed for batter surfaces
LS : Varies:
– 0.91 assumed as average maximum for general surfaces
– 4.39 assumed for batter surfaces
C : 1.0 (Construction stage – i.e. no soil surface protection or ground cover applied)
P : 1.3 (for general construction areas)

Based on the above data, the potential soil loss is:

- 194 t/ha/yr for general surfaces (Soil Loss Class 2)
- 934 t/ha/yr for batter surfaces (Soil Loss Class 6)

Under Blue Book standards, sediment basins are required if the soil loss is > 200 t/yr. Therefore, sediment basins would normally be required for this project. However, sediment basins will not be feasible for some locations on this project due to space/topographical constraints and the proximity to live traffic or waterways. In these instances alternative sediment controls (e.g. decanting sediment basins, rock filter bunds, sediment fences or sumps) will be installed downslope of works or dirty water storage will be provided in boxed out work areas to whatever volume is reasonable and feasible. These controls will also be supplemented with enhanced erosion controls. Trapped water will be treated in-situ or transferred to dewatering basins or sediment basins. Specifications and detailed controls are to be provided within progressive ESCPs.

DESIGN ASSUMPTIONS AND BACKGROUND INFORMATION

- IFD: 2year, 6hour storm intensity = 12.2mm/hr
- Volumetric runoff coefficient (CV) = 0.64 (assuming hydrologic group D runoff coefficient – low infiltration, high runoff)
- 5-day, 85th %ile rainfall depth = 37.2mm
- Runoff coffeficient (C_{10}) = 0.9
- A large proportion of the work area lies below the 100 yr ARI flood level and could become inundated during a flood event.
- Soil landscape mapping for the area has not been completed. Therefore, soil characteristics are based on nearby Cowper SL which shows similar topographical conditions to those of the project location (i.e. levees and back plains). A desktop review of Cowper SL indicates coarser, sandier soils are more likely in the levee areas surrounding the river with increased clay contents becoming more evident in locations further away from the river bank. This would have been the result of alluvium processes over time. Soils are considered to have a moderate risk of dispersion particularly in locations further away from the river. There is a chance that Acid Sulphate Soils could be encountered during piling or works in/near the river bank.

EROSION AND SEDIMENT CONTROL INSTRUCTIONS

Before commencement of clearing, grubbing, topsoil stripping and earthworks in each section/stage of works, the site is to be secured and the following erosion and sediment control measures installed in order except for Items 11 to 18 which are to be undertaken progressively as required throughout all stages of works. Works necessary to install the erosion and sediment controls are permitted but must be kept to an absolute minimium.

1. Progressive ESCPs are to be prepared for each section/stage of the works prior to commencing earth works.
2. Barrier flagging (or alternative measures) will be in place around the edge of the construction boundary to restrict access and in any additional locations as required to minimise unnecessary disturbance. Refer to the 'Access Control' notes.
3. Stabilised site entry/exit points (Standard Drawing SD 6-14) are to be installed anywhere where construction vehicles exit a works area onto a sealed public road. Refer to the 'Access Control' notes. Progressive ESCPs to show locations.
4. Ensure sediment fencing (or approved alternative) is in place downslope of work areas where detailed on the plans and following Standard Drawing SD 6-8 (Refer to the 'Sediment Fencing' notes below). Progressive ESCPs to show locations and details.
5. Offsite (clean) water diversions (where applicable) are to be installed including stabilisation/lining where applicable. Refer to plans. Progressive ESCPs to show detailed locations and requirements.
6. Minor sediment traps (e.g. bunds, sumps, rock filters dams, supplementary traps) are to be installed in the locations shown – refer to the 'Alternative Sediment Control' notes below and to the plan for locations. Progressive ESCPs to show detailed locations, sizing and construction details.
7. Major sediment control devices (e.g. sediment basins, decanting basins and alternative sediment controls) are to be installed – refer to the 'Sediment Basin' and 'Alternative Sediment Control' notes. Progressive ESCPs to show sizing and construction details.
8. Onsite (dirty) water diversions (where applicable) are to be installed including stabilisation/lining where applicable. Refer to progressive ESCPs for detailed locations and requirements.
9. Stockpile/laydown areas are to be established in locations as specified on the plans or as instructed by the site manager and in accordance with the 'Topsoil Stripping, Soil Management and Stockpiling' notes below.
10. Hold Point: Once all of the above measures are complete and stable, construction works can proceed in accordance with the engineering plans. Topsoil should be managed in accordance with the 'Topsoil Stripping, Soil Management and Stockpiling' notes.
11. Enhanced erosion controls are to be implemented progressively in accordance with the 'Enhanced Erosion Control' notes.
12. Slope lengths across disturbed lands are to be maintained at the required intervals during all rainfall events (Refer to the 'Slope Lengths' notes).
13. Dust suppression is to be carried out when required (Refer to the 'Dust Suppression' notes).
14. Temporary stabilisation of lands prior to rainfall is to be undertaken in accordance with the 'Stabilisation' notes and the 'Rainfall Preparation Procedure'.
15. Treatment of dirty water is to be carried out as necessary in accordance with the 'Dirty Water Treatment and Discharge Requirements' notes.
16. Monitoring, maintenance and inspections are to be carried out regularly as required, in accordance with the 'Site Inspection and Monitoring' notes.
17. Undertake progressive stabilisation of lands as final earthworks are complete in each area (rather than waiting until the completion of works).
18. Final stabilisation is to be completed in accordance with the 'Stabilisation' notes and Table 1.

The above are general instructions only. Refer to progressive erosion and sediment control plans for details of each area/section. Refer to ESCP003-008 for typical details, photo examples and standard drawings. Typical controls for various typical work scenarios are also outlined on ESCP103.

ACCESS CONTROL

- Install barrier fences or suitable administrative controls to define the project works and clearing limits.
- Barrier fencing for erosion and sediment control purposes can simply be made from tape or flagging wound around star pickets or stakes. Alternatively, sediment fence, site security/safety fence or chain wire fences can be used for this purpose if so desired. Existing fences and/or site flagging can also be used where they are present in the relevant locations.
- Stabilised site access points (SD 6-14) are to be provided in all locations where construction vehicles enter and exit the works onto a public roadway. Note that locations have not been shown on these plans. All locations are to be shown on updated progressive ESCPs as works proceed.
- Barrier and sediment fencing are to be used to ensure that all vehicles leaving the site pass over a stable access point to minimise bogginess in these areas and minimise sediment tracking onto public roads.
- Barrier fencing is to be used to delineate all 'no go' areas.
- Barrier fencing is to be used at the discretion of the site manager to delineate other 'no go' areas.
- The soil erosion hazard on the site will be kept as low as practicable by minimising land disturbance and staging works.

TOPSOIL STRIPPING, SOIL MANAGEMENT AND STOCKPILING

- Soils are to be stripped and managed in accordance with the following:
  - As much as possible topsoils are to be stripped when moist (not wet or dry).
  - Topsoils are to be stripped (to a depth of approximately 100mm) separately from the underlying subsoils. Topsoil depths may vary across the project site and care should be taken to avoid stripping underlying soil horizons (subsoils) with the topsoil layer.
- Stockpile areas are to be established within the locations specified on the plans. If additional or alternative locations for stockpiling are required then they are to be subject to approval prior to establishment. All stockpiles should incorporate clearly defined access controls and comply with the regulations outlined below. Progressive ESCPs are to detail the required erosion and sediment controls for each stockpile area.
- All stockpiles are to be constructed and maintained generally in accordance with Standard Drawing SD 4-1 and the following regulations:
  - All stockpiles must have sediment fencing or equivalent installed downslope as per Standard Drawing SD 4-1.
  - Stockpiles are to be stabilised to achieve a C-factor of 0.1 (i.e – equivalent to 60% grass cover) within 10 days of formation using a temporary soil stabiliser (e.g. Vital P47/stonewall), geotextile, jute matting or equivalent. Also refer to Table 1.
  - Stockpiles must be located at least 5m away from a concentrated flow area (i.e. drainage line, creek).
  - Where possible position stockpiles at least 40m away of a waterway (river/drainage reserve/creek). If stockpiles are located within these areas they must be stabilised/covered as above but within 5 days of formation rather than 10 days. They must also be stabilised/covered prior to rainfall and potential flow events and prior to any site shut down greater than 2 days.
  - Stockpiles are not to be located within the lower-lying flood prone lands.
  - Mulched vegetation, topsoil and subsoil (if applicable) are to be stockpiled separately wherever possible.
  - Topsoil stockpiles should be constructed to no more than 2 meters in height wherever possible.
  - Stockpiles should be battered down at a maximum slope of 2:1 wherever possible.
- Acid sulphate soils are to be handled and managed in accordance with the Acid Sulphate Soil Management Plan.

STABILISATION

- Undertake progressive stabilisation of disturbed ground surfaces as they are completed rather than at the end of the works program (Refer to Table 1).
- Final stabilisation is to achieve the C-factors (ground cover) detailed in Table 1.
- Final rehabilitation is to be in accordance with the landscaping/rehabilitation plans.
- Areas to be revegetated are to be topsoiled first using the topsoil stripped during the initial stages of works or using approved imported topsoil. Refer to Standard Drawing (SD 4-2) for instructions regarding topsoil replacement.
- Appropriate seedbed preparation should be carried out when revegetating lands (See Standard Drawing (SD 7-1)).
- Wherever possible, re-use cleared/mulched vegetation for either temporary or permanent stabilisation of disturbed areas. If mulch is not available or appropriate then the use of jute mesh, erosion control mattting (ECM), soil stabilisers (e.g. Vital P47/Stonewall) hydomulching or an appropriate approved alternative should be considered for provision of ground cover until vegetation has established.
- Temporary diversion drains are to be stabilised to achieve the C-factors as detailed in Table 1, using jute matting, geotextile fabric, rock or TRM etc. Refer to the plan for details. Also refer to Standard Drawings (SD 5-6 and SD 5-7).
- Refer to engineering plans for permanent drain sizing/lining details.
- Refer to the Stockpiling notes for stabilisation requirements on stockpiles. Also refer to Table 1 and Standard Drawing (SD 4-1).
- As surfaces are stabilised (at least 90% of any finished area has at least 70% ground cover) and permanent drainage measures are installed, temporary erosion and sediment control structures and water management structures can be removed (e.g. sediment fence and diversion drains).
- Temporary stabilisation on high risk areas will be undertaken prior to rainfall in accordance with the 'Rainfall Preparation Procedure' notes.
- All work areas within 40m of the river bank will be constructed from clean rock and will have controls that can be inundated.
- Highly trafficked areas (i.e. site access/haul roads, site compounds) will be stabilised where feasible with suitable trafficable materials such as DGB, roadbase, gravel or dustex to minimise erosion and provide stability to vehicle movements.

(GENERAL REQUIREMENTS ARE CONTINUED ON THE FOLLOWING PAGE)

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A

FINAL

North

CLIENT: Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 – SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY ESCP OVER-ARCHING REQUIREMENTS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP001	00

Plot Date: Tuesday, 6 September 2016 10:47:57 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg

GENERAL REQUIREMENTS CONTINUED

ENHANCED EROSION CONTROL MEASURES

The following high erosion hazard areas have been identified across the project:

- Bridge abutments;
- works within 40m of the river banks;
- Bridge piling works; and
- Fill batters

The following enhanced erosion control measures will be employed for high erosion hazard areas across the project (specific locations to be shown on progressive ESCPs):

- All exposed soils within high erosion hazard areas will be 'locked down' as much as is feasible and practical prior to rainfall and at site shut down. This will be achieved using temporary ground covers such as biodegradable matting, geotextile matting, hydromulch, soil binders (e.g. Vital P47/stonewall) or similar. Also refer to the 'Rainfall Preparation Procedure' for additional details.
  - High erosion hazards areas will be staged as much as possible to minimise the total amount of exposure.All work areas within 40m of the river bank will be constructed from clean rock and will have controls that can be inundated.
  - A flood management plan will be developed prior to construction works.
  - Contour berms will be installed at regular intervals across large exposed areas prior to rainfall to break up slopes, slow flow velocities and minimise erosion. Refer to the 'Slope Lengths, Check Dams and Batter Chutes' notes for details.
  - Highly trafficked areas (i.e. piling platforms, site access/haul roads, site compounds) will be stabilised with suitable trafficable materials such as DGB, roadbase, gravel, rock, aggregate or dustex to minimise erosion and provide stability to vehicle movements.
  - Stabilisation will occur progressively to reduce the total amount of exposed surfaces.
  - Check dams will be installed in concentrated flow paths to slow flow velocities and minimise scour. Refer to plans for locations and to the 'Slope Lengths, Check Dams and Batter Chutes' notes for details.
  - Batter chutes will be installed on batters (where necessary) to control flows and minimise erosion. Refer to progressive ESCPs for locations and to the 'Slope Lengths, Check Dams and Batter Chutes' notes for details.
  - Also refer to the typical control measures for various typical works scenarios outlined on ESCP103.

SEDIMENT BASINS (STANDARD BLUE BOOK DESIGNED BASINS)

- Locations of major sediment control devices are shown on the plan. Progressive ESCPs are to detail the type, size and construction specifications of these major sediment controls including sediment basins.
- Sediment basins will be sized for the maximum area of disturbance (the worst case scenario) considering all stages of construction.
- Sediment basin/s are to be built to incorporate a primary outlet (weir overflow/spillway) sized to have a capacity to pass the 100 year peak flow - Refer to progressive ESCP for details.
- An energy dissipater of equivalent width and lining to the spillway is to be constructed at each spillway outlet. Dissipater is to extend to a watercourse or onto stable, vegetated lands to ensure sheet flow.
- It is recommended that gypsum is to be shallow ripped into the basin internal walls, spillway base and walls and dissipater ground surface during construction at a rate of 5t/ha.
- Safety controls are to be implemented around the sediment basins as required.
- Discharges from sediment basins are only to be carried out following approval from the Environmental Advisor/Manager issued via a Water Discharge Authorisation Form.
- Any release of water from the sediment basins will need to be tested to comply with the water quality requirements prior to being discharged from site (Refer to the 'Dirty Water Treatment and Discharge Requirements' below for further details).
- If water within the sediment basin/s is going to be used within the construction site for construciton or dust-suppression purposes and will drain back into the sediment capture system it will not require flocculation. However, basin capacities must be restored within 5-days following rainfall.
- Note that, if it is pumped into a tanker truck for later use, it cannot be discharged offsite without first being tested and if required, treated.
- The sediment basins must be effectively flocculated (if required), settled, tested to comply with the discharge requirements and discharged within 5-days or less following a rainfall event.
- It is recommended that sediment basin inlets are preloaded with gypsum (spread out over the inlet flow surface area) prior to rainfall. This will help to treat (flocculate) site water.
- An automatic flocculation system at the sediment basin/s inlet may be necessary if water treatment is not being successfully achieved via manual methods (monitor regularly).
- A sediment marker is to be installed within sediment basins indicating the sediment volume level.
- Sediment basins are to be desilted prior to reaching the indicated sediment volume levels.
- A site "Basin Management Plan" should be implemented to ensure appropriate sediment basin management.

ALTERNATIVE SEDIMENT CONTROLS

- Locations of major sediment control devices are shown on the plan. Progressive ESCPs are to detail the type, size and construction specifications of all alternative sediment controls including decanting sediment basins, rock filter dams, filtration swales and supplementary basins/sumps etc.
- Minor sediment controls (e.g. sediment traps/bunds/sumps) are to be formed in the locations shown on this plan and additional locations as specified within progressive ESCPs. Progressive ESCPs are to detail the type, size and construction specifications of all sediment controls.
- Decanting sediment basins, rock filter dams, filtration swales will be designed to collect runoff and promote active settlement of sediments as onsite water is flowing into the structure. Treated water will then filter through the structures outlet system and be released back into the downstream environment. These systems will use pre-treatment within inlet fore bays (or similar) and appropriately designed outlet filters to control release waters.
- Decanting sediment basins are to be designed and managed in accordance with the draft IECA guidelines for Type A sediment basins.
- Rock filter dams are to be designed in accordance with IECA SD RFD-01&02.
- Filtration swales (where suitable) will utilise the permanent swale drainage to promote natural infiltration.
- Dirty water trapped onsite within boxed out road and culvert works can be treated in-situ, pumped into a sediment basin for treatment (ensuring the basin have sufficient capacity considering future rainfall) or alternatively an onsite containment structure or treatment unit (e.g. sump/pond/tank/Enviss unit) can be established to treat dirty construction water.
- Water trapped within sediment traps, contained within excavations or just ponding within the works must not be actively discharged from the site (by a direct action such as pumping or cutting drains) unless it complies with the water quality limits - Refer to the 'Dirty water treatment and discharge requirements' notes below.
- If trapped water is going to be used within the construction site for construction or dust-suppression purposes and will drain back into the sediment capture system it will not require flocculation beforehand.
- As works proceed additional traps or bunds may need to be provided throughout the works, within boxed out road or culvert sections. Details are to be provided on progressive ESCPs.

DIRTY WATER TREATMENT AND DISCHARGE REQUIREMENTS

- Any active discharge of water from the project (i.e. where water is moved offsite via direct action such as pumping rather than flowing off the project as a result of heavy rainfall) is to achieve:
  - 50mg/L or less TSS (Total Suspended Sediment) or equivalent NTU based on RMS approved correlation; and
  - pH 6.5 to 8.5; and
  - <10mg/L oil and grease and no visible trace.
- Flocculation can be achieved by using gypsum at a rate of approximately 30 kg/100 m3 of stormwater. Alternative flocculating agents can only be used if approval by RMS has been granted. Refer to manufacturers guidelines for dosage details.
- Ensure the flocculant/coagulant is thoroughly mixed/diluted with water (e.g. within and IBC) prior to spreading evenly over the entire pond surface for proper treatment of water. Dirty water from the basins can be used for mixing the flocculant/coagulant.
- These de-watering requirements apply to dirty water accumulating in any sort of excavation, sump, or other ponded water body on the project.
- If the water is going to be used within the construction site for dust-suppression or construction purposes and will drain back into the sediment capture system it does not require treatment.

SEDIMENT FENCING

- Install sediment fences (or alternative approved controls) in the locations shown.
- Install all sediment fencing in accordance with Standard Drawing SD 6-8.
- Sediment fences must be firmly trenched into the ground for their entire length.
- Sediment fences must include small 'returns' at maximum 20m intervals (see Standard Drawing 6-8) to minimise the risk of water flowing along them.

DUST SUPPRESSION

- Dust suppression should be carried out whenever necessary to minimise sediments becoming air borne due to wind erosion.
- An appropriate water source for dust suppression and/or dust suppressant management system (e.g. Vital HR/Stonewall, dustex, dustguard or equivalent) must be identified and approved by RMS prior to starting construction works.
- Temporary stabilisers (e.g. Vital Bon-Matt P47), geotextile, jute matting or equivalent can be used in non-trafficked areas to assist with dust control.
- Wherever possible access track running surfaces to be stabilised with crushed rock, aggregate, roadbase, a trafficable soil stabiliser (e.g. Vital HR) or equivalent to assist with dust control on these surfaces.

SLOPE LENGTHS

- Slope lengths are to be restricted to 80m intervals across all exposed surfaces prior to and during rainfall.
- Diversion bunds/drains, low flow earth banks (Standard Drawing SD 5-5) or sandbags/equivalent should be installed prior to rainfall event to achieve this where required. However, slope lengths are often naturally minimised due to the crossfall nature of construction and in this case additional slope breaks will not be necessary.
- Batter chutes are to be provided at regular intervals down batters - Locations and details to be provided within progressive ESCPs.
- Check dams are to be installed within drainage areas and behind in the locations specified on the plans. Refer to Standard Drawing SD 5-4 for check dam installation details.

RAINFALL PREPARATION PROCEDURE

- The weather forecast is to be monitored regularly (at least daily and hourly when rainfall is imminent) by the site environmental manager (or their representative).
- Prior to forecast rainfall (> 60% chance of 5mm or more over 24 hours), the following will occur:
  - The site environment manager (or their representative) is to inspect (and record the condition of, and any action required) the condition of all erosion and sediment controls;
  - Slope breaks will be pushed up or cut in across large, exposed areas to slow down flows and minimise erosion. Also refer to the 'Slope Lengths' notes;
  - If pipes are not in place to take clean water flows temporary diversions are to be installed and/or all exposed soils within these areas are to be stabilised with geotextile, black plastic or equivalent.
  - All exposed soils within 40m from the top bank of the river (both sides) are to be stabilised with temporary ground covers (i.e. Rock, Vital Stonewall, geotextile or black plastic or equivalent).
  - Batter chutes and check dams are to be installed (if not already in place). Progressive ESCPs to detail batter chute locations. Also refer to the 'Batter Chute and Check Dams' notes.
  - Additional bunds and sumps/traps are to be installed for general works areas that don't drain to the sediment basin.
- Prior to forecast rainfall (> 60% chance of 30mm or more over 24 hours), the following will occur in addition to the above:
  - All exposed batters not draining to a full size sediment basin or equivalent sediment control are to be stabilised with temporary ground covers (i.e. Vital P47/stonewall, geotextile or black plastic or equivalent).

SITE INSPECTION, MONITORING AND MAINTENANCE

- Regular site inspections are to be conducted by the site environment manager (or their representative) and records of all such inspections are to be made available for review. Inspections are to be undertaken:
  - At least weekly during normal construction hours; and
  - Prior to forecast rainfall (see above); and
  - Within 24 hours of the cessation of a rain event that causes runoff (if safe to do so).
- Additional erosion and sediment controls will be installed as necessary to ensure satisfactory outcomes in keeping with the project conditions and best-practice Blue Book guidelines.
- Progressive ESCPs will be reviewed when construction works change and will be updated and/or prepared as required.
- Sediment or rocks tracked from the site will be removed from public roads as soon as possible (e.g. with street sweepers).
- After rainfall, sediment accumulated in trapping devices (e.g. filter dams, sediment fence) will be removed to a secure location where it can't wash or blow offsite (preferably to an active stockpile).
- Weather conditions will be monitored onsite and daily rainfall will be recorded.
- Safe storage areas for wastes, fuels, excess concrete and other potential contaminants are to be delineated by the site manager in accordance with the project requirements and based on RMS approval.
- Adequate supplies of erosion control measures (e.g. geofabric rolls, jute matting, polymer soil binders) are to be maintained in the site compound for rapid deployment as required.
- Adequate supplies of flocculant (and flocculating equipment) are to be available as required.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A
FINAL	

North

CLIENT: Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 - SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY ESCP OVER-ARCHING REQUIREMENTS CONTINUED

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP002	00

Plot Date: Tuesday, 6 September 2016 10:48:02 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg

TABLE 1 – STABILISATION REQUIREMENTS AND TREATMENT METHODS

DURING CONSTRUCTION – TEMPORARY STABILISATION
(During periods of inactivity when works are on hold)

LANDS	STABILISATION REQUIREMENT	TIMEFRAMES	TREATMENT METHODS – PRODUCTS	REMARKS
High Risk Areas: – Batters, steep slopes (> 30%), works in and/around waterways, surfaces around culvert headwalls	C-factor = 0.1 (60% grass cover or equivalent ground cover [1])	Applies prior to rainfall and after 10 working days of inactivity (even though works might continue later)	Soil binder (i.e. Vital P47/stonewall or equivalent [1])	– Stabilise all exposed soils by spraying surfaces with Vital P47/stonewall or equivalent [1]. – Vital dilution rate = 1:10 (Vital:Water). – Application rate = 1L / m^2 of diluted Vital mixture. – Re-apply/maintain as necessary to ensure the required cover is provided.
			Geotextile, jute matting, black plastic or equivalent [1]	– Cover all exposed soils. – Re-apply/maintain as necessary to ensure the required cover is provided.
All lands (including waterways and stockpiles)	C-factor = 0.15 (50% grass cover or equivalent ground cover [1])	Applies after 20 working days of inactivity (even though works might continue later)	Soil binder (i.e. Vital P47/stonewall or equivalent [1])	– Spray all stockpile surfaces with Vital P47/stonewall or equivalent [1]. – Vital dilution rate = 1:10 (Vital:Water). – Application rate = 1L / m^2 of diluted Vital mixture. – Re-apply/maintain as necessary (approx. every 3–6 months without suitable vegetation cover) to ensure the required cover is provided.
			Geotextile, jute matting, black plastic or equivalent [1]	– Cover all exposed soils. – Re-apply/maintain as necessary to ensure the required cover is provided.

TYPICAL EROSION AND SEDIMENT CONTROLS FOR VARIOUS WORK SCENARIOS

The following high erosion hazard areas have been identified:

- Bridge abutments
- Works within 40m of the river banks
- Bridge piling works
- Fill batters

Enhanced erosion controls will be employed throughout these areas (e.g. staging works, minimising disturbance, stabilising surfaces where practicable, temporary stabilisaiton/lockdown of exposed working areas prior to rainfall using soil polymers and increased inspection and monitoring).

In addition to the standard suite of erosion and sediment controls for typical road construction projects, the following esc measures are proposed for the following typical work scenarios:

1. Works online with existing roadway
   - Runoff will be directed into swale basins, sediment traps or other small sediment control devices.
   - Excavations/boxed out sections will be broken into cells prior to rainfall. this will allow ponded water to be managed more easily and will decrease delays following rainfall. see detail c.
   - Offline dewatering basins (storage devices) for dewatering and treatment of dirty water will be used as necessary.
   - Surfaces will be temporarily stabilised prior to significant rainfall and where works are on hold.
   - The existing drainage system will be utilised in addition to temporary pipes for management of upslope clean water flows and for drainage of onsite water.
   - Upslope clean water pavement flows will be diverted around the works utilising bunds, pipes or similar devices. see detail b.
   - Alternative temporary sediment control devices (e.g. rock filters, coir logs) will be used where longer term measure are not practical.

2. Bridge piling works and works within 40m of the river bank
   - Barges or temporary work platforms will be used to gain access to the river for piling.
   - EWMSs will be developed for the use of temporary work platforms within or adjacent to the river.
   - Dirty water generating during piling activities will be pumped back to land and treated as required. where possible water will be recycled by using within other construction activities (note – this depends of the ph of the water).
   - Displaced material generated during piling will ideally be maintained in the river in its original location and kept wet to ensure oxidation doesn't OCCUR.
   - All machinery, equipment and vehicles working above the waterway or within the flood zone will be clean and free of contaminants and sediments. wheel washes and wash down devices will be provided for this purpose as required.
   - Hydraulic hoses will be check for fraying or leaks.
   - Disturbance of any kind within 40m of the river banks will be minimised as much as possible.
   - All work areas within 40m of the river bank will be constructed from clean rock and will have controls that can be inundated.
   - A flood management plan will be developed prior to construction works.

3. Bridge approaches and other fill works
   - Runoff will be directed into sediment basins, decanting basins, swale basins or small sediment control devices.
   - As much as possible filtration bunds, check dams, filtration swale basins and/or decanting sediment basins will be used to promote infiltration back into the ground.
   - The permanent swale drains will be used as much as possible as sediment control devices during construction.
   - Progressive stabilisation will be promoted throughout construction.
   - Temporary stabilisation using polymers or biodegradable matting will be applied where permanent stabilisation is delayed, works are on hold or on high risk areas prior to significatn rainfall.
   - Fill batters will be managed during rainfall with windrows and batter chutes. see photo 4 example.

4. New works section (minimal cut/fill)
   - Where possible sediment basins will be installed for the management of these work areas.
   - If sediment basins are not possible (due to space or topographical constraints) measures such as those identified within items 1 and 3 above will be employed.

TABLE 1 – STABILISATION REQUIREMENTS AND TREATMENT METHODS CONTINUED

POST CONSTRUCTION

LANDS	STABILISATION REQUIREMENT	TIMEFRAMES	TREATMENT METHODS – PRODUCTS	REMARKS
Waterways, drainage lines and concentrated flow areas	C-factor = 0.05 (70% grass cover or equivalent ground cover [1])	Applies after 10 working days from completion of formation and before they are allowed to carry concentrated flows	Refer to the drain specifications detailed on the plan for specific lining/stabilisation requirements. Example treatment methods are shown below.	
			Temporary lining – Geotextile (i.e. Bidim A24 or equivalent [1])	– Complete any subsoil treatment before laying the matting. – Install matting in accordance with SD 5-7. – Re-apply/maintain as necessary to ensure the required cover is provided.
			Jute mesh, seeding and soil binder (i.e. Vital P47/stonewall or equivalent [1]) – Low flows to moderate	– Complete subsoil treatment (i.e. gypsum lightly ripped into surgrade at a rate of 5tonnes/ha). – Place topsoil to a depth of at least 75mm. – Complete any fertilisation and seeding before laying the matting. – Install matting in accordance with SD 5-7. – Spray all surfaces with Vital P47/stonewall or equivalent [1]. – Vital dilution rate = 1:10 (Vital:Water). – Application rate = 1L / m^2 of diluted Vital mixture. – Re-apply/maintain as necessary to ensure the required cover is permanently maintained.
			Jute matting (~350gsm) and seeding or equivalent [1] – Low to moderate flows	– Complete subsoil treatment (i.e. gypsum lightly ripped into surgrade at a rate of 5tonnes/ha). – Place topsoil to a depth of at least 75mm. – Complete any fertilisation and seeding before laying the matting. – Install matting in accordance with SD 5-7. – Re-apply/maintain as necessary to ensure the required cover is permanently maintained.
			Turf reinforcement matting (TRM) (e.g. TerraMat or equivalent [1]) – Moderate flows	– Complete subsoil treatment (i.e. gypsum lightly ripped into surgrade at a rate of 5tonnes/ha). – Place topsoil to a depth of at least 75mm. – Complete any fertilisation and seeding before laying the matting. – Install matting in accordance with SD 5-7. – Re-apply/maintain as necessary to ensure the required cover is permanently maintained.
			Rock lining – High flows	– Complete subsoil treatment (i.e. gypsum lightly ripped into surgrade at a rate of 5tonnes/ha). – Install geotextile underlay (if specified) in accordance with SD 5-7. – Install rock armouring (to the depth and size as specified on the plan). – Re-apply/maintain as necessary to ensure the required cover is provided.
Stockpiles	C-factor = 0.10 (60% grass cover or equivalent ground cover [1])	Applies after 10 working days from completion of formation	Seeding and soil binder (i.e. Vital P47/stonewall or equivalent [1])	– Apply seed to all stockpile surfaces (Note: seeding may not be required if existing seedbed is present). – Spray all stockpile surfaces with Vital P47/stonewall or equivalent [1]. – Vital dilution rate = 1:10 (Vital:Water). – Application rate = 1L / m^2 of diluted Vital mixture. – Re-apply/maintain as necessary to ensure the required cover is permanently maintained.
			Geotextile, jute matting, black plastic or equivalent [1]	– Cover all exposed soils. – Re-apply/maintain as necessary to ensure the required cover is provided.
General Surfaces	C-factor = 0.10 / 0.05 (60% / 70% grass cover or equivalent ground cover [1])	C-factor = 0.1 applies after 10 working days from completion of formation and C-factor = 0.05 applies within a further 60 days	Topsoil, seeding and soil binder (i.e. Vital P47/stonewall or equivalent [1])	– Refer to SD 7-1. – Complete subsoil treatment (i.e. gypsum lightly ripped into surgrade at a rate of 5tonnes/ha). – Place gypsum treated topsoil to a depth of at least 75mm. – Apply any fertilisers required. – Apply seed to all surfaces (Note: seeding may not be required if existing seedbed is present). – Spray all surfaces with Vital P47/stonewall or equivalent [1]. – Vital dilution rate = 1:10 (Vital:Water). – Application rate = 1L / m^2 of diluted Vital mixture. – Re-apply/maintain as necessary to ensure the required cover is permanently maintained.
			Hydromulch or equivalent [1]	– Refer to SD 7-1. – Complete subsoil treatment (i.e. gypsum lightly ripped into surgrade at a rate of 5tonnes/ha). – Place topsoil to a depth of at least 75mm. – Apply hydromulch to soil surfaces. – Re-apply/maintain as necessary to ensure the required cover is permanently maintained.

[1] – Equivalent cover/product must achieve the equivalent C-factor with proven reasearch/documentation to verify this.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A
FINAL	

North

CLIENT: Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 – SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY ESCP TABLE 1 AND TYPICAL WORK SCENARIO DETAILS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP003	00

Plot Date: Tuesday, 6 September 2016 10:48:07 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg

DETAIL A

– TYPICAL ARRANGEMENT OF EROSION AND SEDIMENT CONTROLS DURING PRIMARY EARTHWORKS

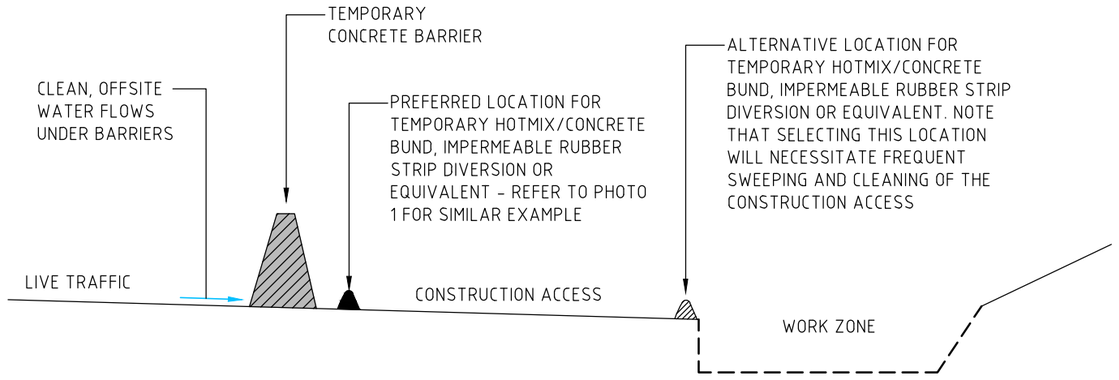


PHOTO 1

EXAMPLE OF A TEMPORARY BUND CREATED TO KEEP CLEAN OFFSITE WATER SEPARATE FROM DIRTY SITE WATER. IT ALSO MINIMISES THE INGRESS OF WATER INTO THE WORK AREA SO FACILITATES EFFICIENT CONSTRUCTION.

DETAIL B

– TYPICAL ARRANGEMENT OF EROSION AND SEDIMENT CONTROLS FOLLOWING INSTALLATION OF NEW STORMWATER INFRASTRUCTURE

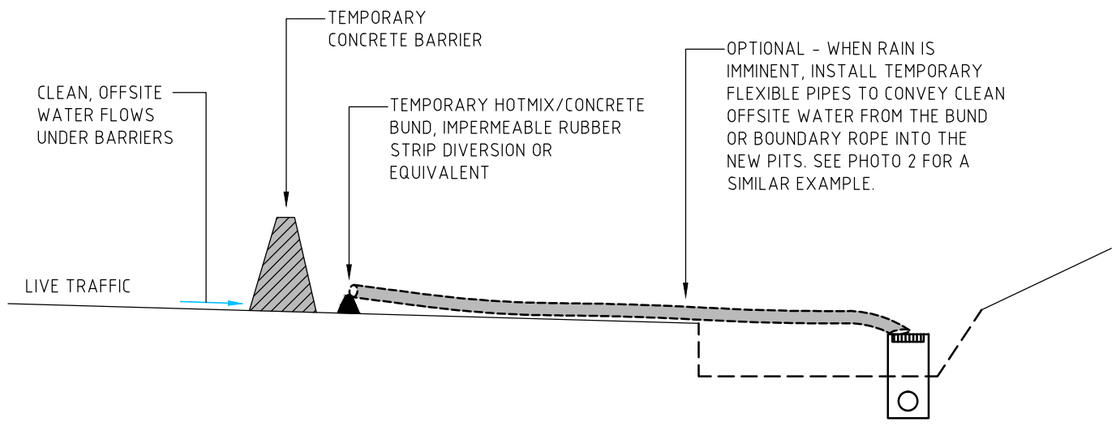


PHOTO 2

EXAMPLE OF A TEMPORARY PIPE TO CONVEY CLEAN OFFSITE WATER ACROSS WIDENING WORKS. THE PIPE IS ONLY INSTALLED WHEN RAIN IS IMMINENT AND IS ROLLED UP OUT OF THE WAY AT OTHER TIMES.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER–ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A
FINAL	

North

CLIENT

Fulton Hogan

SEEC

PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au

WWW.SEEC.COM.AU

PROJECT TITLE
MR83 – SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

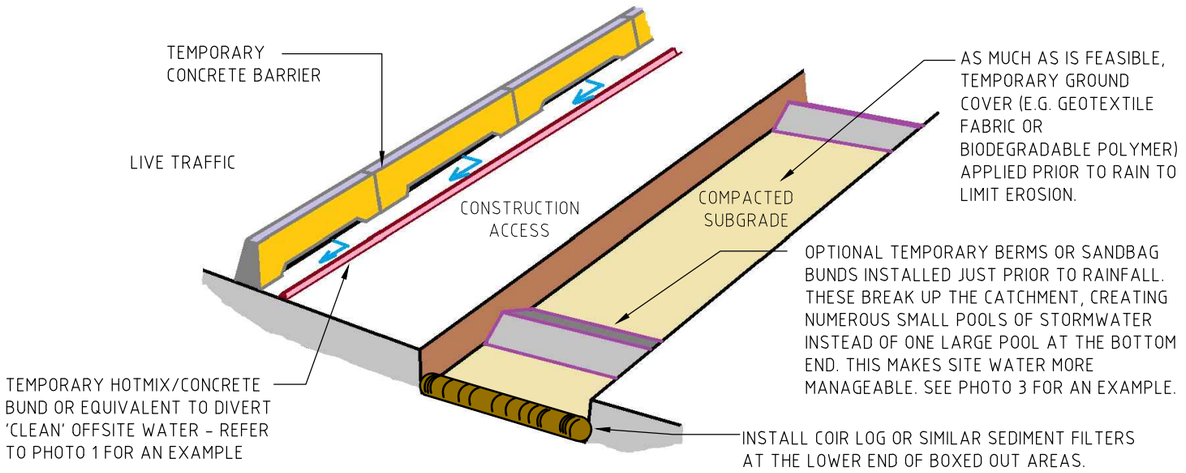
DRAWING TITLE
PRIMARY ESCP
PHOTO EXAMPLES
AND DETAILS

PROJECT NO.	SUB–PR NO.	DRAWING NO.	REV
15000333	P02	ESCP004	00

Plot Date: Tuesday, 6 September 2016 10:48:11 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg

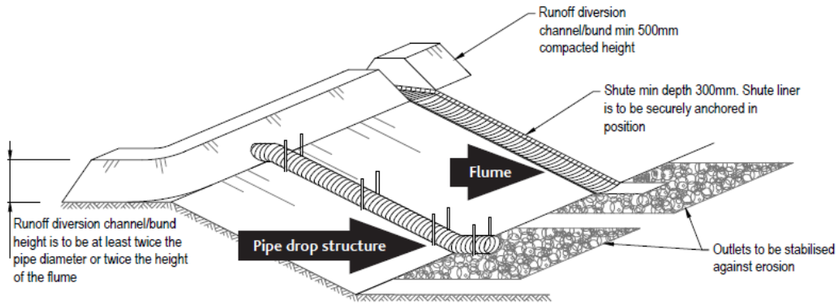
DETAIL C

– TYPICAL ARRANGEMENT OF EROSION AND SEDIMENT CONTROLS DURING WIDENING WORKS



DETAIL D

– TYPICAL DETAIL FOR THE CONSTRUCTION OF BATTER CHUTES – PIPED OR OPEN LINED CHANNELS



Detail D - Continued

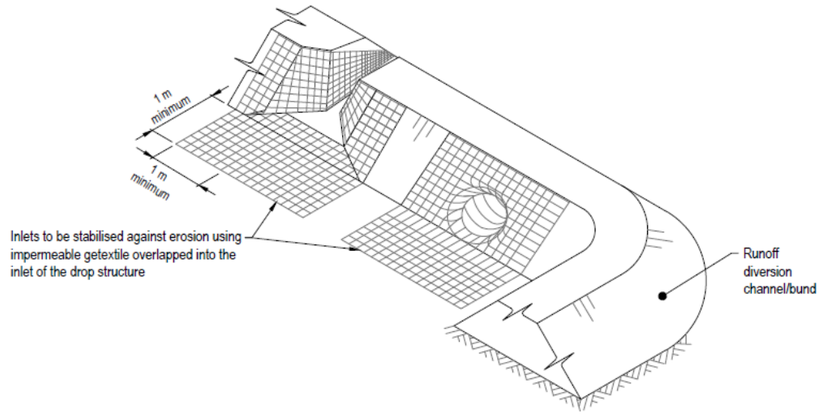


PHOTO EXAMPLE 4

WINDROWS AND BATTER CHUTES TO PROTECT BATTERS BY CONTROLLING DRAINAGE AND MINIMISING EROSION.

JCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A
FINAL	

North

CLIENT

Fulton Hogan

SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

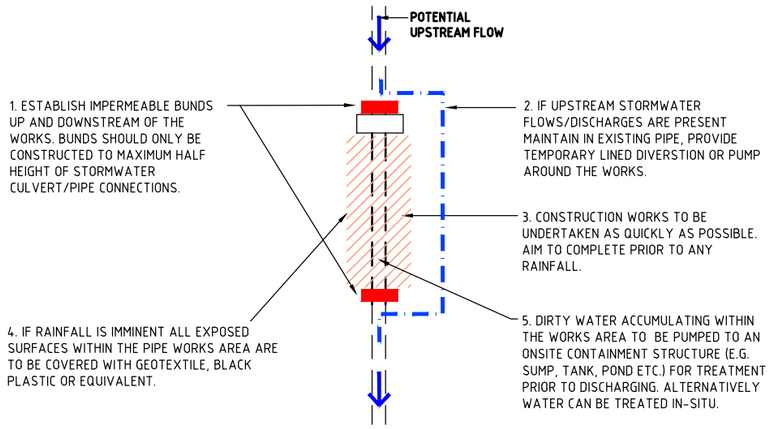
PROJECT TITLE
MR83 – SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

DRAWING TITLE
PRIMARY ESCP
PHOTO EXAMPLES
AND DETAILS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP005	00

Plot Date: Tuesday, 6 September 2016 10:48:16 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg

DETAIL E - CONCEPT WATER MANAGEMENT FOR STORMWATER PIPE INSTALLATIONS



EROSION AND SEDIMENT CONTROL REQUIREMENTS FOR CULVERT/PIPE WORKS

- THIS DETAIL ILLUSTRATES CONCEPT CONTROLS FOR STORMWATER PIPE INSTALLATION WORKS. PROGRESSIVE ESCPs ARE TO PROVIDE ADDITIONAL DETAIL (WHERE NECESSARY) FOR EACH SECTION OF WORKS.
- ALL WORKS ARE TO BE SCHEDULED FOR A PERIOD OF NO RAINFALL AND ARE TO BE COMPLETED AS QUICKLY AS POSSIBLE (INCLUDING PIT AND PIPE CONNECTIONS). AIM TO COMPLETE THE WORKS PRIOR TO FORECAST RAIN.
- WORKS MAY NEED TO BE STAGED TO AVOID OPENING UP LARGE SECTIONS WHICH CANNOT FEASIBLY BE MANAGED OR COMPLETED PRIOR TO UPCOMING RAINFALL.
- PRIOR TO UNDERTAKING ANY CONSTRUCTION OR EARTHWORKS ENSURE TEMPORARY GROUNDCOVER MATERIALS (E.G. GEOFABRIC OR BLACK PLASTIC) ARE TO BE LOCATED ON SITE FOR STABILISATION OF EXPOSED SURFACES.
- UPSTREAM STORMWATER DISCHARGES/FLOWS MAY BE LIKELY EVEN DURING PERIODS OF NO RAINFALL. THESE STORMWATER DISCHARGES/FLOWS ARE TO BE MAINTAINED WITHIN EXISTING PIPE SYSTEMS (WHERE PRESENT), DIVERTED VIA A LINED CHANNEL OR PUMPED AROUND THE WORK SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR DIRTY CONSTRUCTION WATER.
- IF RAINFALL IS IMMINENT ALL EXPOSED SURFACES WITHIN THE WORKS AREA ARE TO BE COVERED WITH GEOTEXTILE, BLACK PLASTIC OR EQUIVALENT.
- DIRTY (ON-SITE) WATER ACCUMULATING WITHIN THE WORKS AREA IS TO BE PUMPED TO AN ONSITE CONTAINMENT STRUCTURE (E.G. SUMP, TANK, POND ETC.) FOR TREATMENT OR TREATED IN-SITU PRIOR TO DISCHARGING.
- ALTERNATIVELY ONSITE WATER CAN BE USED FOR DUST SUPPRESSION ON THE ROADWORK AREAS OUTSIDE OF THE WATERWAY EXTENT (I.E. AREAS THAT DRAIN BACK INTO A SEDIMENT BASIN).

PHOTO EXAMPLE 5 - STABILISATION OF BATTERS

PHOTO EXAMPLE 6 - EXAMPLE OF ROCK FILTER DAM AND SUMP

PHOTO EXAMPLE 7 - SILT CURTAIN

PHOTO EXAMPLE 8 - ROCK PILING PLATFORM

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A
FINAL	

North

CLIENT

Fulton Hogan

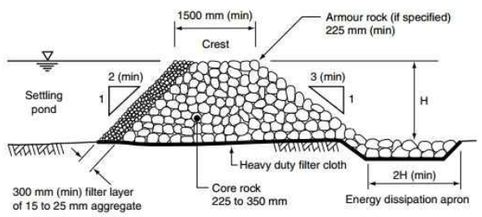
SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
MR83 - SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

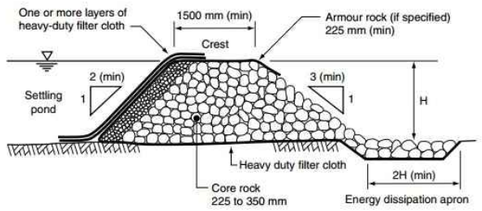
DRAWING TITLE
PRIMARY ESCP
PHOTO EXAMPLES
AND DETAILS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP006	00

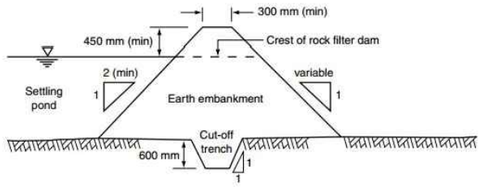
Plot Date: Tuesday, 6 September 2016 10:48:21 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg



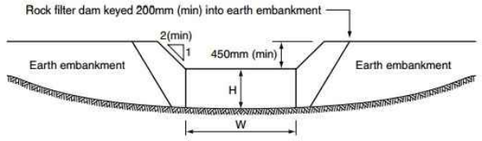
(a) Rock filter dam with aggregate filter



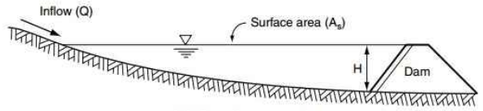
(b) Rock filter dam with geotextile and aggregate filter



(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

INSTALLATION

THE FOLLOWING A GENERAL INSTALLATION REQUIREMENTS. OPERATORS SHOULD OBTAIN INSTALLATION INSTRUCTIONS FROM THE GULLY BAG MANUFACTURER OR DISTRIBUTER.

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

2. ENSURE THAT THE INSTALLATION OF THE SEDIMENT TRAP WILL NOT CAUSE UNDESIRABLE SAFETY OR FLOODING ISSUES.

3. INSTALL SEDIMENT TRAP IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

4. ENSURE THAT NO SEDIMENT-LADEN INFLOW IS ALLOWED TO BYPASS THE GULLY BAG UNTIL THE BAG IS EITHER FULL OF SEDIMENT, OR THE INFLOW EXCEEDS THE HYDRAULIC CAPACITY OF THE BAG.

5. INSTALL APPROPRIATE SEDIMENT AND/OR FLOW CONTROLS ON THE SIDE-ENTRY SLOT (IF ANY).

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

MAINTENANCE

1. INSPECT ALL SEDIMENT TRAPS DAILY AND IMMEDIATELY AFTER RUNOFF-PRODUCING RAINFALL. MAKE REPAIRS AS NEEDED.

2. REMOVE AND REPLACE THE GULLY BAG WHEN IT IS EITHER FULL OF SEDIMENT, OR IS LIKELY TO BE FULL OF SEDIMENT BEFORE THE NEXT INSPECTION, OR THE HYDRAULIC CAPACITY OF THE FILTER BAG IS EXCESSIVELY REDUCED.

3. DISPOSE OF THE SEDIMENT AND FILTER BAG IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

4. ENSURE SEDIMENT DOES NOT ENTER THE STORMWATER DRAIN DURING DE-SILTING OPERATIONS AND MAINTENANCE OF THE TRAP.

5. SEDIMENT ON THE ROAD MUST BE REMOVED IMMEDIATELY IF IT REPRESENTS A SAFETY 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.

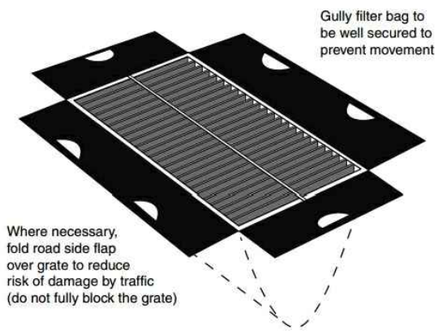


Figure 1 - Gully filter bag

Drawn:	Date:		
GMW	Dec-09	Gully Filter Bag	GB-01

STANDARD DRAWINGS RFD-01, RFD-02 AND GB-01 ARE COPYRIGHT CATCHMENTS AND CREEKS AND REPRODUCED FROM IECA (2008).

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A
FINAL	

North

CLIENT

Fulton Hogan

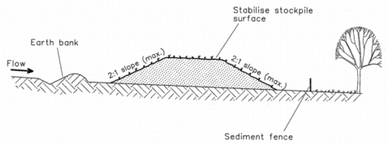
SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
MR83 – SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

DRAWING TITLE
PRIMARY ESCP
STANDARD DRAWINGS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP007	00

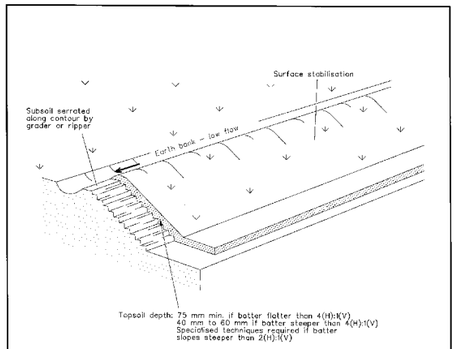
Plot Date: Tuesday, 6 September 2016 10:48:26 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg



Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

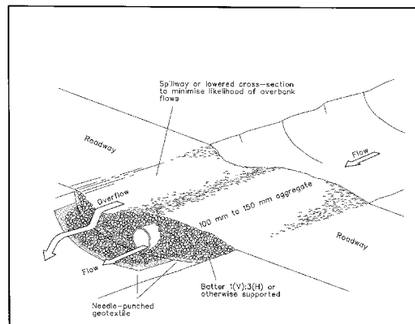
STOCKPILES **SD 4-1**



Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.
2. Add soil ameliorants as required by the ESCP or SWMP.
3. Rip to a depth of 300 mm if compacted layers occur.
4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

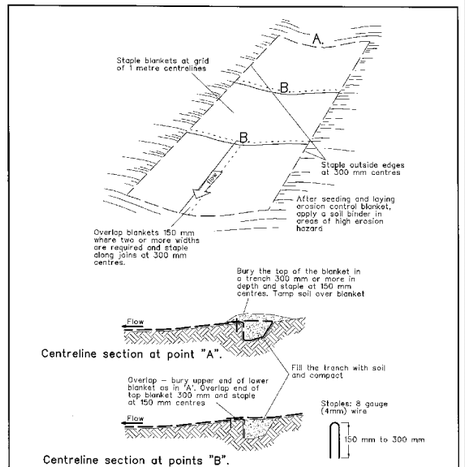
REPLACING TOPSOIL **SD 4-2**



Construction Notes

1. Prohibit all traffic until the access way is constructed.
2. Strip any topsoil and place a needle-punched textile over the base of the crossing.
3. Place clean, rigid, non polluting aggregate or gravel in the 100 mm to 150 mm size class over the fabric to a minimum depth of 200 mm.
4. Provide a 3-metre wide carriageway with sufficient length of culvert pipe to allow less than a 3(H): 1 (V) slope on side battens.
5. Install a lower section to act as an emergency spillway in greater than design storm events.
6. Ensure that culvert outlets extend beyond the toe of fill embankments.

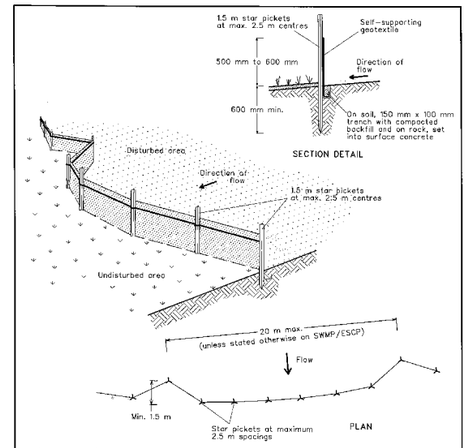
TEMPORARY WATERWAY CROSSING **SD 5-1**



Construction Notes

1. Remove any rocks, clods, sticks or grass from the surface before laying matting
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

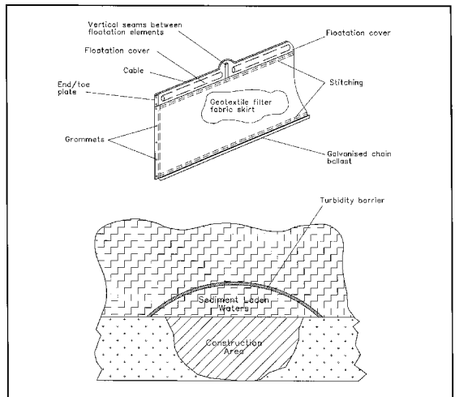
RECP : CONCENTRATED FLOW **SD 5-7**



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

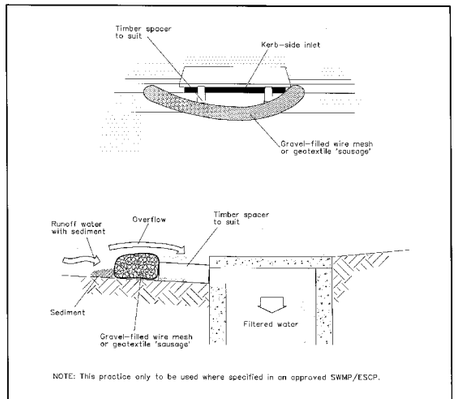
SEDIMENT FENCE **SD 6-8**



Construction Notes

1. Use turbidity barriers only where high flows are unlikely to remove accumulated sediment and/or move the curtain significantly.
2. Where the barrier is to remain in place for more than one month, ensure the floatation cover is a UV-resistant, durable material.
3. Use only closed cell foam or foam-filled PVC piping as floatation elements. Do not use unfilled pipes.
4. Use only woven or heat-set non woven geotextiles. Needle-punched, non woven geotextiles can become fouled with debris that fray and delaminate them as they move with the waves or currents.
5. Remove captured sediment before the barrier is decommissioned.
6. In tidal areas, ensure the barrier can rise and fall without being moved from its position.

TURBIDITY BARRIER **SD 6-10**

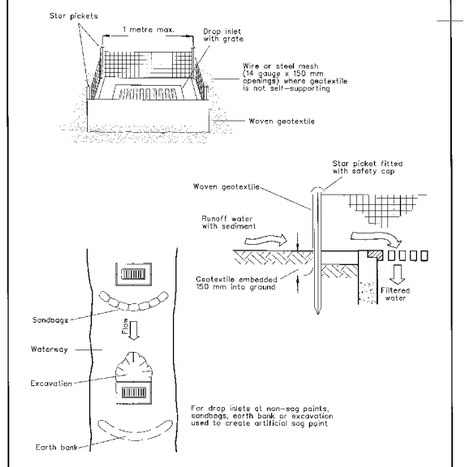


NOTE: This practice only to be used where specified in an approved SWMP/ESCP.

Construction Notes

1. Install filters to kerb inlets only at sag points.
2. Fabricate a sleeve made from geotextile or wire mesh longer than the length of the inlet pit and fill it with 25 mm to 50 mm gravel.
3. Form an elliptical cross-section about 150 mm high x 400 mm wide.
4. Place the filter at the opening leaving at least a 100-mm space between it and the kerb inlet. Maintain the opening with spacer blocks.
5. Form a seal with the kerb to prevent sediment bypassing the filter.
6. Sandbags filled with gravel can substitute for the mesh or geotextile providing they are placed so that they firmly abut each other and sediment-laden waters cannot pass between.

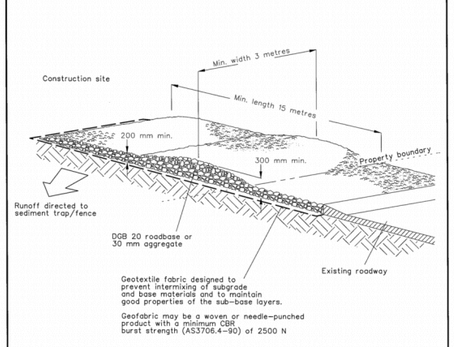
MESH AND GRAVEL INLET FILTER **SD 6-11**



Construction Notes

1. Fabricate a sediment barrier made from geotextile or straw bales.
2. Follow Standard Drawing 6-7 and Standard Drawing 6-8 for installation procedures for the straw bales or geofabric. Reduce the picket spacing to 1 metre centres.
3. In waterways, artificial sag points can be created with sandbags or earth banks as shown in the drawing.
4. Do not cover the inlet with geotextile unless the design is adequate to allow for all waters to bypass it.

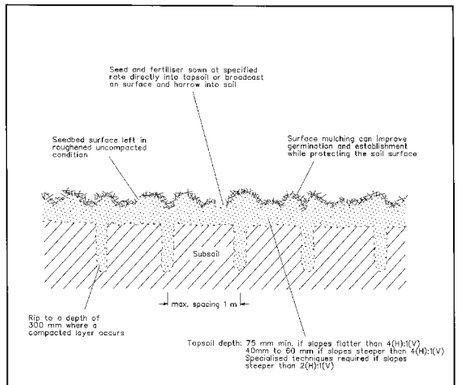
GEOTEXTILE INLET FILTER **SD 6-12**



Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS **SD 6-14**



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION **SD 7-1**

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		MODIFICATIONS FOR ACNCILLARY/STOCKPILING AREAS
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER–ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	N/A
FINAL	

North

CLIENT

Fulton Hogan

SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
MR83 – SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

DRAWING TITLE
PRIMARY ESCP
STANDARD DRAWINGS

PROJECT NO.	SUB–PR NO.	DRAWING NO.	REV
15000333	P02	ESCP008	00

Plot Date: Tuesday, 6 September 2016 10:48:31 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP000_REV 00.dwg

Grafton and South Grafton Flood Levee Works – General Erosion and Sediment Control Plan

Notes: This document details the controls that will be used during the construction of the Grafton Levee bank works commencing in late 2016. Minor works are required to both Grafton and South Grafton flood levee systems to maintain the existing level of flood protection. Existing levees will be raised to target elevations. Typically, lengths of levee will be raised by 50 mm to 200 mm. Approximately 2 km of levees in Grafton and 3.7 km in South Grafton will be adjusted. The project has reduced levee works from 11 km in the EIS to 5.7km in design development; hence the project has reduced impacts. 101 parcels of land are recommended for flood levee works.

The existing flood levee system comprises a number of levee types, including:

- earth fill embankment (this is the predominant levee type)
- concrete blockwork
- concrete blockwork on top of earth fill embankment
- brick walls
- reinforced concrete walls, and
- buildings forming sections of the levee.

The proposed flood levee works will match the existing type of flood levee and materials where possible. Existing earth fill embankment levees will generally remain earth levees when raised to target elevations. Only in exceptional circumstances will the levee type differ, such as a short section of earth levee in between two blockwork levees or when structural requirements dictate a different construction method.
Each of the typical construction scenarios has been risk assessed and a suite of controls is available and will be decided on during the preconstruction walk through involving the engineer, foreman and environmental representative. The pre-construction checklist will be used to record which controls are used in each block. A site specific ESCP will be developed for each site prior to commencing works.

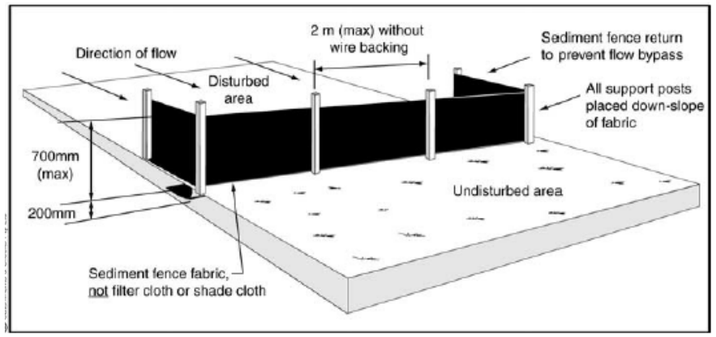
Groundcover the most important control during the increase to the levee bank works will be to limit the risk footprint, site specific erosion and sediment control plan/access plan will be developed for each site prior to breaking ground.

River side slope no works or access is permitted on the downslope side of the levee bank, all works are to be from the top side of the levee bank and away from the river.

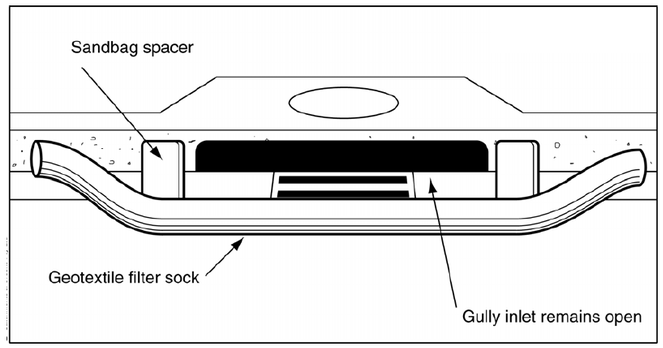
#	Sequence of Work Activities *How will the work be done?*	Potential Hazards *What harm can occur?*	Pre-Control Risk *Ext-High-Med-Low*	Mitigation measures *How can the risk be minimised?*	Post-Control Risk *Ext-High-Med-Low*	Responsibility *Who will ensure that controls are in place?*
Prior to works commencing						
1	Site access	Disturbance of ground and loss of sediment to receiving stormwater pits or open waterways	Medium 13	▪ Install pit controls where works are occurring close to drainage systems including kerbs and pits (or refer to typical details) ▪ In the event of wet weather conditions (forecast rainfall above 5mm) or continual use wearing down the ground use track mats or similar to stabilise surfaces and to reduce the potential impacts ▪ Plan the site access so the impacts are managed and that vehicle movements are minimised ▪ Rehabilitate the area immediately after construction is complete (rehabilitation will include – placed turf, landscaping, hydro-mulching and hand seeding. ▪ Define the access to avoid unnecessary disturbance using flagging or similar ▪ Stabilised access points onto public roads if works are going to damage the ground conditions or drag mud, it is unlikely in most cases that access point would be required due to the short duration of works ▪ If sediment is tracked onto public roads ensure it is cleaned promptly – use street sweepers or similar	Low 6	Engineer Foreman
2	Earth embankments	Works commencing before controls are in plan	Medium 13	▪ The project engineer and foreman will complete a site walk through and confirm which erosion and sediment controls are to be used prior to works starting – the chosen controls will be included on an updated erosion and sediment control plan including details, sizing and lining where applicable ▪ The pre-construction checklist will be used to confirm the controls are in place and which controls have been used ▪ Rehabilitate the area immediately after construction is complete for example lay turf in urban areas, use hydra mulch in agricultural areas	Low 6	Engineer Foreman
		Clean water drainage from roofs, ground, upstream catchments to the river	Medium 13	▪ Identify what the clean water flow pathways are upstream of the works prior to starting, install a clean water diversion or extension taking upstream waters around and away from the work area – pipe extensions, lined clean water drains (e.g. sandbag bunds or earth berms/drains lined with geofabric, black plastic or similar – site specific ESCPs to provide details) ▪ The pre-construction checklist will be used to confirm how clean water has been diverted around the works area ▪ Rehabilitate the area immediately after construction is complete for example lay turf in urban areas, use hydra mulch in agricultural areas	Medium 9	Engineer Foreman
		Sediments are not contained at the works area	Medium 13	▪ Install a control on the downstream side of works - the type of control used could be – refer to typical details - sediment fence - stable earth bund - sandbag barrier dam - coir log bunds - rock filter berms - mulch bunds (not near waterways)	Low 5	Engineer Foreman
3	Concrete block walls	Loss of cementitious materials offsite	Medium 8	▪ Remove all concrete waste from site at the end of the day and take to an appropriate waste storage facility ▪ Concrete waste areas will not be at private residencies	Low 6	Engineer Foreman
4	Stockpiles	Stockpiled materials are mobilised and lost to the receiving environment	Medium 13	▪ Stockpiles will in general not be kept for longer than the period of works at each block ▪ Sediment fence to be provided around the low side of stockpiles ▪ Cover stockpiles with fabric, hydra-mulch or soil stabilisation polymer if for any reason they need to stay for more than one week or prior to forecast rainfall above 5mm ▪ Rehabilitate the area immediately after construction is complete – refer to the rehabilitation item below ▪ Topsoil will be managed locally and reused to rehabilitee the area immediately after works are complete	Low 5	Engineer Foreman
5	Other structural features	Ground disturbance resulting in loss of sediment	Medium 8	▪ Install a control such as sediment fence, containment bund or mulch berm, to be chosen by the engineer/environmental rep during the detailed site assessment prior to construction. A progressive plan is to be prepared prior to works ▪ Rehabilitate the area immediately after construction is complete	Low 5	Engineer Foreman
6	Rehabilitation and temporary stabilisation	Untimely rehabilitation of areas causes loss of sediments	Medium 13	▪ Prioritise the rehabilitation of works immediately after completion ▪ Works will be completed in small packages - large areas of disturbance will not be created ▪ Stabilisation of the ground required for construction will be done using a suite of techniques including but not limited to: turf replacement, landscape gardening, hand seeding and organic fibre mesh placement and hydra mulching,		

Typical details of erosion and sediment controls to be used

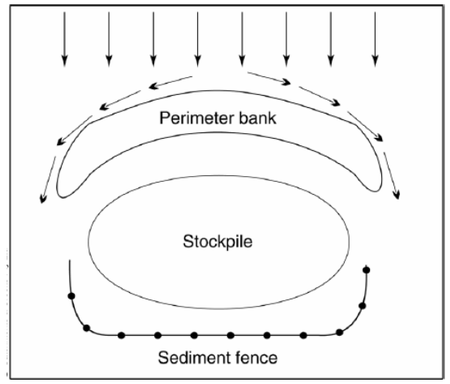
Sediment fence

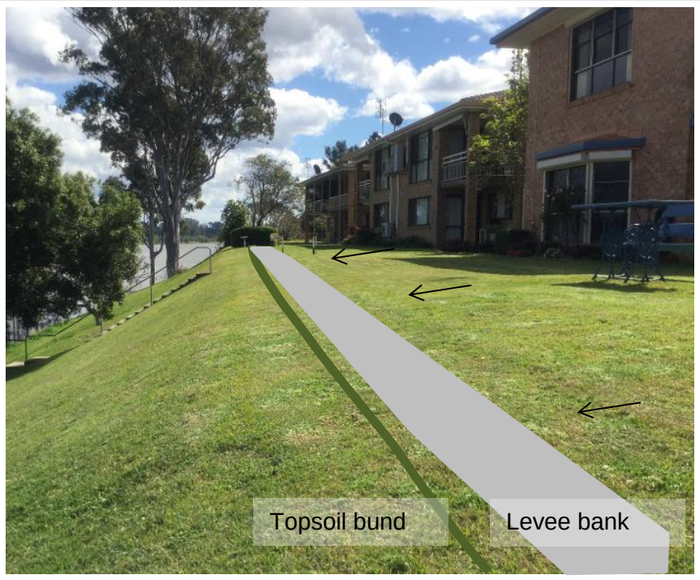


Stormwater pit controls



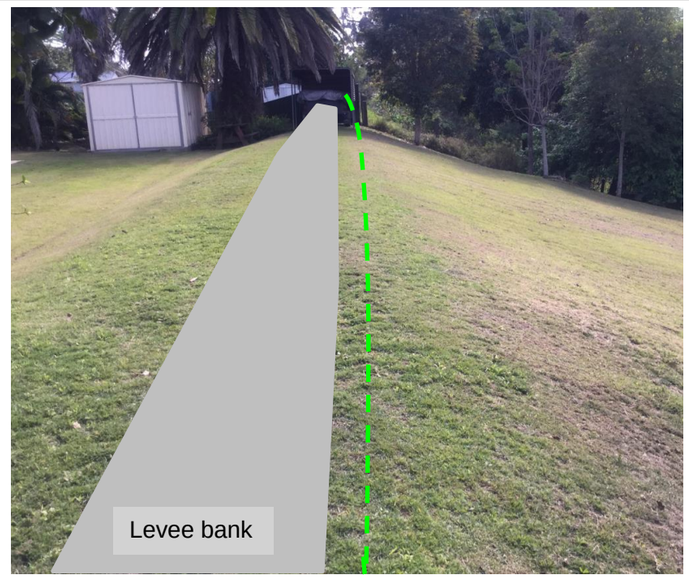
Stockpile control





Example scenario 1: Earth embankment controlled with a topsoil bund. Stripped topsoil is placed on the river side of works a silt fence can also be installed on the downstream side of the bund. The levee is increased in height a few hundred mm, area is topsoiled and re-turfed

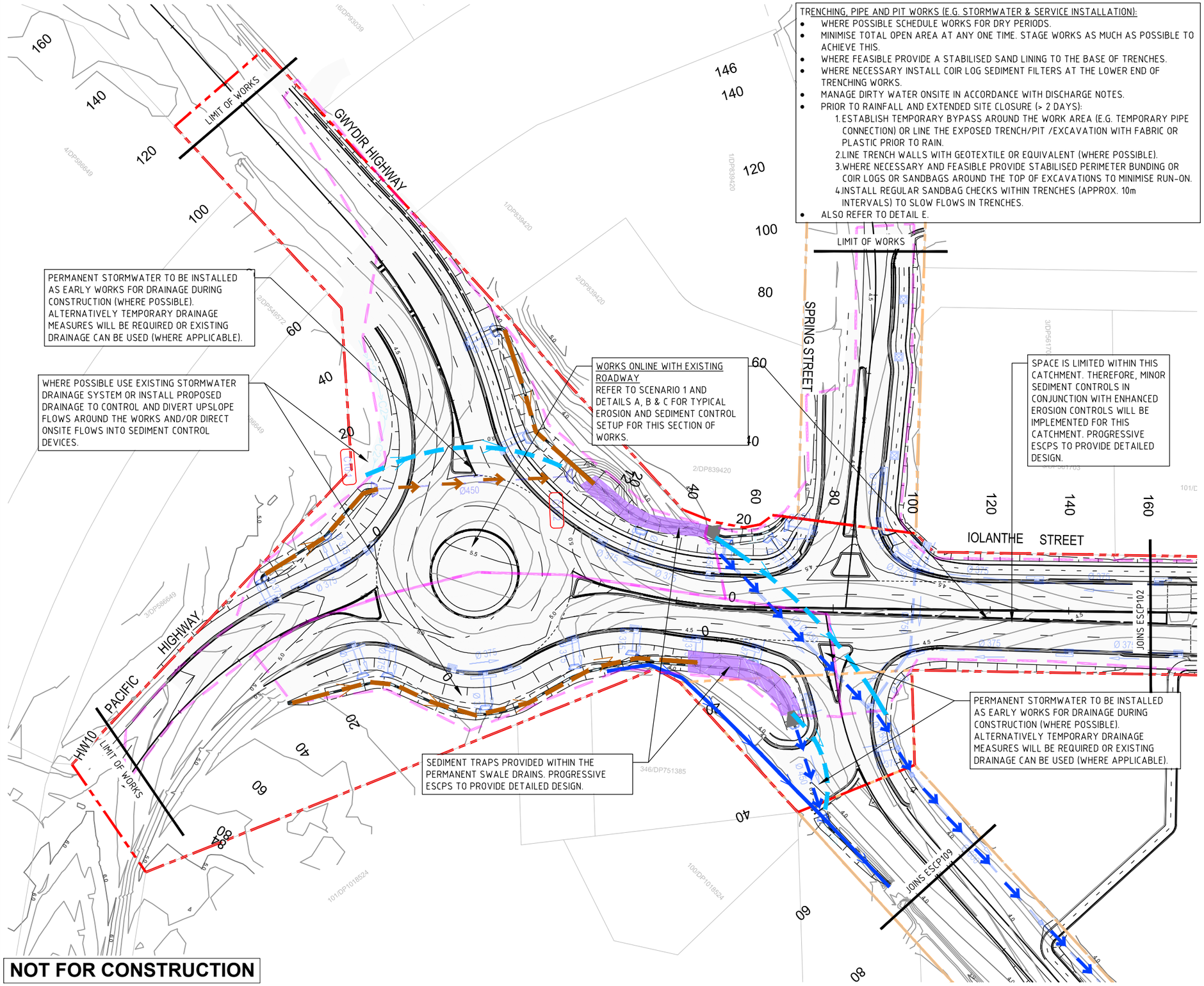
Example scenario 2: Earth embankment area controlled with a mulch windrow produced during clearing



Example scenario 3: Embankment works controlled with a sediment fence on the downstream side, installed prior to works starting

Example scenario 5: Concrete block wall height extension shown by the black line. Remove all waste materials, control cementitious material, do not store chemicals at the site remove each day.

Example scenario 4: Levee embankment controlled with sediment fence, clean waters maintained and not affected by the works



LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) – REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW – PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP – PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) – INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS – REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Fulton Hogan

SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 – SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 1 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP101	00

Plot Date: Tuesday, 6 September 2016 10:54:44 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

WHERE POSSIBLE USE EXISTING STORMWATER DRAINAGE SYSTEM OR INSTALL PROPOSED DRAINAGE TO CONTROL AND DIVERT UPSLOPE FLOWS AROUND THE WORKS AND/OR DIRECT ONSITE FLOWS INTO SEDIMENT CONTROL DEVICES.

WORKS ONLINE WITH EXISTING ROADWAY
REFER TO SCENARIO 1 AND DETAILS A, B & C FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

NEW ALIGNMENT - FILL WORKS
REFER TO SCENARIO 3 AND PHOTO 4 FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

SCD-13 PROVIDED FOR COMPOUND/LAYDOWN AREA. SIZING AND SPECIFICATION TO FUTURE DETAIL.

GENERAL - EROSION AND SEDIMENT CONTROLS TO BE CONSIDERATE OF FLOOD LEVEES. NO EROSION AND SEDIMENT CONTROL STRUCTURES OR MEASURES ARE TO COMPROMISE OR IMPACT FLOOD LEVEES.

MAJOR SEDIMENT CONTROL DEVICES PROVIDED WITHIN THE PERMANENT SWALE DRAINS FOR ROADWORKS. SIZING AND SPECIFICATIONS TO FUTURE DETAIL.

THROUGH STREET

IOLANTHE STREET

JOINS ESCP101

JOINS ESCP103

JOINS ESCP110

BUTTERS LANE

SCD-1

SCD-2

SCD-3

SCD-4

SCD-13

PERMANENT STORMWATER TO BE INSTALLED AS EARLY WORKS FOR DRAINAGE DURING CONSTRUCTION (WHERE POSSIBLE). ALTERNATIVELY TEMPORARY DRAINAGE MEASURES WILL BE REQUIRED OR EXISTING DRAINAGE CAN BE USED (WHERE APPLICABLE).

SEDIMENT TRAP PROVIDED WITHIN THE PERMANENT SWALE DRAIN/S. PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN.

MAJOR SEDIMENT CONTROL DEVICE PROVIDED WITHIN THE PERMANENT SWALE DRAINS. SIZING AND SPECIFICATIONS TO FUTURE DETAIL.

TEMPORARY CLEAN WATER DIVERSIONS PROVIDED TO DIVERT UPSLOPE FLOWS AROUND/THROUGH THE WORKS.

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) - REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW - PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP - PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) - INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS - REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000
FINAL	

North

CLIENT: Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 - SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 2 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP102	00

Plot Date: Tuesday, 6 September 2016 10:54:52 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

SEDIMENT TRAPS PROVIDED WITHIN THE PERMANENT SWALE DRAIN/S TO SUPPLEMENT SCD-2 AS NECESSARY. PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN.

BRIDGE APPROACHES (MAJOR FILL WORKS)
REFER TO SCENARIO 3 AND PHOTO 4 FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

GENERAL - EROSION AND SEDIMENT CONTROLS TO BE CONSIDERATE OF FLOOD LEVEES. NO EROSION AND SEDIMENT CONTROL STRUCTURES OR MEASURES ARE TO COMPROMISE OR IMPACT FLOOD LEVEES.

NEW ALIGNMENT - FILL WORKS
REFER TO SCENARIO 3 AND PHOTO 4 FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

SCD-8 TO BE USED TO TAKE RUNOFF FROM BOTH ROAD WORKS AND THE COMPOUND/LAYDOWN (ANCILLARY) AREA. DESIGN OF THE MUST ALLOW FOR BOTH CATCHMENTS.

SCD-2

SCD-8

JOINS ESCP102

JOINS ESCP104

MR83 SUMMERLAND WAY

BUTTERS LANE

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) - REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW - PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP - PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) - INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS - REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 – SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 3 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP103	00

Plot Date: Tuesday, 6 September 2016 10:55:02 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

SCD-8 TO BE USED TO TAKE RUNOFF FROM BOTH ROAD WORKS AND THE COMPOUND/LAYDOWN (ANCILLARY) AREA. DESIGN OF THE MUST ALLOW FOR BOTH CATCHMENTS.

SEDIMENT BASINS WILL NOT BE FEASIBLE FOR THIS CATCHMENT. THEREFORE, MINOR SEDIMENT CONTROLS IN CONJUNCTION WITH ENHANCED EROSION CONTROLS WILL BE IMPLEMENTED FOR THIS CATCHMENT - REFER TO SCENARIO 3. PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN.

BRIDGE APPROACHES (MAJOR FILL WORKS)
REFER TO SCENARIO 3 AND PHOTO 4 FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

SCD-9

SCD-10

MR83 SUMMERLAND WAY

JOINS ESCP103

JOINS ESCP105

PERMANENT STORMWATER TO BE INSTALLED AS EARLY WORKS FOR DRAINAGE DURING CONSTRUCTION (WHERE POSSIBLE). ALTERNATIVELY TEMPORARY DRAINAGE MEASURES WILL BE REQUIRED OR EXISTING DRAINAGE CAN BE USED (WHERE APPLICABLE).

BRIDGE PILING WORKS AND WORKS WITHIN 40m OF THE RIVER BANK
REFER TO WORK SCENARIO 2 FOR TYPICAL EROSION AND SEDIMENT CONTROLS REQUIRED FOR THIS SECTION OF WORKS.

MAJOR SEDIMENT CONTROL DEVICE PROVIDED WITHIN THE PERMANENT SWALE DRAINS. SIZING AND SPECIFICATIONS TO FUTURE DETAIL.

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) - REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW - PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP - PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) - INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS - REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Fulton Hogan

SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
MR83 - SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

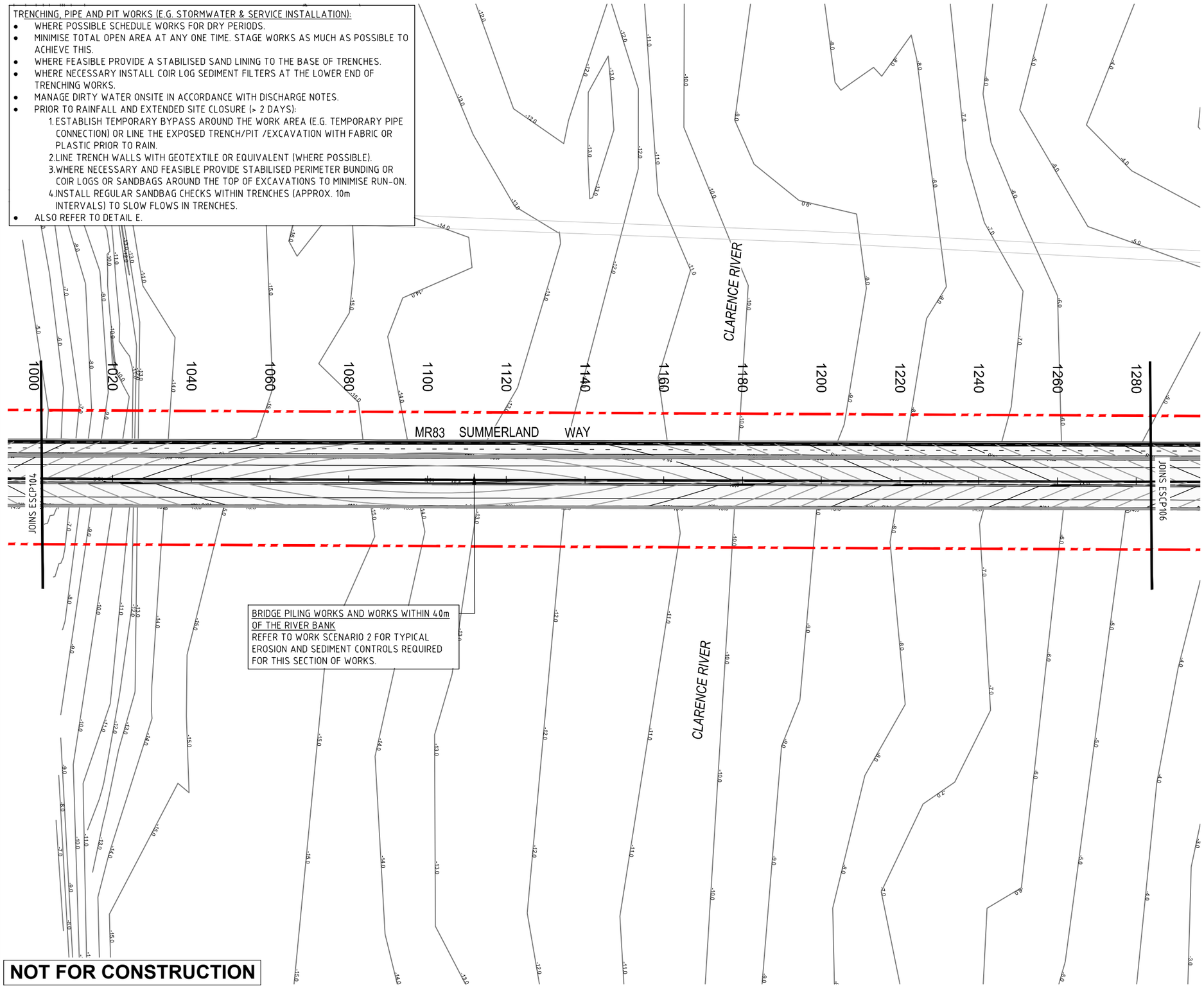
DRAWING TITLE
PRIMARY EROSION AND SEDIMENT CONTROL PLAN
SHEET 4 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP104	00

Plot Date: Tuesday, 6 September 2016 10:55:12 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.



BRIDGE PILING WORKS AND WORKS WITHIN 40m OF THE RIVER BANK
REFER TO WORK SCENARIO 2 FOR TYPICAL EROSION AND SEDIMENT CONTROLS REQUIRED FOR THIS SECTION OF WORKS.

NOT FOR CONSTRUCTION

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) – REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW – PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP – PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) – INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS – REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT

Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
MR83 – SUMMERLAND WAY
ADDITIONAL CROSSING
OF THE CLARENCE RIVER
AT GRAFTON

DRAWING TITLE
PRIMARY EROSION AND SEDIMENT CONTROL PLAN
SHEET 5 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP105	00

Plot Date: Tuesday, 6 September 2016 10:55:22 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

BRIDGE APPROACHES (MAJOR FILL WORKS)
REFER TO SCENARIO 3 AND PHOTO 4 FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

THE CATCHMENT DRAINING INTO THIS BASIN WILL INCLUDE CLEAN WATER FLOWS DRAINING INTO THE EXISTING/PROPOSED STORMWATER SYSTEM. THEREFORE, ALTERNATIVELY TREATMENT AND MANAGEMENT OF THIS BASIN WILL BE REQUIRED (E.G. AS A DECANTING SEDIMENT BASIN) AND ADDITIONAL EROSION AND SEDIMENT CONTROLS WILL BE IMPLEMENTED THROUGHOUT THE CATCHMENT. PROGRESSIVE ESCPS TO PROVIDE DETAILS.

MINOR SEDIMENT CONTROLS IN CONJUNCTION WITH ENHANCED EROSION CONTROLS WILL BE IMPLEMENTED FOR THIS CATCHMENT - REFER TO SCENARIO 3. PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN.

SEDIMENT CONTROL DEVICE TO BE PROVIDED IN PERMANENT BASIN LOCATION AS EARLY WORKS AND USED DURING CONSTRUCTION. SIZING AND SPECIFICATIONS TO FUTURE DETAIL.

WORKS ONLINE WITH EXISTING ROADWAY
REFER TO SCENARIO 1 AND DETAILS A, B & C FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

PERMANENT STORMWATER TO BE INSTALLED AS EARLY WORKS FOR DRAINAGE DURING CONSTRUCTION (WHERE POSSIBLE). ALTERNATIVELY TEMPORARY DRAINAGE MEASURES WILL BE REQUIRED OR EXISTING DRAINAGE CAN BE USED (WHERE APPLICABLE).

BRIDGE PILING WORKS AND WORKS WITHIN 40m OF THE RIVER BANK
REFER TO WORK SCENARIO 2 FOR TYPICAL EROSION AND SEDIMENT CONTROLS REQUIRED FOR THIS SECTION OF WORKS.

OVERFLOWS FROM SEDIMENT CONTROL STRUCTURE TO BE TAPPED INTO THE STORMWATER DRAINAGE SYSTEM. DETAILS TO BE CONFIRMED ONSITE.

MAJOR SEDIMENT CONTROL DEVICE PROVIDED FOR STOCKPILE/LAYDOWN AREA. SIZING AND SPECIFICATIONS TO FUTURE DETAIL.

STOCKPILE/LAYDOWN AREA. SEDIMENT CONTROL DEVICE TO BE ESTABLISHED PRIOR TO UTILISING THIS AREA.

GENERAL - EROSION AND SEDIMENT CONTROLS TO BE CONSIDERATE OF FLOOD LEVEES. NO EROSION AND SEDIMENT CONTROL STRUCTURES OR MEASURES ARE TO COMPROMISE OR IMPACT FLOOD LEVEES.

SCD-11

SCD-12

MR83 SUMMERLAND WAY

GREAVES STREET

POUND STREET

NORTH COAST RAILWA

JOINS ESCP105

JOINS ESCP107

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) - REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW - PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP - PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) - INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS - REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Fulton Hogan

SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 - SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 6 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP106	00

Plot Date: Tuesday, 6 September 2016 10:55:33 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

THE CATCHMENT DRAINING INTO THIS BASIN WILL INCLUDE CLEAN WATER FLOWS DRAINING INTO THE EXISTING/PROPOSED STORMWATER SYSTEM. THEREFORE, ALTERNATIVELY TREATMENT AND MANAGEMENT OF THIS BASIN WILL BE REQUIRED (E.G. AS A DECANTING SEDIMENT BASIN) AND ADDITIONAL EROSION AND SEDIMENT CONTROLS WILL BE IMPLEMENTED THROUGHOUT THE CATCHMENT. PROGRESSIVE ESCPS TO PROVIDE DETAILS.

BRIDGE APPROACHES (MAJOR FILL WORKS)
REFER TO SCENARIO 3 AND PHOTO 4 FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

STABILISED LAYDOWN/COMPOUND AREA. SURFACES MUST BE MAINTAINED STABLE AND CLEAN AT ALL TIMES. IF STOCKPILING IS TO OCCUR HERE APPROPRIATE SEDIMENT CONTROL MEASURES MUST BE PROVIDED.

DEWATERING BASINS TO BE PROVIDED AS REQUIRED AND IN LOCATIONS TO SUIT CONSTRUCTION FOR DEWATERING ONLINE WORK AREAS. ALTERNATIVELY DEWATERING CAN BE UNDERTAKEN WITHIN SCD-12.

WHERE POSSIBLE USE EXISTING STORMWATER DRAINAGE SYSTEM OR INSTALL PROPOSED DRAINAGE TO DIRECT ONSITE FLOWS INTO THE SEDIMENT BASIN.

STABILISED LAYDOWN/COMPOUND AREA. SURFACES MUST BE MAINTAINED STABLE AND CLEAN AT ALL TIMES. IF STOCKPILING IS TO OCCUR HERE APPROPRIATE SEDIMENT CONTROL MEASURES MUST BE PROVIDED.

WORKS ONLINE WITH EXISTING ROADWAY
SPACE IS LIMITED WITHIN THIS SECTION OF WORK. WHERE POSSIBLE DIRECT FLOWS TO SCD-12 OR USE MINOR SEDIMENT CONTROLS IN CONJUNCTION WITH ENHANCED EROSION CONTROLS. PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN.
REFER TO SCENARIO 1 AND DETAILS A, B & C FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

NOT FOR CONSTRUCTION

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) - REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW - PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP - PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) - INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS - REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD
STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000
FINAL	

North

CLIENT: Fulton Hogan

SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 - SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 7 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP107	00

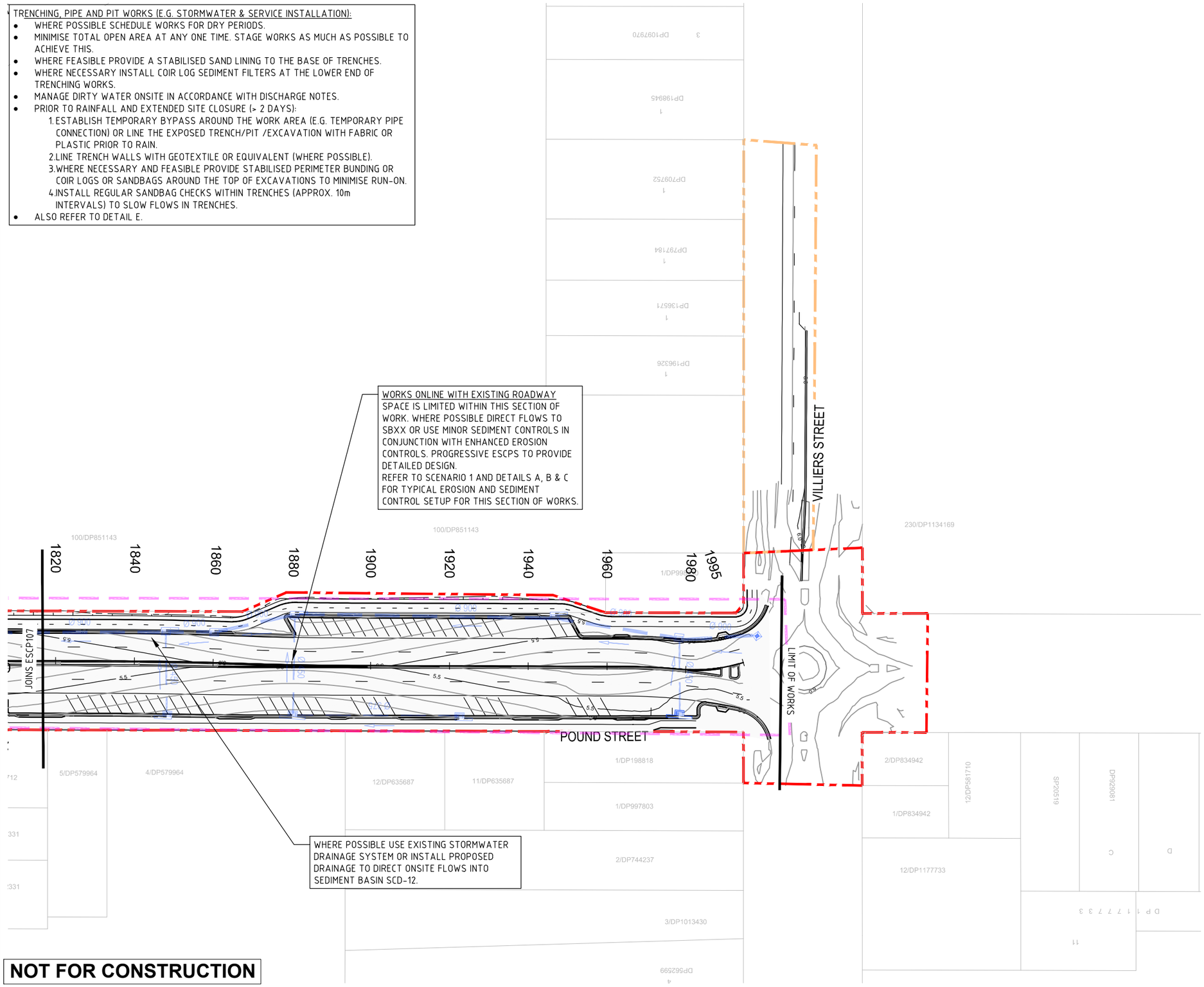
Plot Date: Tuesday, 6 September 2016 10:55:43 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

WORKS ONLINE WITH EXISTING ROADWAY
SPACE IS LIMITED WITHIN THIS SECTION OF WORK. WHERE POSSIBLE DIRECT FLOWS TO SBXX OR USE MINOR SEDIMENT CONTROLS IN CONJUNCTION WITH ENHANCED EROSION CONTROLS. PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN.
REFER TO SCENARIO 1 AND DETAILS A, B & C FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

WHERE POSSIBLE USE EXISTING STORMWATER DRAINAGE SYSTEM OR INSTALL PROPOSED DRAINAGE TO DIRECT ONSITE FLOWS INTO SEDIMENT BASIN SCD-12.



NOT FOR CONSTRUCTION

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) – REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW – PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP – PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) – INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS – REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD
STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000
FINAL	

North

CLIENT: Fulton Hogan

SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 – SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

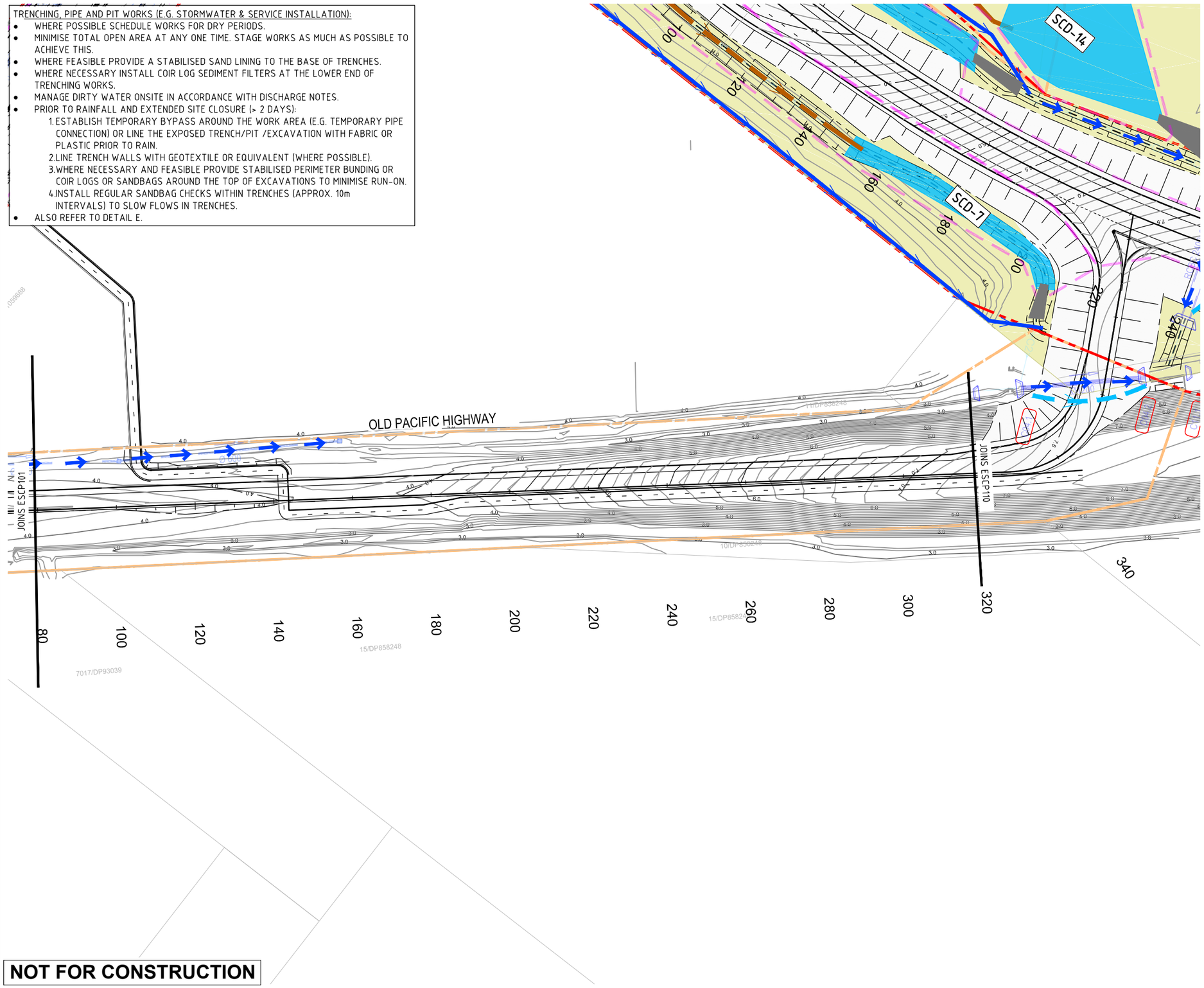
DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 8 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP108	00

Plot Date: Tuesday, 6 September 2016 10:55:53 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.



LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) – REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW – PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP – PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) – INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS – REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Fulton Hogan

SEEC
PO.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 – SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 9 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP109	00

Plot Date: Tuesday, 6 September 2016 10:56:02 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

GENERAL - EROSION AND SEDIMENT CONTROLS TO BE CONSIDERATE OF FLOOD LEVEES. NO EROSION AND SEDIMENT CONTROL STRUCTURES OR MEASURES ARE TO COMPROMISE OR IMPACT FLOOD LEVEES.

PERMANENT STORMWATER TO BE INSTALLED AS EARLY WORKS FOR DRAINAGE DURING CONSTRUCTION (WHERE POSSIBLE). ALTERNATIVELY TEMPORARY DRAINAGE MEASURES WILL BE REQUIRED OR EXISTING DRAINAGE CAN BE USED (WHERE APPLICABLE).

MAJOR SEDIMENT CONTROL DEVICES PROVIDED WITHIN THE PERMANENT SWALE DRAINS. SIZING AND SPECIFICATIONS TO FUTURE DETAIL.

SCD-13 PROVIDED FOR COMPOUND/LAYDOWN AREA. SIZING AND SPECIFICATION TO FUTURE DETAIL. KEEP OUT OF WATERWAY AREA (LOW POINT).

NEW ALIGNMENT - FILL WORKS
REFER TO SCENARIO 3 AND PHOTO 4 FOR TYPICAL EROSION AND SEDIMENT CONTROL SETUP FOR THIS SECTION OF WORKS.

LAYDOWN/COMPOUND WORKS NOT TO BE LOCATED WITHIN WATERWAY (LOW POINT).

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

TEMPORARY CLEAN WATER DIVERSIONS PROVIDED TO DIVERT UPSLOPE FLOWS AROUND/THROUGH THE WORKS.

SEDIMENT TRAP PROVIDED WITHIN THE PERMANENT SWALE DRAIN TO SUPPLEMENT SBXX AS NECESSARY. PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN.

DECANTING SEDIMENT BASIN PROVIDED WITHIN THE PERMANENT SWALE DRAIN. SIZING AND SPECIFICATIONS TO FUTURE DETAIL.

PERMANENT STORMWATER TO BE INSTALLED AS EARLY WORKS FOR DRAINAGE DURING CONSTRUCTION (WHERE POSSIBLE). ALTERNATIVELY TEMPORARY DRAINAGE MEASURES WILL BE REQUIRED OR EXISTING DRAINAGE CAN BE USED (WHERE APPLICABLE).

SCD-5 SCD-6 SCD-7 SCD-14

HW10 PACIFIC HIGHWAY

JOINS ESCP102 JOINS ESCP111 JOINS ESCP109

LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) - REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW - PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP - PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) - INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS - REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Fulton Hogan

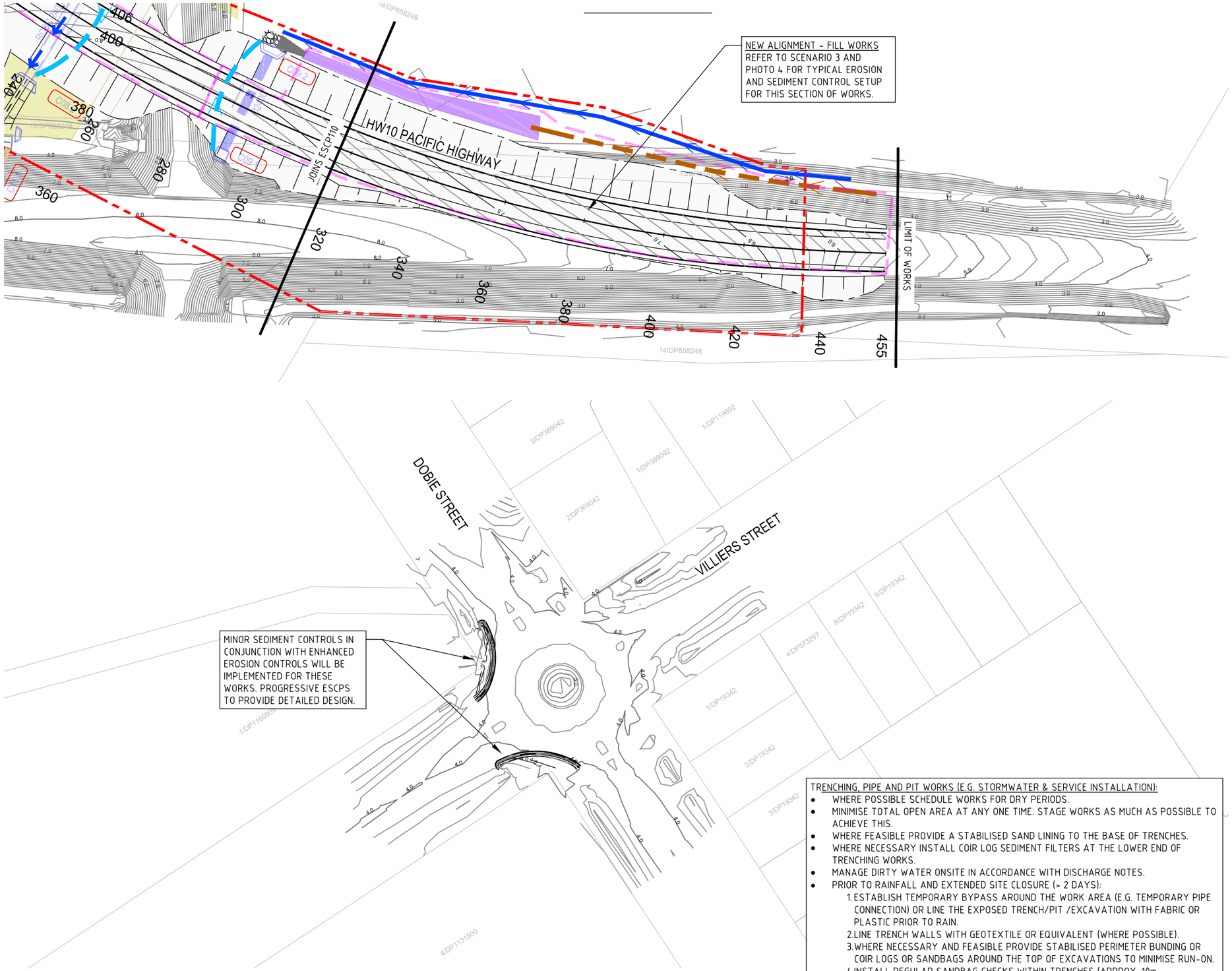
SEEC
P.O.Box 1098, Bowral, NSW. 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 - SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 10 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP110	00

Plot Date: Tuesday, 6 September 2016 10:56:06 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg



LEGEND

- CLEAN WATER DIVERSION
- DIRTY WATER DIVERSION
- DEWATERING BASIN
- MAJOR SEDIMENT CONTROL DEVICE (SCD) – REFER TO THE OVER-ARCHING DESIGN STANDARD BELOW – PROGRESSIVE ESCPS TO PROVIDE DETAILED DESIGN
- MINOR SEDIMENT TRAP – PROGRESSIVE ESCPS TO PROVIDE DETAIL DESIGN
- DISSIPATER OUTLET/INLET (GEOTEXTILE + ROCK Ø200MIN. OR CONCRETE)
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- SITE BOUNDARY
- LOCAL ROADS BOUNDARY
- TEMPORARY WORKS BOUNDARY
- COMPOUND / LAYDOWN AREA (ANCILLARY AREA) – INDICATIVE LOCATION
- CATCHMENT BOUNDARY
- CLEAN AND DIRTY WATER SEPARATION FOR ONLINE STORMWATER DRAINAGE WORKS – REFER TO 'TRENCHING PIPE AND PIT WORKS' REQUIREMENTS PROVIDED ON THIS PLAN AND TO DETAIL E

THESE ARE PRIMARY EROSION AND SEDIMENT CONTROL PLANS SHOWING MAJOR CONTROLS ONLY. MINOR CONTROLS, DETAILED MEASURES AND INSTRUCTIONS ARE TO BE IDENTIFIED PRIOR TO STARTING CONSTRUCTION WORKS ON PROGRESSIVE CONSTRUCTION STAGE EROSION AND SEDIMENT CONTROL PLANS.

REFER TO DRAWINGS 15000333_P01_ESCP000-008 FOR EROSION AND SEDIMENT CONTROL DESIGN ASSUMPTIONS, TYPICAL WORK SCENARIO SPECIFICATIONS AND TYPICAL DETAILS.

OVER-ARCHING SEDIMENT CONTROL DESIGN STANDARD

STANDARD BLUE BOOK DESIGNED SEDIMENT BASINS WILL NOT BE SUITABLE FOR MANY LOCATIONS OF THIS PROJECT DUE TO SPACE/TOPOGRAPHICAL CONSTRAINTS AND THE PROXIMITY TO LIVE TRAFFIC OR WATERWAYS. THEREFORE, EITHER DECANTING TYPE SEDIMENT BASINS (DESIGNED IN ACCORDANCE WITH THE IECA GUIDELINES FOR 'TYPE A' SEDIMENT BASINS) OR ALTERNATIVE SEDIMENT CONTROLS (E.G. ROCK FILTER BUNDS, SEDIMENT FENCE/COIR LOG TRAPS, SWALE BASINS OR ONLINE SUMPS) WILL BE USED INSTEAD OR IN CONJUNCTION WITH STANDARD SEDIMENT BASINS. WHERE SPACE IS RESTRICTED FOR PROVIDING LARGE SCALE SEDIMENT CONTROLS, ENHANCED EROSION CONTROLS WILL BE APPLIED IN CONJUNCTION WITH MINOR SEDIMENT CONTROL DEVICES. TRAPPED WATER WILL BE TREATED IN-SITU OR TRANSFERRED TO DEWATERING BASINS OR SEDIMENT BASINS. DETAILED CONTROLS AND SPECIFICATIONS ARE TO BE PROVIDED WITHIN PROGRESSIVE ESCPs.

TRENCHING, PIPE AND PIT WORKS (E.G. STORMWATER & SERVICE INSTALLATION):

- WHERE POSSIBLE SCHEDULE WORKS FOR DRY PERIODS.
- MINIMISE TOTAL OPEN AREA AT ANY ONE TIME. STAGE WORKS AS MUCH AS POSSIBLE TO ACHIEVE THIS.
- WHERE FEASIBLE PROVIDE A STABILISED SAND LINING TO THE BASE OF TRENCHES.
- WHERE NECESSARY INSTALL COIR LOG SEDIMENT FILTERS AT THE LOWER END OF TRENCHING WORKS.
- MANAGE DIRTY WATER ONSITE IN ACCORDANCE WITH DISCHARGE NOTES.
- PRIOR TO RAINFALL AND EXTENDED SITE CLOSURE (> 2 DAYS):
  1. ESTABLISH TEMPORARY BYPASS AROUND THE WORK AREA (E.G. TEMPORARY PIPE CONNECTION) OR LINE THE EXPOSED TRENCH/PIT /EXCAVATION WITH FABRIC OR PLASTIC PRIOR TO RAIN.
  2. LINE TRENCH WALLS WITH GEOTEXTILE OR EQUIVALENT (WHERE POSSIBLE).
  3. WHERE NECESSARY AND FEASIBLE PROVIDE STABILISED PERIMETER BUNDING OR COIR LOGS OR SANDBAGS AROUND THE TOP OF EXCAVATIONS TO MINIMISE RUN-ON.
  4. INSTALL REGULAR SANDBAG CHECKS WITHIN TRENCHES (APPROX. 10m INTERVALS) TO SLOW FLOWS IN TRENCHES.
- ALSO REFER TO DETAIL E.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	06/09/16	A.J.B.	A.J.B.		ADDITIONAL ANCILLARY AREAS ADDED
B	16/08/16	A.J.B.	A.J.B.	A.M.	ADDITIONAL OVER-ARCHING REQUIREMENTS AND DETAILS
A	12/08/16	A.J.B.	A.J.B.		DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.B.
DRAWN BY	A.J.B.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:1000

FINAL

North

CLIENT: Fulton Hogan

SEEC
PO Box 1098, Bowral, NSW 2576
Suites 7 & 8, 68-70 Station Street
Bowral NSW 2576.
(t) 02 4862 1633
(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: MR83 – SUMMERLAND WAY ADDITIONAL CROSSING OF THE CLARENCE RIVER AT GRAFTON

DRAWING TITLE: PRIMARY EROSION AND SEDIMENT CONTROL PLAN SHEET 11 OF 11

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
15000333	P02	ESCP111	00

Plot Date: Tuesday, 6 September 2016 10:56:15 AM CAD File Name: I:\15000333 Grafton Bridge Pacific Highway\Drawings\15000333_P02_ESCP100_REV 00.dwg

Annexure B
Water Quality Monitoring Program

Water Sampling Locations

Five water sampling locations have been selected, two upstream (WQUS1, WQUS2) and three downstream (WQDS1, WQDS2, WQDS3) of the bridge works, along the Clarence River. One of those locations is near the mouth of Alipou Creek (WQDS2). These locations are shown in Figure B-1 and on the Sensitive Area Plans included in Appendix A6 of the CEMP.

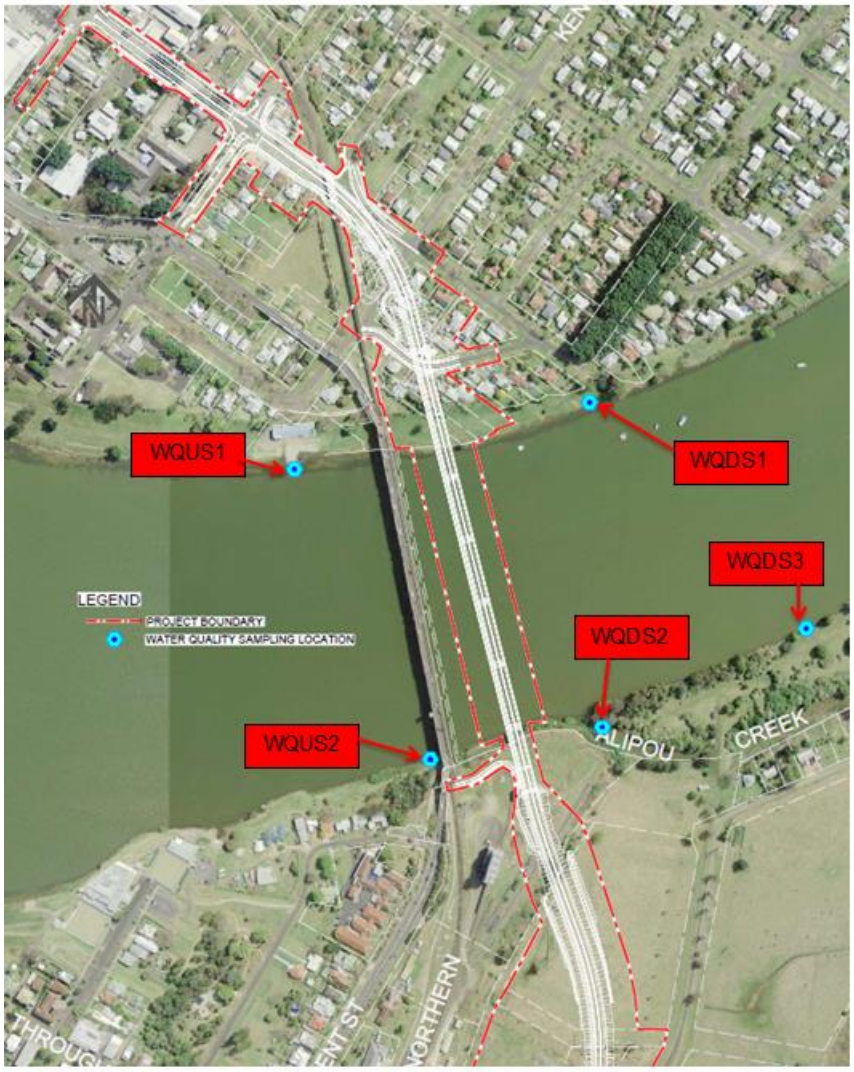


Figure B-1. Water quality monitoring locations

The precise location (easting and northing) of each water sampling location will be determined once the project team mobilises to site and agrees the location with the various landowners (where relevant).

Refer to Table B-1 for the location and rationale of all water sampling locations associated with the Project

Table B-1 Location and rationale for water sampling locations

Water quality sampling location No.	Location	Rationale
WQUS1	Clarence River northern bank upstream of bridge works at Clarence River Sailing Club	To monitor upstream water quality impacts from activities unrelated to bridge works. Use existing jetty to safely collect river samples.
WQUS2	Clarence River southern bank upstream of bridge works adjacent to existing Grafton bridge	To monitor upstream water quality impacts from activities unrelated to bridge works.
WQDS1	Clarence River northern bank downstream of bridge works	To monitor potential water quality impacts on the Clarence River from bridge works.
WQDS2	Clarence River southern bank downstream of bridge works and near the mouth of Alipou Creek.	To understand the water quality of Alipou Creek and hence its impact on the water quality of the Clarence River downstream of the bridge works. This water quality sampling location was recommended by the EPA during the face-to-face meeting held on 16 November 2015.
WQDS3	Clarence River southern bank downstream of bridge works	To monitor potential water quality impacts on the Clarence River from bridge works.

Soil and water quality monitoring program

Regular monitoring and inspections will be undertaken during construction as shown in Table B-2. Additional requirements and responsibilities in relation to inspections are documented in Chapters 8 and 9 of the CEMP.

Monitoring will be undertaken both upstream and downstream of the Project site to assess construction water quality impacts on the Clarence River. Table B-2 details the water quality monitoring frequency for the pre-construction and construction stages of the Project.

Table B-2 Location and rationale for water sampling locations

Monitoring Details	Area	Record	Responsibility	Frequency
Pre-Construction Water Quality Monitoring	Water monitoring points (refer to Figure B-1)	Water quality sampling field record Chain of custody form (for environmental samples)/ Laboratory results Environmental Sampling Register	Environment Manager	For at least 1 month prior to construction
Construction Water Quality Monitoring	Water monitoring points (refer to Figure B-1)	Water quality sampling field record Chain of custody form (for environmental samples)/ Laboratory results Environmental Sampling Register	Environment Manager	Monthly or as required in response to spills
	Sediment basins	Dewatering record (sediment basins) Chain of custody form (for environmental samples)/ Laboratory results Environmental Sampling Register	Environment Manager / Project Engineer	Prior to discharge
	Areas other than sediment basins	Dewatering record (other than sediment basins) Chain of custody form (for environmental samples)/ Laboratory results Environmental Sampling Register	Environment Manager / Project Engineer	Prior to discharge
Monitoring Bureau of Meteorology	All	Email Record to staff	Environment Manager /	Daily or hourly

Monitoring Details	Area	Record	Responsibility	Frequency
forecast			Administration	during periods of wet weather
Daily rainfall records	Site compound	Rainfall Register	Environment Manager	Daily
ERSED Inspection	All	Environmental Inspection Checklist	Environment Manager	Weekly or daily during periods of rainfall causing runoff, if safe to do so.
Soil Conservationist Inspection	All	Soil Conservationist Inspection Report	Project Soil Conservationist / Environmental Manager	Fortnightly inspections/ as per Deed
Acid Sulfate Soils				
Monitoring of disturbed soil for ASS	Incidental finds	Record developed as required in IN Acid Sulfate Soil Management Procedure.	Environment Manager	Weekly/ As required
Monitoring of treated ASS	Incidental finds	Record developed as required in IN Acid Sulfate Soil Management Procedure.	Environment Manager	Regular pH monitoring, chromium suite monthly to confirm neutralisation
Validation of amended material	ASS treatment areas	Laboratory report	Qualified soil scientist	When removing verified material from treatment pad
Monitoring effectiveness of ASS control measures	All	Environmental Inspection Checklist	Environment Manager	Weekly / As Required
Spoil, fill and materials stockpiles				
Monitoring of effectiveness of control measures for handling of spoil, including disposal, and stockpile management	All	Environmental Inspection Checklist	Environment Manager	Weekly / As Required

Annexure C
Acid Sulfate Soil Management Procedure

Acid Sulfate Soil Management Procedure

Purpose

This procedure details the actions to be taken when actual Acid Sulfate Soils (ASS) or Potential Acid Sulfate Soils (PASS) are encountered during excavation/ construction activities. This procedure is prepared to demonstrate compliance with the following standards and guidelines:

- The Acid Sulfate Soils Manual (1998)
- Acid Sulfate Soils Assessment Guidelines (1998)
- Laboratory Methods Guidelines (2004), and
- EPA Waste Classification Guidelines (2014), Part 4: Acid Sulfate Soils.

Scope

This procedure applies to all construction activities undertaken as part of the Project that have the potential to uncover/ disturb ASS/ PASS.

Induction and training

All site personnel and subcontractors working in areas of high probability acid sulfate soil risk will be trained in the relevant parts of this procedure.

Procedure

1. Actual or Potential Acid Sulfate Soils encountered during excavation/ construction activities

If ASS/ PASS is encountered during excavation/construction activities the Foreman must:

- STOP ALL WORK in the immediate/ affected area and contact the Environmental Officer (EO).
- Recommence works in alternate area where practicable.

The EO is responsible for testing of ASS/ PASS and will undertake testing to determine the acidity (field pH test) and potential for acidity (field 30% peroxide test) of the material encountered.

2. Action criteria for management intervention

Table C-1 details the texture based action criteria for management of ASS disturbance. Where soils containing concentrations at or above the action criteria are disturbed, management of spoil is required.

For the purposes of the Project, both action criteria have been included for reference purposes, i.e. < 1,000 tonnes for fine texture soils, and > 1,000 tonnes for all soil types.

Table C-1 Action criteria based on the ASS analysis for three broad texture categories

Type of Material		Action Criteria 1- 1000 tonnes disturbed		Action Criteria > 1000 tonnes disturbed	
Texture range (McDonald et al. (1990)	Approx clay content (%<0.002 mm)	Sulphur trail % S oxidisable e.g. STOS or SPOS	Acid trail mol H+/tonne e.g. TPA or TSA	Sulphur trail % S oxidisable e.g. STOS or SPOS	Acid trail mol H+/tonne e.g. TPA or TSA
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture Sandy loams to light	5 – 40	0.06	36	0.03	18

Type of Material		Action Criteria 1- 1000 tonnes disturbed		Action Criteria > 1000 tonnes disturbed	
clays					
Fine Texture Medium to heavy clays and silty clays	≤40	0.1	62	0.03	18

Source: Ahern et al. 1998

3. Neutralisation of Excavated Acid Sulfate Materials(ASM) from Earthworks

If field tests are positive or inconclusive, laboratory analysis using the Chromium Suite will be required to determine if the material is in fact ASS and/or the required treatment rates based on the net acidity.

Neutralising agents must be incorporated within all ASS/PASS. All cut batters shall be coated with fine aglime at the rate of 5kg/m and the lime coating should be checked and re-limed as necessary on a daily basis during periods of dewatering during construction excavation. The base of all fill areas where treated material is to be placed shall be treated with a neutralising agent forming a guard layer prior to the placement of any fill soils to neutralise downward seepage of acidic drainage water. This application may need to be increased depending on stockpile height and actual and potential acidity of the ASM developed through detail assessment.

Aglime rates will be as determined through analytical assessment to establish S% to determine an indicative level of treatment as specified in Table C-2. Interpretation of analytical data must be conducted by an appropriately qualified and experienced in dealing with ASS/PASS management.
ASS/PASS must be sufficiently dry before neutralising is commenced so that the lime can be thoroughly mixed through the soil. Where moisture levels in soil are high, the soil must be dried by spreading and leaving open to the atmosphere. Drying can be accelerated by regular aeration by turning with an excavator or backhoe. Drying should be carried out on a guard layer and protected from stormwater ingress.

Mixing of ASS/PASS with neutralising agent shall be carried out by spreading the soil in layers of not more than 300-400mm thick using an agricultural spreader and disc plough, rotary hoe or similar. Care shall be taken to ensure that mixing occurs throughout the depth of the layer prior to placement of new material.

Following the successful treatment of the lot (as determined through the validation testing), the material shall be compacted and the next layer of excavated material to be treated shall be placed over the already treated material. This process shall be continued until the required site elevation is achieved.

Table C-2 Treatment levels and aglime required to treat total weight of disturbed ASS

The tonnes (t) of pure fine aglime, $CaCO_3$ required to fully treat the total weight/volume of acid sulfate soils (ASS) can be read from the table at the intersection of the weight of disturbed soil [row] with the existing plus potential acidity [column]. Where the exact weight or soil analysis figure does not appear in the heading of the row or column, use the next highest value.

Disturbed ASS (tonnes) (≈m³×BD) †	Soil Analysis# – Existing Acidity plus Potential Acidity (converted to equivalent S% units)													
	0.03	*0.06*	*0.1*	*0.2*	*0.4*	*0.6*	*0.8*	*1*	*1.5*	*2*	*2.5*	*3*	*4*	*5*
1	0	0	0	0	0	0.03	0.04	0.05	0.1	0.1	0.1	0.1	0.2	0.2
5	0	0	0	0.05	0.1	0.1	0.2	0.2	0.4	0.5	0.6	0.7	0.9	1.2
10	0	0.03	0.05	0.1	0.2	0.3	0.4	0.5	0.7	0.9	1.2	1.4	1.9	2.3
50	0.1	0.1	0.2	0.5	0.9	1.4	1.9	2.3	3.5	4.7	5.9	7.0	9.4	12
100	0.1	0.3	0.5	0.9	1.9	2.8	3.7	4.7	7.0	9.4	12	14	19	23
200	0.3	0.6	0.9	1.9	3.7	5.6	7.5	9.4	14	19	23	28	37	47
250	0.4	0.7	1.2	2.3	4.7	7.0	9.4	12	18	23	29	35	47	59
350	0.5	1.0	1.6	3.3	6.6	10	13	16	25	33	41	49	66	82
500	0.7	1.4	2.3	4.7	9.4	14	19	23	35	47	59	70	94	117
600	0.8	1.7	2.8	5.6	11	17	22	28	42	56	70	84	112	140
750	1.1	2.1	3.5	7.0	14	21	28	35	53	70	88	105	140	176
900	1.3	2.5	4.2	8.4	17	25	34	42	63	84	105	126	168	211
1000	1.4	2.8	4.7	9.4	19	28	37	47	70	94	117	140	187	234
2000	2.8	5.6	9.4	19	37	56	75	94	140	187	234	281	374	468
5000	7.0	14	23	47	94	140	187	234	351	468	585	702	936	1170
10000	14	28	47	94	187	281	374	468	702	936	1170	1404	1872	2340

L	**Low treatment:** (≤0.1 tonnes lime)
M	**Medium treatment:** (>0.1 to 1 tonne lime)
H	**High treatment:** (>1 to 5 tonnes lime)
VH	**Very High treatment:** (>5 to 25 tonnes lime)
XH	**Extra High treatment:** (>25 tonnes lime)

Note: Lime rates are for pure fine aglime, $CaCO_3$ assuming an NV of 100% and using a safety factor of 1.5. A factor that accounts for Effective Neutralising Value is needed for commercial grade lime. (See the *Information Sheets* on *Neutralising Agents – Neutralising Considerations*).

† An approximate soil weight (tonnes) can be obtained from the calculated volume by multiplying volume (cubic m) by bulk density (t/m³). (Use 1.7 if B.D. is not known.) Dense fine sandy soils may have a BD up to 1.7, and hence 100 m³ of such soil may weigh up to 170 t. In these calculations, it is necessary to convert to dry soil masses, since analyses are reported on a dry weight basis.

Potential acidity can be determined by Chromium Reducible Sulfur (S_{CR}), Peroxide Oxidisable Sulfur (S_{POS}) and Total Oxidisable Sulfur (S_{TOS}). For samples with pH <5.5, the existing acidity must also be determined by appropriate laboratory analysis eg. Titratable Actual Acidity (TAA). Soils with retained acidity eg. jarosite or other similar insoluble compounds have a less available acidity and will require more detailed analysis. The amount of treatment required may be reduced if the self-neutralising capacity of the soil is appropriately measured. Consult the **Queensland Acid Sulfate Soils Technical Manual, Laboratory Methods Guidelines**.

Source: (based on soil analysis) (Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines 2002).

4. Neutralising Materials

For management or neutralisation of ASS/PASS soils, medium-fine Aglime will be used. Dolomitic Aglime, or magnesium-blend Aglime, will not be used. In general, a finer grind is better. The Aglime purity should preferably be 90% or better, (that is, Neutralising Value [NV] > 90), unless there is a significant savings to be made by use of less pure Aglime. In the latter case, however, the individual lime dosing rates will need to be increased accordingly. The requirement for greater amounts of Aglime of lower purity should be borne in mind when assessing the supplies of this material, as the cost savings from less pure material may be offset by the need for more, and correspondingly higher total transport costs.

ASS/PASS treatment will occur within an ASS treatment area. Material which is transported to treatment cells must be completely treated and removed from the treatment area before new material is introduced. This will ensure that treated material remains segregated and is not mixed with contaminated material. Aglime or other suitable treatment material will be stored at the treatment area in sufficient quantities to enable the treatment of all ASS/PASS material expected to be treated in the upcoming few weeks/months and will be determined by the expected delivery schedule of treatment material. The management of onsite treatment is the responsibility of the Site Foreman, with assistance from the Environmental Officer (EO).

Aglime is non-corrosive, and requires no special handling – it may be necessary to cover the stockpile with a tarpaulin or cover the stockpile with plastic, to minimise dust generation and prevent wetting, since it is then more difficult to spread. Intermittently, until such time as field testing suggests otherwise, a small quantity of Aglime will be stored on site, in the order of 200kg or so. This will enable the regular treatment of soil and cater for any unexpected occurrences of 'hotter' ASS/PASS.

Dolomitic aglime, or magnesium-blend aglime, should not be used as these materials impose environmental risks from overdosing with the potential to damage estuarine ecosystems. A reasonable quantity of calcium hydroxide solution (hydrated lime) shall be kept on site at all times for treatment of acidic waters. The supply shall be stored in a covered and bunded area to prevent accidental release to waters. Neutralising agents must be replenished and or replaced regularly to remain effective against loss by wind or water erosion.

5. Validation of Ameliorated ASS/PASS

Samples of the treated soil should be taken and laboratory analysed to demonstrate compliance with the performance criteria (ie. verification testing). These performance criteria equate to there being no net acidity in the soil following neutralisation. Soil that has been treated by neutralisation techniques and has not met these criteria must be retreated until the above performance criteria are met.

The objective of ameliorating ASS/PASS materials is to ensure that there is no chance that net acidity will be produced. Validation testing only occurs when soils have been treated (with a neutralising agent) to prevent any future acidification. If results of the validation testing indicate a failure to comply with the performance criteria, soil may need to be re–treated with an additional application of neutralising agent.

Soils that have been mixed with aglime will be analysed by either the SPOCAS or SCR Suite test methods at a rate of one sample per 250m³. All validation samples are to be recorded by GPS or survey, clearly marked on a map/sketch or otherwise recorded.

Where large quantities (>1,000m³) of ameliorated soils are involved and 'net acidity' rates are generally low (18 – <125 mol H+/t or 0.03 – 0.20 %S), a reduced rate of sampling may be appropriate subject to approval. A rate of one sample per 1,000m³ may be suitable for example.

The following performance criteria must be attained for soil that has been treated using neutralisation:

- The neutralising capacity of the treated soil must exceed the existing plus potential acidity of the soil.
- Post-neutralisation, the soil pH is to be greater than 5.5.
- Excess neutralising agent should remain within the soil until all acid generation reactions are complete and the soil has no further capacity to generate acidity.

If ameliorated ASS is going to be reused on site, due environmental regard for areas of placement should be assessed, documented and approved by the FH EM. Assessment measures may include:

- location of proposed placement areas and potential receptors (waterways, sensitive flora and fauna, structures)
- stability and suitability of materials as select fill (especially clays), and
- suitability of soil type for plant growth.

In the unlikely event that the treated material is unable to be reused on-site for other purposes, the material will need to be disposed of to an appropriately licensed waste disposal facility. The EM/ EO will liaise with a licensed waste facility and coordinate the process.

6. Large-scale dewatering or drainage

Earthworks and/or pumping that result in localised drainage or lowering of groundwater and the exposure of sulfidic soils to the ingress of oxygen may generate acidity as a function of soil type(s), sulfide contents, area exposed, and length of time the excavation remains ‘dry’. The scale of the dewatering or drainage should be defined by the size of the cone of depression rather than the size of the void. Activities of this type are high-risk, and should not be undertaken without technical risk assessment by qualified personnel and the formulation of management measures sufficient to reduce risk to levels acceptable by the administering authorities.

7. Neutralising acid leachate and drain water using lime

The liming rate for treating acid water should be carefully calculated to avoid the possibility of "overshooting" the optimum pH levels of 6.5 - 8.5. This can occur quite easily if more soluble or caustic neutralising agents such as hydrated lime (pH 12) or magnesium hydroxide (pH 12) are used. It should be noted that when neutralising acid water, no safety factor is used. However, monitoring of pH should be carried out regularly during neutralisation procedures.

Agricultural lime (pH 8.2) is the safest neutralising agent. It equilibrates around a pH of 8.2 that is not generally harmful to plants, stock or humans and most aquatic ecology species. The main shortcoming associated with the use of lime is its insolubility in water.

When using alkaline materials, strict protocols must be established for the use, handling and monitoring of these materials. Prior to any ASS/PASS management, appropriate personal protective equipment (PPE) is to be worn as per relevant SDSs (e.g. for Lime). This may include:

- Eye goggles and/or face masks
- Hard Hat
- Rubber boots, gloves, and
- Appropriate clothing (e.g. long sleeved shirts).

8. Calculating the quantity of lime

The current pH is measured with a recently calibrated pH detector. The desired pH is usually between 6.5 and 8.5 with pH 7 is normally targeted. The volume of water can be calculated by assuming 1 cubic metre of acid water is equivalent to 1 kilolitre (1000 litre) and 1,000 cubic metre is equivalent to 1 megalitre (ML).

As a general guide, Table C-3 shows minimum quantities of pure lime, hydrated lime or sodium bicarbonate needed to treat dams or drains of 1 ML (1,000 m3) capacity.

Table C-3 Quantity of pure neutralising agent required to raise from existing pH to pH 7 for 1 megalitre of low salinity acid water

Current Water pH	[H+] {mol/L}	H+ in 1 Megalitre {mol}	Lime to neutralise 1 Megalitre {kg pure CaCO3}	Hydr. lime to neutralise 1 Megalitre {kg pure Ca(OH)2}	Pure NaHCO3/ 1 Megalitre {kg }
0.5	.316	316,228	15,824	11,716	26,563
1.0	.1	100,000	5,004	3705	8390
1.5	.032	32,000	1,600	1185	2686
2.0	.01	10,000	500	370	839
2.5	.0032	3,200	160	118	269
3.0	.001	1,000	50	37	84
3.5	.00032	320	16	12	27
4.0	.0001	100	5	4	8.4
4.5	.000032	32	1.6	1.18	2.69
5.0	.00001	10	0.5	0.37	0.84
5.5	.0000032	3.2	0.16	0.12	0.27
6.0	.000001	1	0.05	0.037	0.08
6.5	.00000032	.32	0.016	0.12	0.027

Notes on Table C-3: 1 m3 = 1,000 litre = 1 Kilolitre = 0.001 Megalitre

- *Agricultural lime has very low solubility and may take considerable time to even partially react.*
- *Hydrated lime is more soluble than aglime and hence more suited to water treatment. However, as Ca(OH)2 has a high water pH, incremental addition and thorough mixing is needed to prevent overshooting the desired pH. The water pH should be checked regularly after thorough mixing and time for equilibration before further addition of neutralising product.*
- *Weights of lime or hydrated lime are based on theoretical pure material and hence use of such amounts of commercial product will generally result in under treatment.*
- *To more accurately calculate the amount of commercial product required, the weight of lime from the table should be multiplied by a purity factor (100/ Neutralising Value for aglime) or (148/ Neutralising Value for hydrated lime).*
- *Calculations are based on low salinity water acidified by hydrogen ion, H+ (acid) and do not take into account the considerable buffering capacity or acid producing reactions of some acid salts and soluble species of aluminium and iron. For example, as the pH increases towards 4, the precipitation of soluble ferric ion occurs, liberating more acid:*
- *$Fe3+ + 3H2O \rightarrow Fe(OH)3 + 3H+$*
- *If neutralising substantial quantities of acid sulfate soil leachate, full laboratory analysis of the water will be necessary to adequately estimate the amount of neutralising material required.*

9. Application of lime to water

To increase the efficiency, lime should be mixed into a slurry before adding. A slurry can be prepared in a concrete truck, cement mixer or large vat with an agitator. Methods of application of the slurry include:

- spraying the slurry over the water with a dispersion pump
- pumping the slurry into the water body with air sparging (compressed air delivered through pipes) to improve mixing once added to water
- pouring the slurry out behind a small motorboat and letting the motor mix it in
- incorporating the slurry into the dredge line (when pumping dredge material)
- using mobile water treatment equipment such as the 'Neutra- mill' and 'Aqua Fix' to dispense neutralising reagents to large water bodies.

A change in pH will not be instantaneous. The rate of neutralisation will vary with the solubility, fineness of the lime, the application technique and the acidity (pH) of the water. The finer the lime (preferably microfine with the consistency of white dust) and the more agitated the water, the faster the lime will dissolve and become effective. The pH must be carefully monitored even after the desired pH has been reached. If the water has not reached the desired pH within two weeks, more lime may need to be added. Before additional lime is added, the lack of success should be investigated. Issues to consider may include:

- the quality of the lime being used
- the effectiveness of the application technique
- the existence of additional sources of acid leaching into the water body further acidifying the water, and
- the lime has become lumpy and is sitting on the bottom

Neutralisation may be faster if higher rates are used, but is not recommended as it is expensive and resource wasteful. Moreover, over-dosing may result, though this is unlikely to be a concern with agricultural lime.

Annexure D
Heavy Rainfall Event Procedure

Heavy Rainfall Event Procedure

Purpose

To detail the actions to be taken in the event of a 'heavy' or 'violent' rainfall forecast as defined by the Australian Government Bureau of Meteorology. The procedure outlines how to monitor rainfall forecasts and prepare site to minimise impacts as much as practicable.

For management measures and procedures to be implemented prior to a flooding event, including timeframes for securing work sites and moving plant and equipment, refer to the Construction Flood Management Plan (CFMP).

Definition of rain or showers intensity

Category	Description
Light	Up to 2 mm per hour. Individual drops easily identified, puddles form slowly, small streams may flow in gutters.
Moderate	2.2 mm to 6 mm per hour. Rapidly forming puddles, down pipes flowing freely, some spray visible over hard surfaces.
Heavy	6.2 mm to 50mm mm per hour. Falls in sheets, misty spray over hard surfaces, may cause roaring noise on roof.
Violent	Over 50mm per hour. Gutters and downpipes overflowing, spray to height of several centimetres over hard surfaces, may cause roaring noise on roof.

Source: Australian Government Bureau of Meteorology website http://www.bom.gov.au/info/wwords

Induction and training

All Fulton Hogan Superintendents, Foremen and Engineers will be trained in this procedure.

Procedure

1. Monitoring of 'heavy' or 'violent' rain or shower events (through the Australian Government Bureau of Meteorology):
    - On each working day, the Environmental Manager (EM)/ Environment Officer (EO) or delegate will log on to the Australian Government Bureau of Meteorology website http://www.bom.gov.au/weather/nsw/, review the weather forecast for the next three days and notify the Project team of the same by email. When rain or showers are described as 'heavy' or 'violent', the EM/EO or delegate will highlight that:
        - rain or showers are described as 'heavy' or 'violent' (as applicable)
        - the Heavy Rainfall Event Procedure must be followed.
    - The EM/ EO or delegate will keep a record of all weather forecast emails.
    - The daily weather forecast may be discussed at Prestart Meetings as deemed required by the Fulton Hogan Foreman/ Superintendent.
2. When rain or showers are described as 'heavy' or 'violent' the Fulton Hogan Superintendent will notify the Project team of personnel who will monitor and maintain erosion and sediment controls if required.
3. The Foremen will ensure that there is an adequate supply of erosion and sediment control measures on site.

4. Prior to the ‘heavy’ or ‘violent’ rainfall or shower event, the Foremen and the EM/ EO or delegate will inspect erosion and sediment control measures, focusing on the critical areas first. These may include stockpile areas, chemical storage areas and sediment basins.

Site Shutdown Checklist

This checklist must be completed by zone Foremen prior to each site shutdown; it will be reviewed in the field with site foreman and environmental team prior to leaving site.

Shutdown period: ***Any period during which construction is suspended for an extended period of time (usually greater than 2 days) prior to the works being continued or completed.***

Wet Weather Shutdown: ***Shutdown of site prior to heavy rain forecasted.***

Actions to be undertaken prior to shutdown include:

- Engage sediment basins - cut drains to sediment basins (refer list of basins below)
- Engage sediment sumps
- Properly constructed batter chutes to get water off fill areas
- Windrows/bunds at the top of embankments
- Clean water diversions online
- Kerb protection in place
- Spoil removed from site
- Controls reinstated where removed for construction

Sediment basins checklist

Basin ID	Foreman	Engaged	Date	Signoff	Comments

Annexure E
Stockpile Management Protocol

Stockpile Management Protocol

Purpose

This protocol provides a process for the establishment of *temporary* stockpile areas within and outside the approved project boundary to ensure that environmental impacts associated with stockpiling are minimised during construction.

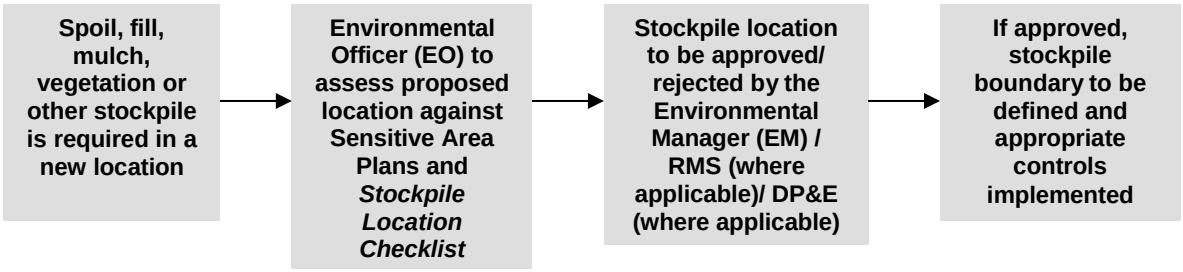
Stockpile sites may typically be required to store material including, but not limited to:

- Excavated materials to be used in fill embankments and other design features
- Acid sulfate soils subject to treatment prior to reuse
- Excavated material unsuitable for reuse in the formation
- Excess concrete, pavement, rock, steel and other material stored for either future use in the Project or prior to removal from site, and
- Topsoil, mulch, excess timber for landscaping and revegetation works.

Scope

This protocol and associated *Stockpile location checklist* describe the environmental criteria/ factors to be considered to ensure stockpiles are located in areas where potential environmental harm is minimised.

To avoid duplication, refer to the relevant issue-specific plan e.g. CAQMP, CWEMP, CFFMP, CNVMP, CHMP and this CSWQMP for the mitigation measures that will be implemented to avoid/ minimise air quality; waste management; flora and fauna; noise; heritage; and erosion and sediment impacts respectively from stockpiles.



Induction and training

All site personnel and subcontractors will be trained in this procedure.

Protocol

1. Proposed Stockpile Information

Prior to requesting the assessment of a stockpile location from the EO, the person requesting the new stockpile location should check approved stockpile locations to ensure current approved stockpile sites cannot be better utilised. Minimise the number of stockpiles sites wherever practicable.

If existing sites cannot be used, the expected quantity of material, expected dimensions required, expected stockpiling timeframes, whose land the stockpile will be located on and the type of material to be stockpiled must be detailed. Once this information is known, the EO shall be contacted for an assessment of the proposed stockpile location.

2. Assessment of Stockpile Site

The EO shall utilise the *Stockpile Location Checklist* (included in this Protocol, Table E-1) to assess the stockpile location.

Note stockpiles within the approved project boundary are intrinsic to and undifferentiated from the bulk earthworks operations, these stockpiles are assessed in accordance with Section 3.1.

Where stockpile areas located outside the approved project boundary are proposed an assessment will be undertaken in accordance with Section 3.2 and 3.3.

3. Approval of Stockpile Site

3.1 Stockpiles within the approved project boundary

The EO shall give the completed *Stockpile Location Checklist* (Table E-1) to the EM for review and assessment. Following this review, the EM shall either approve or reject the proposed stockpile location and notify the EO of the decision.

A register of all stockpile sites (Table E-2, included in this Protocol) shall be kept on file by the EO and they shall also ensure that any additional erosion and sediment control measures are included in the relevant progressive erosion and sediment control plan (PESCP).

3.2 Stockpiles on RMS land outside the approved project boundary

Where a stockpile is proposed outside the approved project boundary but on RMS owned land, the EM will assess whether the proposal is consistent with the Infrastructure Approval and complete the *Stockpile Location Checklist*.

Note: As approval of stockpiles on RMS owned land outside the approved project boundary will be determined by RMS and potentially the Secretary of DP&E (where the proposal is inconsistent with the Infrastructure Approval), the timeframes for approval will be greater than through the Environmental Team.

3.3 Stockpiles not on RMS land outside the approved project boundary

Where a stockpile is proposed on land outside the approved project boundary that is not RMS owned land, the EM will assess whether the proposal is consistent with the Infrastructure Approval, complete the *Stockpile Location Checklist* and obtain evidence of landowner consent.

Note: As approval of stockpiles on land outside the approved project boundary will be determined by RMS and potentially the Secretary of DP&E (where the proposal is inconsistent with the Infrastructure Approval), the timeframes for approval will be greater than through the Environmental Team.

4. Preparing Stockpile Site

If the proposed stockpile site is approved, the boundaries will be agreed between the person proposing the stockpile and the EO (or RMS where required). The proposed stockpile site will be marked out and appropriate erosion and sediment controls installed. Stockpile sites will also be signposted to clearly identify and delineate between other stockpiles. The erection of signs will be agreed with the Site Foreman.

Details of stockpile management in regard to erosion and sediment control will be included in the relevant ESCP/ PESCP.

5. Mulch Stockpiles

Locate and manage mulch stockpiles to minimise and manage tannin generation. Refer to Annexure F of this CSWQMP for *RMS Environmental Direction: Management of Tannins from Vegetation Mulch.*

Stockpile location checklist

Proposed Stockpile number:	
Chainage:	
Location sketch is attached? (mandatory)	☐ Yes
Stockpile type and dimensions (HxWxD):	

The location of stockpile sites will be determined following review of the following documents and requirements:

- Sensitive Area Plans
- Stockpile Management Protocol
- Environmental management measure (EMM) SW15 and EMM SW16
- RMS Specification D&C G36, G38 and G40
- RMS Stockpile Site Management Guideline

Where proposed sites do not comply with the criteria below, provide justification and additional mitigation measures to demonstrate how potential impacts will be managed.

Table E-1 Stockpile location criteria

	Criteria	Source of requirement	Does the proposed site meet the criteria?	If proposed site does not meet the criteria, provide justification/ additional mitigation measures to demonstrate how potential impacts will be managed
Vegetation	Site should not require removal of areas of native vegetation (where feasible and reasonable)	EMM SW15		
	Site should be located outside of the 'dripline' of trees	EMM SW15		
	Site should be located outside of the tree protection zone of trees or native vegetation identified for retention. Refer to AS 4970.	G 38 cl 3.2		
	Site should be located outside known areas of weed infestation	EMM SW15		
	Site be located on land that does not require the removal of threatened species, EECs or roosting habitat for listed fauna species	CSWQMP stockpile template criteria		
Drainage	Site should be located away from areas subject to concentrated overland flow.	EMM SW16		
	Site should be located away from drainage lines and watercourses	G36 cl 4.8.2 G40 cl 4.2		
	Site should be located such that waterways and drainage lines are not directly impacted	EMM SW15		
	Site should be located at least 5 m from likely areas of concentrated water flows and at least 10 m from waterways that are classified as Class 1 and Class 2 from the DPI Fisheries guideline "*Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings"*	G 38 cl 3.2		

	Criteria	Source of requirement	Does the proposed site meet the criteria?	If proposed site does not meet the criteria, provide justification/ additional mitigation measures to demonstrate how potential impacts will be managed
	Site located on a floodplain should be managed so as to minimise loss of material in flood or rainfall events.	EMM SW16		
Dust and noise	Site should be located away from dust sensitive locations	G36 cl 4.4		
	Site should be located away from noise sensitive locations	G36 cl 4.4		
	Site must be positioned so that the stockpiled material is accessible at any time	G36 cl 4.8.2 G40 cl 4.2		
Access	Have ready access to the road network or direct access to the construction corridor	CSWQMP stockpile template criteria		
	Site must be positioned so that the stockpiled material is accessible at any time	G36 cl 4.8.2 and G40 cl 4.2		
Heritage	Site be located in areas of low heritage conservation significance (including identified Aboriginal Cultural value) and not impact on heritage sites beyond those already impacted by the Project.	CSWQMP stockpile template criteria		

For potential sites in and outside the corridor near heritage, involving fauna, or near TEC/ EEC, RMS and the ER are to be consulted in advance of signoffs.

Prepared by Environment Officer: ……..……..... Date: ……..

Environmental Manager:……..... Date: ……..……

Approved / Rejected (please circle) by: …… Date: ……

Table E-2 Approved stockpile location register

Stockpile number/ identifier	Date approved	Location description	Chainage	Issued To	Updated PESCP? (yes/ no/ not

Annexure F
RMS Environmental Direction:
Management of Tannins from Vegetation Mulch

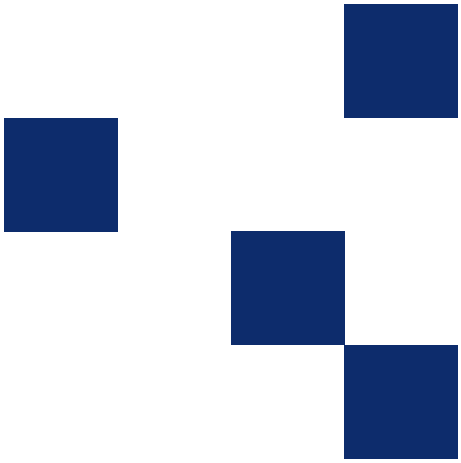
Transport Roads & Maritime Services

NSW GOVERNMENT

ENVIRONMENTAL DIRECTION

Management of Tannins from Vegetation Mulch

JANUARY 2012



ABOUT THIS RELEASE

Environmental Direction number	25
Environmental Direction title	Management of Tannins from Vegetation Mulch
Author	Environment Branch (Environmental Policy)

Issue	Date	Revision description
1	December 2011	Final draft
2	January 2012	Final

CONTENTS

1 PURPOSE

The purpose of this environmental direction is to set RMS's minimum management measures to minimise the generation and discharge of tannins from vegetation mulch on Roads and Maritime Services (RMS) construction projects. Additional background information on tannins and the use of mulch on construction sites is included in section 3 of this direction.

2 MANAGEMENT MEASURES

The primary focus must be to minimise tannin generation on construction sites.

2.1 General mulch management measures

These general mulch management measures are to be followed for all RMS construction projects.

2.1.1 Planning and works staging

The first step in planning and works staging is to identify the amount of mulch to be generated. With this information, a strategy can be prepared to manage mulch on site. Staging of chipping, tub grinding and/or mulching activities should be planned to reduce the volume of mulch to be managed at any one time. The volume of excess mulch can then be assessed and plans made to dispose of this off site.

Other general considerations at the planning and works staging phase are as follows:

- Mulch stockpile sites should be established with appropriate controls in place before the main site clearing activities commence. Limited clearing may be required earlier for establishment of stockpile areas and access.
- Stage the mulching of cleared vegetation to ensure that mulch can be progressively moved to elevated, or otherwise suitable, stockpile locations. It is preferred that mulch should be transferred to a stockpile or reused on the day of mulching.
- Plan to efficiently reuse mulch in progressive works to reduce the time that mulch is concentrated in stockpile locations.
- Excess mulch can be managed by community giveaway. This takes considerable time and mulch needs to be suitably located and managed as this occurs. The conditions for community giveaway of mulch are included as Appendix 3.
- Any other form of bulk offsite mulch disposal (eg to Council parkland or a development site) must be assessed to ensure waste management provisions are adhered to for off site disposal.

2.1.2 Stockpile location and management

- Mulch stockpile sites should be established on elevated ground where possible.
- Stockpile sites with a duration of not more than 1 month should be constructed not less than 20 metres from a watercourse, including floodplains.
- Stockpile sites with a duration of more than 1 month should be constructed not less than 50 metres from a watercourse, including floodplains.
- Mulch stockpiles should be designed and constructed to divert upgradient water to prevent it from entering the stockpile site.

2.1.3 Management measures for the use of mulch on site

- Do not use mulch for surface cover or sedimentation controls in any low lying areas of the site that remain consistently wet. Alternative controls such as geofabric (for surface protection) or sediment fence will be required in these areas.
- Do not spread surface mulch in thicker than 100mm layers. Mixing mulch with topsoil is encouraged for batters to prevent loss of topsoil during initial stabilisation. It should be noted that mulch will generally cause nitrogen draw down which may inhibit plant growth, unless mulch has been composted first.
- Care is to be taken to ensure that excessive mulch is not applied for sedimentation controls such as perimeter bunds or catch dams.

2.1.4 Monitoring and response

- Monitor the site for generation of tannins. Tannin impacts can be readily identified visually as dark coloured ponded water. Site staff should be trained to identify and report potential impacts to the site project management or environment staff.
- Review management practices where required to prevent the generation of tannins in identified problem areas.

2.2 Mulch management methods for high risk sites

2.2.1 High risk sites

High risk sites, where additional management measures may be required, include:

- where large quantities of mulch will be generated and stockpiled.
- where high tannin generating vegetation types are to be mulched (see 3.1).
- where the receiving environment is identified as sensitive (eg Marine Park, threatened aquatic species habitat).
- where tannins have been observed to be generated or discharged from an operating site with standard management controls.

2.2.2 Stockpile management measures for high risk sites

- Mulch stockpiles for high tannin generating vegetation types should incorporate an impermeable bund to capture stockpile leachate or tannin impacted water. Impervious bunds must be a minimum of 300 mm high, preferably higher to capture tannin impacted water. All bunded stockpiles that are in place for a period longer than one month must include a lined discharge point for overflow in extreme rainfall events.
- Stockpiles established on sloping sites must be designed to provide temporary stormwater containment equivalent to a 300 mm minimum height bund on a flat site.
- Tannin impacted water should be pumped out of bunded stockpiles within 5 days of the end of a rainfall event to maintain the storage capacity. This water should be used for on site purposes including dust suppression and landscape watering. These activities must be managed to prevent any pooling or runoff of tannin impacted water.
- Bunded stockpiles must be inspected within 24 hours of cessation of any rainfall event greater than 10mm to ensure tannin impacted water does not overflow.

2.3 Site management procedures

Site management procedures must be prepared for all sites where tannins are identified as a potential issue. Site management procedures should be based on the management measures provided in this Environmental Direction.

3 BACKGROUND

3.1 Tannin generation from vegetation mulch

See Plates 1 – 3 in Appendix 1.

Tannins are naturally occurring plant compounds. Tannin generation from vegetation mulch is likely to be highest from low-lying coastal floodplain areas. The species of vegetation (eg *Melaleuca*) will have a major impact on the likelihood of tannin generation.

Tannin generation is generally highest from mulched vegetation that is stockpiled in areas that are subject to inundation. Placement in wet areas will result in accelerated leaching of tannins into water, concentration of tannins in pooled water, and greater impacts on water quality.

3.2 Tannin impacts on water quality

See Plates 4 – 5 in Appendix 1.

The main concern with the discharge of water that is high in tannins is that it may increase the biological oxygen demand (BOD) of the receiving environment. Increases in BOD may result in a decrease in available dissolved oxygen. A lack of dissolved oxygen is identified as the main cause of about 80 percent of fish kills in NSW rivers and estuaries.

Tannin impacts may result in dark coloured water discharge from construction sites. This impact can be obvious and may raise the concern of the community and other stakeholders including regulatory authorities. Once discharged to the environment, tannins may reduce visibility and light penetration and change the pH of receiving waters. These impacts may affect aquatic ecosystems in receiving environments.

Tannins cannot be readily treated with standard construction site water quality controls. Once water on site is impacted with tannins it is not possible to treat effectively with currently approved flocculants. Minimisation of tannin generation in the first place is the management strategy that must be applied.

3.3 Use of mulch on construction sites

See Plates 10 – 16 in Appendix 2.

The RMS Biodiversity Guidelines provide guidance on the benefits of reusing various sizes of vegetation for different purposes. Mulch is a readily available and cheap source of material for temporary site stabilisation and sedimentation control. The re-use of mulch reduces the need to transport this material off-site and reduces handling and disposal costs for construction contracts.

Unprotected mulch sedimentation controls should not be placed in concentrated flow lines where mulch may be washed away. Mulch may be protected by wrapping it with geofabric or other materials to provide a stable control. All temporary catch dams constructed from mulch must have a stable outlet to minimise the washing away of mulch in high rainfall events, and the possible failure of the control.

4 ADDITIONAL RESOURCES

- RTA Biodiversity Guidelines- Protecting and Managing Biodiversity on RTA Projects, 2011
- Pacific Highway Mulch Protocol 2011

5 APPENDICES

Appendix 1: Plates showing tannin generation & water quality impacts

Plate 1: Melaleuca vegetation community – mulch from this vegetation type will generally produce high amounts of tannins.

Plate 2: Vegetation mulching activity – mulch should be progressively moved into prepared stockpile areas.

Plate 3: Tannin generation from recently felled and partially mulched vegetation in an area subject to localised inundation. Mulched vegetation should be progressively moved to prepared stockpiles to manage tannin impacted water.

Plate 4: Tannin impact in stormwater at the discharge point from a road construction site. The discharge of impacted water may be obvious to community and other stakeholders.

Plate 5: Tannins in a drainage line generated from very thickly applied mulch on the batter above. Note that the sedimentation fence is not effective in treating the tannins.

Appendix 2: Plates showing the use of mulch for erosion & sedimentation controls

Plate 6: Mulched vegetation stockpiled in a low-lying area subject to inundation. This is not an appropriate stockpile location and may increase the generation of tannins from stockpiled mulch.

Plate 7: Mulch being placed as batter erosion control. Mulch should not be applied in layers more than 100 mm thick for surface stabilisation.

Plate 8: Site showing recent application of a mulch/topsoil mix on batters (40% mulch to 60% topsoil). Mulch mixes are used to provide temporary stabilisation to prevent the loss of topsoil from batters in heavy rainfall events. Mulch use is also shown as a mounded sedimentation control to prevent sediment entering the median drain.

Plate 9: A mulch/topsoil mix used to provide temporary batter stabilisation and to assist cover crop establishment.

Plate 10: Successful establishment of cover crops on batters where mulch has been used with topsoil to assist temporary stabilisation.

Plate 11: Geofabric wrapped mulch bunds used for sedimentation control

Plate 12: Mulch used as a bund for a temporary sedimentation catch dam. Mulch is effective as it can provide both containment and filtering of site water. Mulch should not be used as a control in areas of concentrated flow where it may be washed away. Any mulch containment control should have a defined and lined outlet that allows discharge from the control without washing mulch away. Note that this control does not have a defined discharge outlet which should be installed to prevent failure of the control in heavy rainfall events.

Appendix 3: Minimum requirements for community mulch giveaways

The purpose of community mulch giveaways is to provide mulch for residential landscaping purposes.

The activities of a community mulch giveaway are permissible under the *Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A* (the Raw Mulch Exemption 2008). However, the activities remain subject to other relevant environmental regulations within the Act and Regulations. The Raw Mulch Exemption 2008 is subject to the following conditions:

- The raw mulch can only be applied to land for the purposes of filtration or as a soil amendment material or used either singularly or in any combination as input material(s) to a composting process.
- The consumer must land apply the raw mulch within a reasonable period of time.

Further information can be found at: www.environment.nsw.gov.au/resources/waste/ex08mulch.pdf

It is the mulch generators responsibility to ensure that the mulch is reused in an environmentally responsible manner.

A safe work method statement (SWMS) must be prepared that identifies potential OHS risks and all prevention and mitigation measures. The SWMS must apply to both the community and site workers involved in the mulch giveaway.

Each member of the community who participates in the mulch giveaway must read and understand a site specific information sheet. A template information sheet is attached as Appendix 4.

The site occupier must maintain written records for each load of mulch that is taken away and to ensure that each community participant understands the conditions of the community mulch giveaway information sheet. A suggested template to record this information is attached as Appendix 5.

Appendix 4: Community mulch giveaway information sheet

The following community mulch giveaway information sheet must be populated with site specific information.

Community Mulch Giveaway
Information Sheet

Details of Mulch Supply	
Site Occupier	<insert name of contractor / alliance etc>
Project Name	<insert project name>
Location	<insert location of mulch stockpile>
Mulch stockpile access directions	<insert adequate directions for community members to find the stockpile location>

Background

- This information sheet supports the non-commercial giveaway of mulch for local residents.
- The product is raw vegetation mulch from <insert project location / name>.

Conditions

- Any one individual may only take a maximum of 5 trailer loads from this project.
- The mulch may only be used for residential landscaping purposes.
- Mulch must not be placed in or immediately adjacent to waterways.
- The raw mulch can only be applied to land for the purposes of filtration or as a soil amendment material or used either singularly or in any combination as input material(s) to a composting process.
- The consumer must apply the raw mulch to land within a reasonable period of time.

Community Safety Requirements

- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>

Appendix 5: Records template for community mulch giveaway

The records in the following suggested template must be kept as a minimum.

Community Mulch Giveaway Record Sheet				
Date	**Car Registration**	**I have read and understand the 'Community Mulch Giveaway Information Sheet'**	**Name**	**Signature**
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		

Annexure G

Not used.

Annexure H
Pacific Highway Projects Dewatering Practice Note

Technical Guideline

Environmental Management of Construction Site Dewatering

EMS-TG-011

Issue 2 April 2011

Environmental Management System (EMS)

About this release

Guideline number:	EMS-TG-011
Guideline title:	Environmental Management of Construction Site Dewatering
Author:	Environment Branch (Environmental Policy)

Issue	Date	Revision description
1	March 2011	Draft
2	April 2011	Final

1.0 Purpose

The purpose of this Guideline is to assist RTA and Contractor project management teams to develop work method statements (WMS) for dewatering activities for main road construction and maintenance projects.

2.0 Scope

This Guideline applies to all projects undertaken by the RTA or engaged contractors that will involve the dewatering of ponded stormwater or infiltrated groundwater. It provides guidance on the preparation of WMS for dewatering activities where required under either RTA specification G35 (Environmental Protection - Management Plan) or G36 (Environmental Protection - Management System).

3.0 Introduction

Dewatering, for the purposes of this guideline, is any activity that involves the removal of ponded stormwater or infiltrated groundwater from any location on site and the subsequent reuse or discharge of that water.

Captured stormwater and infiltrating groundwater will fill sedimentation controls and pool in low lying areas of construction formations and excavations. These areas must be dewatered to maintain the effectiveness of sedimentation controls and to ensure formations and excavations are not adversely affected by long periods of inundation.

During construction activities there may be a requirement to dewater numerous locations including:
- Sedimentation controls (eg sedimentation basins and sumps)
- Excavations
- Culvert and drainage constructions
- Low lying areas of road formations.

It is the objective of this guideline to ensure that all site dewatering activities are completed in a manner that does not cause harm to the environment. To achieve this, a site-specific WMS must be developed for all construction and maintenance projects to ensure that dewatering actions are planned, approved and supervised to minimise impacts on the receiving environment.

No construction site dewatering activity should be carried out unless it is in accordance with a WMS.

4.0 Planning Construction Site Dewatering Activities

Every dewatering activity must be planned to achieve satisfactory environmental outcomes. Sections 4.1 to 4.8 describe critical decisions that must be made in preparing dewatering WMS.

4.1 Identify areas of the site that will require dewatering.

Dewatering locations will be identified though detailed design, in development of the CEMP and during construction as earthworks and construction phases result in changing site drainage conditions. These may include:
- Sedimentation controls (eg sedimentation basins and sumps)
- Excavations
- Culvert and drainage constructions
- Low lying areas of road formations.

Under no circumstances should first flush concrete batching water be pumped to sediment basins for treatment. These waters should be reused within the batching process or must be treated in-situ to ensure accidental discharges do not occur.

4.2 Consider dewatering methods to minimise potential environmental impacts

There are various methods available for dewatering sedimentation controls and inundated areas of construction excavations and formations. The Contractor should assess different technologies with a view to providing the highest level of protection against environmental impacts.

Dewatering methods for sedimentation controls such as basins include pumping, low flow pipes and siphon discharges. Consideration should be given to alternatives to pumped discharges in all cases where practical.

Pumped dewatering presents specific risks relating to the pump inlet falling to the level of deposited sediment, resulting in direct discharge of polluted water to the environment. Any pumped discharge should be designed to prevent this scenario. Likewise, deposited sediment in controls such as basins must be maintained (removed) to ensure that inlets to dewatering systems are always above the level of deposited sediment.

There are two general methods for achieving water quality objectives for any site discharge, being:

a) Water quality treatment prior to discharge.

This is required for sedimentation basins and is the preferred method for any construction excavation or inundated area that has a sufficient volume and depth of water to provide flocculation of sediments prior to discharge. All area other than defined sedimentation basins that can be treated prior to discharge should have a designed dewatering method (eg a defined pumping point, low flow or siphon discharge).

b) Treatment with best practice controls prior to discharge.

Treatment with best practice erosion sedimentation controls during discharge is applicable for minor stormwater ponding and for activities such as individual culvert extensions where the volume of stormwater captured is minor and the dewatering activity is infrequent.

In these cases a suite of sedimentation controls, and appropriate erosion controls must be designed and implemented to provide on-site treatment of water prior to discharge to the environment. Controls may include sedimentation fences, mulch bunds, sedimentation sumps, geofabric wrapped gravel or mulch bunds, use of onsite grassed areas or a combination of techniques. The discharge from these activities must be managed to prevent erosion of the receiving environment.

4.3 Assess opportunities for reuse

Onsite reuse of stormwater or detained groundwater should be considered as a priority for all dewatering activities. Onsite reuse may include applications such as dust suppression, earthworks compaction, vegetation establishment/rehabilitation, and plant/vehicle wash-down.

Reuse of water on the construction site may reduce the need for imported or extracted water and provide a lower risk to the environment than direct discharge to the environment. Common minimum requirements for any reuse activity are that the reuse should not cause the ponding or runoff of water, which may then cause concentrated runoff and unauthorised discharge.

4.4 Assess limitations for any proposed reuse methods

Any reuse activity may be limited by climatic or site conditions. During heavy rainfall periods when the need is greatest to remove treated stormwater from sedimentation basins, construction sites may be closed and un-trafficable due to the wet condition of the site. In these cases, onsite reuse for dust suppression or compaction is not feasible or possible. In these cases the water must be discharged to meet the sedimentation basin

maintenance timeframes specified in either the environmental protection licence or the CEMP (for non-licensed sites).

Planning for any reuse activity and the WMS for dewatering must take these limitations into consideration, and a WMS developed for the management of discharge which may be required in high rainfall events.

Discharge water quality objectives (see 4.6) will not apply only in the cases where the reuse activity is designed to be operational under all climatic and construction conditions and discharge to the environment will not be required.

4.5 Select discharge locations and provide adequate energy dissipation

It is important to ensure that dewatering activities do not cause subsequent erosion at the discharge location or in receiving environments. Consideration must be given to the potential for erosion at discharge locations when designing dewatering outlets. Preference should be given to locations with established stable drainage.

Energy dissipation must be provided at all dewatering discharge points. This may include the use of surface protection such as concrete aprons, geofabric, shade cloth, gabions or form ply depending on the condition of the receiving environment.

4.6 Determine and document water quality criteria for discharge and/or reuse

Sites with Environmental Protection Licenses will have defined water quality objectives for discharges from sedimentation basins. Best management practice still applies when discharging water from all other sites. This includes defining representative water quality criteria for the receiving environment and ensuring all discharges comply with these requirements. Standard project water quality objectives criteria are as follows:

- Total suspended solids 50mg/L
- pH 6.5 – 8.5
- oil an grease no visible trace

Specific water quality criteria may be required for activities that have the potential to impact water quality through a range of pollutants including:

- general earthworks in soils with contamination issues
- earthworks in soils with naturally occurring issues such as acid sulphate soils, saline soils or high levels of other sulphide minerals (which may result in high concentrations of heavy metals in runoff).
- hydrocarbon spills
- concrete works (including batching operations)
- stabilised pavements
- precoat aggregates and spray sealing

Generally a review of environmental assessment and approval conditions and onsite conditions will provide further information on potential pollutants that may be present onsite or in site waters. Other methods to determine water pollutants may include the use of a testing probe, indicator strips, laboratory analysis, local knowledge and consultation with environmental officers and regulatory agencies.

If reuse activities are properly designed and managed then ponded stormwater or groundwater may be able to be reused onsite without specific treatment.

4.7 Assess the treatment techniques required to meet the water quality criteria.

Treatments should be designed to achieve the water quality outcome specified for the project, as well as to cater for the time constraints that may be applicable to the activity (ie 5 day management period for sedimentation basins). Treatments should be applied to waters as soon as the requirement is determined, and should be applied only by experienced and competent personnel. Care needs to be taken to ensure treatment methods do not adversely affect water quality.

Examples of common treatment applicable to RTA projects may include;

- Flocculation of turbid waters is used to minimise the settling duration of suspended particles, as well as facilitate the clearing of waters exposed to dispersive soils that are prevalent throughout NSW. Flocculation enables water quality standards to be achieved within an accepted time period. A suitable flocculent should be chosen for sites based on an impact assessment of the receiving environment. In most cases RTA projects would utilise gypsum which is considered to be inert. There are other flocculants available however the use of these must be subject to consultation with relevant stakeholders, including DECCW and NSW Industry & Investment (Fisheries) prior to use.
- pH adjustment using a base such as hydrated lime (for acidic waters) and inversely an acid such as hydrochloric acid (for alkaline waters). Low volume trials for each location will need to be carried out to determine dosage rates. Special care must be taken when adjusting pH to understand the buffer capacity of the waters, ensuring the neutral point is not over-shot. Any personnel involved in the adjustment of pH must be suitably trained and competent in the use of any additives.
- Absorption of oils and grease is used to remove traces of hydrocarbons that may have been mobilised by rainfall. Sources of oil and grease on a project may include spill and leaks from machinery, runoff from precoat aggregate stockpiles, and runoff from adjacent travel lanes. Generally oils and grease will be removed from the surface of water detention structure by the use of floating booms, pads and socks.

4.8 Assess water sampling and testing requirements

Water quality sampling and testing may be required to ensure that the water quality objectives are met prior to either reuse or discharge of the water. Techniques may include sample collection and laboratory testing or in-situ field assessment.

A list of approved testing methods for various analytes can be referenced from "Approved Methods for the Sampling and Analysis of Water Pollutant in New South Wales" (DEC 2004). Licensed premises require approved testing methods as per the conditions of the environmental protection licence (EPL) unless formal agreement has been reached with the relevant agencies. Any such agreement must be documented, and records kept onsite at all times

Non-licensed sites still require an approach to demonstrate due diligence for the testing of waters prior to discharge. This may include the use laboratory analysis and the approved testing methods, but alternatively can include calibrated comparison samples, turbidity tubes, portable probe analysis, or indicator strips. With the use of any of these alternative methods, their use should be discussed with environmental officers and personnel testing must be trained and competent. Regardless of the type testing utilised, comprehensive records must be kept onsite of all discharges.

5.0 Minimum Requirements for Dewatering Work Method Statements

5.1 WMS format

The format of site-specific WMS is flexible according to the procedures used by each Contractor. This guideline and RTA specifications G35 or G36 do not require an individual WMS for each dewatering location on each site.

Maps should be used to show all identified dewatering locations that the WMS applies to. Coded systems for similar type activities (eg pumping from sedimentation basin) can be used. The WMS should provide clear guidance for each dewatering activity on the following:

a) a map showing areas of the Site that will require dewatering
b) detailed description and justification of all selected dewatering methods

c) description of onsite water reuse requirements
d) a map showing proposed discharge locations for any offsite discharge
e) design requirements for each offsite discharge location to prevent erosion at the discharge location or in the receiving environment
f) water quality objectives relevant to the type of dewatering activity
g) description of the water quality treatment techniques to be used
h) water sampling and testing regime to validate water quality prior to and (if required) during dewatering
i) Proposed monitoring and supervision regime.

If changes are proposed to the dewatering method used at any location or new dewatering requirements are identified during construction you must submit either of the following to the Principal before commencing the activity:
a) revised and updated the Site WMS, or
b) a site-specific WMS for the activity.

5.2 Document the site activity approvals process

All sites discharging water must have in force a robust delegation for the approval of all controlled discharges. This process is to be clearly documented in work method statements and must nominate specific personnel who can approve dewatering activities. Delegates responsible for dewatering approval must be suitably trained and experienced in their duties. The approval process for dewatering activities is to be included in the worksite induction and training of onsite personnel to ensure unauthorised discharges are eliminated.

The minimum requirements of this approval are:

- water quality is demonstrated to meet the objectives in the WMS
- inspection of intake and discharge locations, equipment and receiving environment completed
- trained personnel are available to supervise and monitor the activity as specified on the WMS.

5.3 Document training and induction requirements

All staff responsible for approval and/or carrying out dewatering activities must be trained and inducted into use of the WMS. The WMS should include an induction register as a record of staff that are approved to conduct or approve dewatering activities.

5.4 Document the requirements for supervision of dewatering activities

The WMS must provide a clear description of all supervision and monitoring required for each dewatering activity. All dewatering activities must be inspected and monitored by inducted, experienced and competent personnel. Prior to commencing any dewatering activity the entire system, including intake and outlet, pump, and discharge location must be inspected.

All dewatering activities must be directly supervised for the entire duration. To remove the need for direct supervision, sites may carry out risk assessments and implement mitigation measures to ELIMINATE risks of causing environmental harm. Mitigation measures must be demonstrated to eliminate the possibilities of the following incidents:

- Intakes dropping into deposited sediments and discharging sediment laden waters,
- Erosion of the discharge locations and downstream environment,
- Inadvertent or intentional controlled discharge of untreated waters.

5.5 Record keeping for dewatering activities

You must keep the following records:

a) A copy of the dewatering WMS
b) date, time and estimated volume of water released for each discharge location

c) water quality test results for each discharge
d) records indicating who provides approval for each dewatering activity, and
e) evidence of discharge monitoring or risk assessment.

.

DEWATERING PRACTICE NOTE

Pacific Highway Projects

May 2012

Document control

Document Title	Dewatering Practice Note (Pacific Highway Projects)
Author	RMS Pacific Highway Office

Issue	Date	Revision Description
1	January 2012	Draft
2	February 2012	Draft
3	May 2012	Final

Disclaimer

The information contained within this practice note is for general information only and is not intended to constitute legal advice. RMS accepts no responsibility for any loss arising out of reliance on any information contained in this document.

Acknowledgements

This practice note was prepared by RMS Pacific Highway Office.

RMS Pacific Highway Office would like to acknowledge RMS Environment Branch (Environmental Policy) and their publication *Environmental Management of Construction Site Dewatering EMS-TG-011*; this publication has served as the basis for this practice note.

RMS Pacific Highway Office would also like to acknowledge the assistance of EPA who provided comment on and assisted in the development of this practice note.

Contents

1. How to use the Practice Note

The Dewatering Practice Note is intended for use by RMS project managers, staff and contractors on Pacific Highway construction projects. It has been designed as a means to ensure key mitigation and management principles for dewatering are indentified and included in project specific Environmental Work Method Statements (EWMS) to be implemented prior to the need to conduct dewatering activities. It should be employed by RMS project teams as a means to proactively plan, assess and improve on-site procedures involving dewatering. When used correctly the practice note will aid in the enhancement of RMS environmental procedures, ensuring detrimental environmental impacts from RMS construction projects are kept to a minimum.

Refer to this practice note when preparing or assessing EWMS for work activities associated with the removal of ponded stormwater or infiltrated groundwater from any location on site, as well as the subsequent reuse or discharge of that water.

2. Introduction

2.1. Background

Dewatering is considered as any activity involving the removal of ponded stormwater or infiltrated groundwater from any location on site. For the purposes of this practice note and other RMS documentation, dewatering also encompasses any activity involving the subsequent reuse or discharge of such water.

Dewatering is a necessary part of any construction or maintenance project as captured stormwater and infiltrating groundwater will fill and pool in low-lying areas of construction sites over time. Without dewatering, pooling water may otherwise adversely affect project objectives. Reduced sediment control effectiveness, damage to formations and excavations, decreased site-access and increased downtime may all result without dewatering activity.

2.2. Objective

It is a requirement of all RMS Pacific Highway construction projects that ALL dewatering activities are undertaken in a manner that does not pollute the environment. As such project teams working on Pacific Highway projects must develop and comply with appropriately planned, approved and supervised procedures to govern such activities. Documentation of such procedures shall be in the form of an environmental work method statement (EWMS). An EWMS shall be both activity related and project specific and ALL dewatering activities must be addressed for each project. Minimum requirements for each EWMS have been outlined within this practice note, although the use of innovation is encouraged to continually enhance RMS environmental best practice.

Specific aims of this practice note are to deliver best practise and due diligence requirements on Pacific Highway construction projects that enable:

- dewatering activities to be managed to avoid pollution and/or environmental harm as defined under the Protection of the Environment Operations Act (NSW, 1997), (POEO Act) and Regulation;
- that promote sustainability in reusing valuable resources; and
- compliance with conditions of approval, permits, and licence conditions.

3. Considerations in planning dewatering activities

Every dewatering activity must be planned to achieve satisfactory environmental outcomes. In the preparation of an effective and acceptable dewatering EWMS, the following actions must be undertaken:

- Identify areas of the site that will require dewatering
- Identify receiving environment where water will be discharged with consideration and assessment of the sensitivity of the receiving environment (E.g. threatened frog/fish species habitat, Marine Park Areas, etc) - wherever possible dewatering to environmentally sensitive areas should be avoided.
- Consider dewatering methods that will minimise potential environmental impacts
- Assess opportunities for reuse

- Assess limitations for any proposed reuse methods
- Select discharge locations and provide adequate energy dissipation
- Determine and document water quality criteria for discharge and/or reuse
- Assess the treatment techniques required to meet the water quality criteria
- Assess water sampling and testing requirements
- Where discharge to sensitive areas is unavoidable, discharge methods, monitoring, sampling and testing should all reflect the specific nature of that receiving environment, its sensitivity and potential threats. This includes specifically targeting relevant parameters based on consideration of the nature of these sensitive environments.
- Identification of any potential contaminants. It is possible that previous land use activity and or the natural geology may produce contaminants. Where there is evidence to suggest there may be contamination within the catchment of an area requiring dewatering the testing regime should identify any risk and be targeted to ensure that risk is managed.
- Indication of likely volumes and duration of dewatering
- Monitoring requirements / regime
- Ensuring that dewatering does not result in discharged water re-entering the site / disturbed surfaces.
- Considering and addressing potential impacts on natural flows / water levels down stream.
- Considering and addressing mixing rates and dilution to the receiving environment.
- Training requirements / assessment of competency
- Incident management response
- Arrangement and management of the pump inlet
- Bunding of the pump

The subsequent sections (*sections 3.1 to 3.8*) will outline considerations associated with each of the actions listed above. These actions are highly recommended in the early stages of preparing an EWMS although do not constitute necessary deliverable inclusions in an EWMS document. (for minimum deliverable requirements in an EWMS document refer *Section 4: Minimum requirements for dewatering environmental work method statements*)

In addition the *Appendix* of this document provides photographs taken of dewatering activities on RMS construction projects. The photographs may be used to illustrate example designs, aiding in the design consideration process.

3.1. Identify areas of the site that will require dewatering

Dewatering locations will be identified through detailed design, in the development of the CEMP and during construction phase as earthworks and construction processes result in changing site drainage conditions. Typically locations that will require dewatering on RMS projects include:

- Sedimentation controls (e.g. sedimentation basins and sumps)
- Excavations
- Culvert and drainage constructions
- Low lying areas of road formations

3.2. Consider dewatering methods to minimise potential environmental impacts

There are various methods for dewatering sedimentation controls and inundated areas of construction excavation and formations. Common dewatering methods for sedimentation controls such as basins include pumping, low flow pipes and siphon discharges.

When selecting dewatering methods, consideration should be given to alternatives to pumped discharges where practical. Pumped dewatering presents specific risks relating to the pump inlet falling to the level of deposited sediment. This would result in direct discharge of polluted water to the receiving environment. In situations where pumping is necessary, additional protection measures should be designed into the dewatering methodology to prevent this scenario from occurring. Likewise, deposited sediment in controls such as basins must be routinely maintained (removed) to ensure that inlets to dewatering pumps and pipes are always above the level of deposited sediment.

There are two general methods for achieving water quality objectives for any site discharge, these being:

1) Water quality treatment prior to discharge.

This is required for sedimentation basins and is the preferred method for any construction excavation of inundated area that has sufficient volume and depth of water to provide flocculation of sediments prior to discharge. Any area other than defined sedimentation basins that can be treated prior to discharge should have a designed dewatering method (e.g. a defined pumping point, low flow or siphon discharge). This method would be designed to address appropriate water quality parameters and limits, and the type and volume of treatments required.

2) Treatment with best practise controls prior to discharge.

Best practise controls are those referred to within Blue Book Volume 1 and Volume 2D. Controls may include sedimentation fences, mulch bunds, sedimentation sumps, geofabric wrapped gravel or mulch bunds, use of onsite grassed areas or a combination of techniques. Treatment with best practise controls is undertaken prior to discharge. These controls must be designed, implemented, monitored and maintained to prevent erosion of the receiving environment and pollution of waters.

Treatment with best practise erosion and sedimentation controls during discharge is only applicable for minor stormwater ponding and for activities such as individual culvert extensions where the volume of stormwater captured is minor and the dewatering activity is infrequent. Addressing due diligence, risk pollution and environmental harm, site conditions and receiving environment would still need to be considered when determining whether to treat or not to treat water prior to discharge, When considering discharge location and treatment method. The following factors should also be considered:

- application rates,
- soil types,
- hydraulic loading,
- evapo-transpiration rates (as per s6.2 Blue Book Volume 2D, page 28).

The effectiveness of treatments are to be monitored and assessed and need to rectify controls and management strategy as required.

3.3. Assess opportunities for reuse

Onsite reuse of stormwater or detained groundwater should be considered as a priority for all dewatering activities. Onsite reuse may include applications such as dust suppression, earthworks compaction, vegetation establishment/rehabilitation, and plant/vehicle wash-down.

Reuse of water on construction site may reduce the need for imported or extracted water and provide a lower risk to the environment than direct discharge to the environment. A common minimum requirement for any reuse activity is that any reuse should not cause the ponding or runoff of water, which may then cause concentrated runoff and unauthorised discharge.

3.4. Assess limitations for any proposed reuse methods

Any reuse activity may be limited by climatic or site conditions. During heavy rainfall periods, when there is the greatest need to remove treated stormwater from sedimentation basins, construction sites may be closed or access limited due to the wet conditions. In such cases, onsite reuse for dust suppression or compaction is neither feasible nor possible. In these cases the water must be discharged to meet the sedimentation basin maintenance timeframes specified in either the environmental protection licence or the CEMP (for non-licensed site).

Planning for any reuse activity and the EWMS for dewatering must take these limitations into consideration, and an EWMS developed for the management of discharge which may be required as a result of high rainfall events. Planning may include controls such as lining basins, sumps, and excavations with gypsum and/or ensuring the capacity of sumps, excavations are re-instated prior to forecast rain events.

3.5. Select discharge locations and provide adequate energy dissipation

It is important to ensure that dewatering activities do not cause erosion at the discharge location or in receiving environments. Consideration must be given to the potential for erosion at discharge locations when designing dewatering outlets. Preference for treated discharge should be given to locations with established drainage and outlet structures. Locations of designated discharge points should be included on all relevant erosion and sediment control plans for the specific construction activity.

Energy dissipation must be provided at all dewatering discharge points. This may include the use of surface protection such as concrete aprons, rock bunds, geofabric, shade cloth, gabions or form ply and will be dependent on the condition of the receiving environment.

Discharge locations should be chosen with consideration to the receiving environment that may contain environmentally sensitive receivers such as threatened frog/fish species, Marine Park, etc.

Where it is not possible to avoid discharges to sensitive areas, discharge methods, monitoring, sampling and testing should all reflect the specific nature of the receiving environment and relevant parameters should be targeted to monitor, control and minimise any potential impacts.

It is possible that previous land use activity and or the natural geology of the receiving environment may produce contaminants requiring identification and assessment. Where there is evidence to suggest there may be contamination within the catchment of an area requiring dewatering then the testing regime should also identify any risk and be targeted so that the risk is managed.

3.6. Determine and document water quality criteria for discharge and/or reuse

Sites with environmental protection licences will have defined water quality objectives for licensed discharge points. The water quality parameters are also only applicable to basin discharges registered under the license. A discharge that does not achieve the environmental outcomes permitted by an EPL is likely to be considered pollution under s120 of the POEO Act. Any discharges containing contaminants other than those specifically identified in the EPL must not result in pollution to waterways. Best management practice applies when discharging water from all other sites or non-licensed discharge points. This includes defining representative water quality criteria for the receiving environment and ensuring all discharges comply with these requirements as required under the license. For the majority of EPLs for Pacific Highway projects only the outlets of basins is a licensed discharge point registered under the EPL. Standard project water quality objectives criteria for Pacific Highway projects are as follows:

- Total suspended solids 50mg/L
- pH 6.5 – 8.5
- Oil and grease no visible trace

Additional specified receiving water quality criteria may be required for activities that have the potential to impact water quality through a range of pollutants including:

- general earthworks in soils with contamination issues
- earthworks in naturally occurring problematic soils such as acid sulphate soils, saline soil or high levels of other sulphide minerals
- lime storage areas
- tannin leachate
- hydrocarbon spills
- concrete works (including batching operations)
- stabilised pavements
- precoat aggregates and spray sealing
- polymers
- curing compounds

Generally a review of environmental assessment and approval conditions and onsite conditions will provide further information on potential pollutants that may be present onsite or in site waters. Other methods to determine water pollutants may include the use of a testing probe, indicator strips, laboratory analysis, local knowledge and consultation with environmental officers and regulatory agencies.

If reuse activities are properly designed and managed then ponded stormwater or groundwater may be able to be reused onsite without specific treatment.

3.7. Assess the treatment techniques required to meet the water quality criteria

Treatments should be designed to achieve the water quality outcome specified, as well as to cater for the time constraints that may be applicable to the activity (i.e. 5 day management period for sedimentation basins). Treatments should be applied to waters, and should be applied only by

experienced and competent personnel. Care needs to be taken to ensure treatment methods do not adversely affect water quality or the receiving environment.

Examples of common treatment applicable to RMS projects may include:

- Flocculation of turbid waters to minimise the settling duration of suspended particles, as well as facilitate the clearing of waters exposed to dispersive soils. Flocculation enables water quality standards to be achieved within an acceptable time period. A suitable flocculent should be chosen for sites based on an impact assessment of the receiving environment. In most cases RMS projects would utilise gypsum, which is considered to be inert. There are other flocculants available; however the use of these must be subject to consultation with relevant stakeholders, including EPA and NSW DPI (Fisheries) prior to use.
- pH adjustment using a base such as hydrated lime (for acidic waters) and inversely an acid such as hydrochloric acid (for alkaline waters). Low volume trials for each location will need to be carried out to determine dosage rates. Special care must be taken when adjusting pH to understand the buffer capacity of the waters, ensuring the neutral point is not over-shot. Any personnel involved in the adjustment of pH must be suitably trained and competent in the use of any additives.
- Absorption of oils and grease is used to remove traces of hydrocarbons that may have been mobilised by rainfall. Sources of oil and grease on a project may include spills and leaks from machinery, runoff from precoat aggregate stockpiles and runoff from adjacent travel lanes. Generally oils and grease will be removed from the surface of water detention by the use of floating booms, pads and absorption socks.

Additional information is provided in Blue Book references:

- Appendix B, page 41 of Blue Book Volume 2D for basin management immediately after rain
- Appendix E of the Blue Book Volume 1 with regards to the best practice methodology of flocculation of basins.
- Attachment 5, page 51 of Blue Book V2D for managing pH.

3.8. Assess water sampling and testing requirements

Water quality sampling and testing may be required to ensure that the water quality objectives are met both prior to and during either reuse or discharge of the water. Techniques may include sample collection and laboratory testing or in-situ field assessment.

A list of approved testing methods for various analytes can be referenced from "Approved Methods for the Sampling and Analysis of Water Pollutant in New South Wales" (EPA 2004). All sampling should be representative of the water to be discharged and testing methods in accordance with this document. Licensed premises require approved testing methods as per the conditions of the environmental protection licence (EPL) unless formal agreement has been reached with the relevant agencies. Any such agreement must be documented, and records kept onsite at all times.

Using turbidity as a tool for Total Suspended Solids (TSS) requires an established NTU/TSS correlation and ongoing laboratory verification to ensure the NTU/TSS correlation being applied for the project is correct.

4. Minimum requirements for dewatering environmental work method statements (EWMS)

4.1. EWMS format

The format of site-specific EWMS is flexible according to the procedures used by each project team. This practice note and RMS specification G36 do not require an individual EWMS for each dewatering location on each site although it is necessary for ALL dewatering activities to be accounted for within a documented EWMS.

The EWMS should provide clear guidance for each dewatering activity utilising each of the following:

a) a map showing areas of the site/project that will require dewatering. This map should identify environmentally sensitive areas and features to be considered when planning discharge locations
b) detailed description and staged methodology of selected dewatering methods. This should include a clear and concise step by step procedure
c) description of onsite water reuse requirements
d) a map showing proposed discharge locations for any offsite discharge
e) design requirements for each offsite discharge location to prevent erosion at the discharge location or in the receiving environment
f) water quality objectives relevant to the type of dewatering activity
g) description of the water quality treatment techniques to be used
h) water sampling and testing regime to validate water quality prior to and (if required) during dewatering. Water quality sampling records should include, times, persons, method, parameters, treatment, consistent location, results etc.
i) Treatment volumes, time of application, who, how etc.
j) details of delegated approval of dewatering activities eg. Internal permit signed off by Environment Construction Manager.
k) proposed monitoring and supervision regimes.

If changes are proposed to the dewatering method used at any location or new dewatering requirements are identified during construction the project team must submit either of the following to the Principal before commencing the activity:

a) a revised and updated the site/project EWMS, or
b) a new stand-alone EWMS for the activity.

5. Document the site activity approvals process

All sites discharging water must have a robust procedure in place for the approval of all controlled discharges from dewatering activities and include a mechanism for quality assurance and verification. This process is to be clearly documented in the EWMS and must nominate specific personnel who can approve dewatering activities and specifically the controlled discharge of water. Delegates responsible for dewatering approval must be suitably trained and experienced in their duties. The approval process for dewatering activities is to be included in the worksite induction and training of onsite personnel. The inclusion and enforcement of these procedures will ensure that the risk of unauthorised discharges is significantly reduced.

The minimum requirements of this approval are:

- water quality is demonstrated to meet the objectives in the EWMS and this practice note
- inspections of intake and discharge locations, equipment and receiving environments are completed
- trained personnel are available to supervise and monitor the activity as specified on the EWMS.

5.1. Document training and induction requirements

All staff responsible for approval and/or execution of dewatering activities must be trained and inducted into use of the EWMS. The EWMS should include an induction register as a record of staff that are approved to conduct or approve dewatering activities.

5.2. Document the requirements for supervision of dewatering activities

The EWMS must provide a clear description of all supervision and monitoring required for each dewatering activity. All dewatering activities must be inspected by inducted, experienced and competent personnel. Prior to commencing any dewatering activity of the entire system including intake and outlet, pump, and discharge locations must be inspected.

All dewatering activities must be directly supervised for the entire duration of the dewatering. To remove the need for direct supervision, sites may carry out risk assessments and implement mitigation measures to ELIMINATE risks of causing environmental harm. Due diligence must be demonstrated to eliminate the possibilities of the following incidents:

- intakes dropping into deposited sediments and discharging sediment-laden waters
- erosion of the discharge locations and downstream environment
- inadvertent or intentional controlled discharge of untreated waters.

5.3. Record keeping for dewatering activities

You must keep the following records:

a) a copy of the dewatering EWMS
b) date, time and estimated volume of water released for each discharge location
c) water quality test results for each discharge
d) records to verify persons monitoring, and monitoring data including water quality parameters and criteria, timing and location of monitoring
e) records indicating who provides approval for each dewatering activity, and
f) evidence of discharge monitoring or risk assessment

Appendix:
Photographs of Dewatering Activity on RMS Projects

Figure 1. Application to a sediment basin allows faster settling of sediments and improvements to water quality prior to discharge.

Figure 2. Consideration should always be given to measures to prevent pumped inlets from falling into sediment zones at the bottom of basins. In this example an anchored bucket was seen to be effective.

Figure 3. Informal use of bunding and geotextile was assessed as a suitable outlet treatment for scour protection in this example. The use of a tyre provided both energy dissipation for the discharge flow and anchorage for the discharge pipe.

Figure 3. Use of formal signage indicating discharge procedures was an effective management tool to prevent unauthorised discharges.

Figure 4. A sump adjacent to a working area may require higher levels of maintenance in order to remain effective. Dewatering to a larger sediment basin will be a more viable treatment measure when compared to flocculating the sump itself. Consideration to minimising exposed fines around the immediate catchment (e.g. bottom left corner of the figure) will also reduce sediment entering the sump if deemed practical for construction purposes.

Figure 5. A siphon and float system used for discharging a basin without use of pumps. Floats may be useful for preventing inlets from falling into sediment zones.

Figure 6. An inlet designed with up-turned pipe to ensure settled sediment is not sucked up during discharge. Note that sediment storage zone needs regular maintenance to ensure levels do not reach the inlet level.

TEMPORARY CLEAN WATER DIVERSION PRACTICE NOTE

Pacific Highway Projects

MAY 2012

Document control

Document Title	Temporary Clean Water Diversion Practice note (Pacific Highway Projects)
Author	RMS Pacific Highway Office

Issue	Date	Revision Description
1	January 2012	Draft
2	February 2012	Draft
3	May 2012	Final

Disclaimer

The information contained within this practice note is for general information only and is not intended to constitute legal advice. RMS accepts no responsibility for any loss arising out of reliance on any information contained in this document.

Acknowledgements

This practice note was prepared by RMS Pacific Highway Office.

RMS Pacific Highway Office would like to acknowledge the following sources that have been referenced and/or have contributed ideas and concepts to this practice note:

- Department of Environment & Climate Change NSW, 2008, Managing Urban Stormwater: Soils and Construction, Volume 2D Main Road Construction
- Landcom, 2004, *Managing Urban Stormwater: Soils and Construction*
- RMS Environment Branch (Environmental Policy), 2011, *Temporary stormwater drainage for road construction* and suite of standard drawings contained within Appendix A

RMS Pacific Highway Office would also like to acknowledge the assistance of EPA who provided comment and assisted in the development of this practice note.

Table of contents

1. How to use this Practice Note

The Temporary Clean Water Diversion practice note is intended for use by RMS project managers, staff and contractors on RMS Pacific Highway construction projects. They have been designed as a means to ensure key mitigation and management principles for temporary clean water diversions are identified and included in project specific Environmental Work Method Statements (EWMS). They should be employed by RMS project teams as a means to assess and improve onsite procedures involving temporary clean water diversions. The practice note has included design advice and example drawings that may be used as the basis for site-specific solutions to temporary clean water diversions, including their design, construction and maintenance. For the purposes of this practice note, temporary creek diversions are classified as temporary clean water diversions.

When used correctly the practice note will aid in the enhancement of RMS environmental procedures, ensuring detrimental environmental impacts from RMS construction projects are kept to a minimum.

Refer to this practice note when preparing or assessing EWMS for work activities associated with the installation and management of clean water diversions.

2. Introduction

2.1. Background

Soil and water management is a critical compliance risk for all RMS construction projects. It is an ongoing risk that requires continual management effort throughout all phases of construction as construction sites and site conditions evolve over time. Effective soil and water management includes a range of principles, these include:

1) The intercepting, diverting and safe disposing of 'clean' run-on water from undisturbed areas so that it does not flow onto the works
2) Passing 'clean' water through the site without mixing it with 'dirty' sediment-contaminated run-off from the works
3) Ensuring that sediment-laden runoff from works areas is effectively transferred to and treated by control measures (e.g. sedimentation basins).
(DECC, 2008)

It is a requirement of RMS projects that temporary clean water diversions are constructed and continually maintained in order to achieve these principles over the entire life of a project.

For the purposes of this practice note temporary clean water diversions are considered as any drainage or flow alteration measure used to prevent 'clean' water mixing with 'dirty' water that does not constitute part of the final design. For the purposes of this practice note temporary creek diversions are classified as a temporary clean water diversion. 'Clean' and 'dirty' water are defined as follows:

Offsite ('clean') Water	Any water that enters the site from external lands; OR any water that lands within the site but does not make contact with exposed soil or other 'dirty' water. Also referred to as 'clean water'.
Onsite ('dirty') Water	Any water that makes contact with exposed soil within the site. Also referred to as 'dirty water'.

Without the proper implementation of temporary clean water diversions, offsite 'clean' water flows may contribute to additional water being captured onsite, adversely affecting project objectives. Additional water captured will likely result in both greater flow quantities and velocities onsite, increasing potential for erosion and the quantity of sediment mobilised. Project works may also be detrimentally impacted. Among other effects, higher risks of inadvertent dirty water discharge lead to a heightened risk of breach of the NSW *Protection of the Environment Operations Act 1997*, potentially resulting regulatory action.

2.2. Scope

This Practice Note has been prepared to assist project delivery. The design advice and example drawings may be used to prepare site-specific solutions to complex temporary drainage issues and provide minimum standards. These minimum standards are required to be consistent with Blue Book and Environmental Protection License (EPL) requirements. The use of innovation is encouraged to provide effective temporary drainage that minimises impacts to the environment.

3. Considerations in temporary clean water diversion design

Selected temporary clean water diversion designs to be implemented on a project shall be included in an EWMS. An EWMS shall be both activity-related and project specific and all clean water diversion construction activities must be addressed for each project. In addition an EWMS must provide evidence that all works towards the construction and maintenance of clean water diversions are undertaken in an appropriately planned, approved and supervised manner. This provides assurance that risk of 'harm' to the environment during the construction phase are minimised. Harm to the environment, as described in the POEO Act, includes any direct or indirect alteration of the environment that has the effect of degrading the environment and, without limiting the generality of the above, includes any act or omission that results in pollution.

The key principles that apply to the design of temporary clean water diversions on construction sites are:

- Transfer clean water across the site/project without it becoming contaminated with sediment from onsite
- Avoid mixing 'clean' water with 'dirty' water
- Ensure onsite water is conveyed to an appropriate sediment retention structure (e.g. sediment basin, sediment trap) prior to release
- All temporary channelized flow paths constructed should be lined. Lining material should be appropriate for use in channel-flow conditions and should provide protection from erosion in both the short and long term

There are a number of considerations to be taken into account when designing a clean water diversion. These have been outlined in sections 3.1-3.8 as follows. Photographed examples of temporary clean water diversions that have successfully applied such considerations on RMS projects have also been included in *Appendix C* of this Practice Note.

3.1. Required functional design life

Required functional design life is important in determining the most suitable temporary clean water diversion designs in terms of both effectiveness and required resources. Depending on the specific circumstances a temporary clean water diversion may be required to function for a time period anywhere between 1 week and 12 months or occasionally even longer periods. Such a large variance will likely affect the performance requirements for any given situation as:

1) the likelihood of high rainfall events increase, and
2) adjacent site conditions change with time.

Any change in performance requirements will likely mandate other design considerations, such as those discussed the following sections. Design life may also govern the relative appropriateness of associated costs and construction efforts given project and work activity budget, time and resource constraints. Considerations made with regard to the design life of a temporary clean water diversion should not disregard the requirement to comply with the POEO and EPL which make it an offense to pollute waters.

It should be noted that although a control may be constructed on the basis of a short design life, if weather or operational changes extend the period the control will be used for the design should be reviewed and assessed for its suitability so that the licensee achieves compliance with the POEO and EPL.

3.2. Existing flow paths

Where existing flow paths exist, consideration should be given to:

- The existing type of flow (e.g. perennial or intermittent)
- Existing channel characteristics (e.g. width, depth, channel form)
- Surrounding topography and catchment areas
- Surrounding soil types that may present higher risks of erosion with flow alteration
- Surrounding vegetation that may aid in attenuating flows and/or erosion potential

Impacts of flow alterations, particularly scenarios involving the temporary reduction or restriction of an effective flow path must be considered carefully in the development of a suitable design.

3.3. Flow characteristics

Flow characteristics are essential in determining the capacity requirements of any clean water diversion. Surrounding topography will both define catchment areas, and indicate flow quantities and velocities. Consideration should also be given to vegetation (existing and remnant vegetation) present in the area, as this will also affect flow characteristics.

Designed clean water diversions should control flows and maximum velocities should not exceed those recommended in Table 5.2 (*Appendix B*).

3.4. Boundary, constructability and maintenance constraints

Ideally both boundary and constructability constraints should be assessed at the conceptual stage of project design with adequate land (within project clearing limits) provided for any clean water diversion measures to be implemented. Consideration of constructability of such measures is imperative to ensure adequate space is available onsite. Adequate space for temporary clean water diversion construction and maintenance ensures that:

1) the most suitable designs are not discounted on the basis of constructability constraints,
2) designs are able to be constructed efficiently, and
3) designs are able to be maintained to a functional standard over their required life.

Consideration should also be given to any existing services in the area.

Assessment of design space requirements should consider:

- Accessibility for clean water diversion construction
- Potential conflicts with services, project boundaries or other exclusion zones
- Space requirements for construction plant (also consider working platforms)
- Space requirements for temporary erosion and sediment controls during construction of diversions
- Space requirements for permanent erosion and sediment controls (e.g. energy dissipating structures)
- Space requirements for safe access and operational/maintenance activity

3.5. Fish passage

It is important that fish passage is maintained, particularly in waterways that are classified as a Class 1 or Class 2 waterway under NSW DPI Fisheries Practice note (*Policy and Practice note for Bridges, Roads, Causeways, Culverts and Similar Structures, 1999*).

3.6. Construction materials

Clean water diversions can be constructed from a wide range of materials including, but not limited to, a combination of compacted earth, rock gabions, geomembranes, geofabrics, jute mesh, shotcrete, asphalt, pipe or vegetated channels. Various materials should be assessed on the basis of their suitability in:

1) Controlling flows
2) Constructability in accordance with site constraints

A number of clean water diversion design aspects in regard to construction materials have been discussed below:

Earth-based diversions:

- Should be constructed following Standard Drawings 5-5 and 5-6 (*Appendix B*)
- Require assessment of any additional lands that may be disturbed as a result
- Require assessment into any applicable stabilisation measures and stabilisation timeframes

Vegetated channels:

- Consider species selection and planting method and sequencing
- Consider early scour protection methods
- Consider topsoil requirements

Fabric and biodegradable linings (e.g. jute mesh):

- Should be constructed following Standard Drawing 5-7 (*Appendix B*)
- Useful for temporary protection of diversions

Gravel/Rock linings:

- Size selection MUST be based on expected flow velocities in accordance with Table 5.2 (*Appendix B*)
- Gravel/rock must be clean and free of fines.
- Rock should be placed above a filter layer of suitable geotextile and where necessary, properly graded layers of sand and gravel
- Useful for bends and outlet sections of diversions

Concrete, shotcrete and asphalt linings:

- Should ONLY be considered is situations where ecological functions are non-existent or have no potential.
- Require additional assessment of downstream erosion protection
- Chutes and flumes require anchor lugs and inlet/outlet sections a minimum of 1.5m in length
- Useful for high velocity situations or steep slopes

Pipes

- Require additional assessment of downstream erosion protection
- Useful for high velocity situations or steep slopes

- Particularly useful in directing clean water through site without constraining vehicle access *(this is often overlooked and results in having to deal with more dirty water than necessary)*
- Use of pipes may reduce the potential for clean water to be contaminated as it is directed through the project site.

3.7. Consider construction sequencing

It is important that temporary clean water diversions are constructed as early as possible. Diverting clean water prior to major works commencing will result in less run-on water to a site, in turn leading to benefits such as increased construction efficiency, savings in ERSED control installation and maintenance and higher site accessibility.

3.8. Onsite alterations

Although it is important that the design of temporary clean water diversions takes all of the above aspects into careful consideration, there may be instances that designs require modification as construction progresses. In such an event the construction crew should be proactive in making necessary adjustments to the temporary clean water diversion. In addition, any changes (onsite alterations) should be recorded/reported in accordance with commitments made in project documents such as the EWMS/PESCP and/or relevant sub-plans.

4. Standard drawings for temporary clean water design

RMS has compiled a suite of standard drawings for various clean water diversion designs. The drawings are available for reference in *Appendix A* of this document. They include:

a) New online culvert (preferably as early works)
b) New offline culvert (preferably as early works)
c) Continuous culvert extension (online) option 1
d) Continuous culvert extension (online) option 2
e) Continuous culvert extension (online) option 3
f) Temporary clean water controls for construction works in road cuttings
g) Temporary water management on a roadside cutting
h) Temporary water management of road works positioned in depression
i) Cut/fill batter water management
j) Online pipe replacement/installation – small intermittent depressions only (pump option)
k) Online pipe replacement installation – small intermittent drainage lines (temporary pipe option)

5. Minimum requirements for temporary clean water diversion environmental work method statements (EWMS)

5.1. Summary of minimum EWMS requirements

The format of site-specific EWMS is flexible according to the procedures used by each project team.

As a minimum requirement, an EWMS for clean water diversions shall:

- Incorporate design drawings of any clean water diversion/s (*Section 5.2*)
- Incorporate maps identifying the clean water diversion/s (*Section 5.3*)
- Incorporate a complete work method risk assessment (*Section 5.4*) that:
    - Lists the sequence of work activities to be undertaken in construction and maintenance of the temporary clean water diversion/s
    - Lists the sequence of work activities to be undertaken when removal clean water diversion. This should also include any stabilisation/revegetation required
    - Identifies potential environmental hazards for each work activity specified
    - Assigns specific risk ratings to individual hazards specified
    - Identifies control measures to eliminate or reduce risks, or where this is not possible, describe mitigation measures to be utilised in the event of a risk event occurring
    - Assigns responsibility of each control measure to a member of the project team
- Incorporate an induction register as a record of staff who have been approved to partake in activities detailed within the EWMS (*Section 5.5*)
- Incorporate evidence of document control such as revision number, release date, a signed authorisation for document release etc.

If changes are proposed to the clean water diversion EWMS used at any location or new temporary clean water diversion requirements are identified during construction, the project team must submit either of the following to the Principal before commencing the activity:

a) a revised and updated the site/project EWMS, or
b) a new stand-alone EWMS for the activity.

5.2. Incorporation of design drawings

Each EWMS shall incorporate design drawings of any clean water diversion structure they pertain to. Design drawings shall:

a) Clearly identify all construction materials incorporated in the clean water diversion
b) Clearly specify design dimensions
c) Clearly specify construction tolerances
d) Clearly identify flow directions (including inlet and outlet flows)

Drawings shall be location specific.

Method of drawing production is for the determination of the project team.

5.3. Incorporation of maps

Maps should be used to show all identified clean water diversion locations that the EWMS applies to. Maps shall:

a) Clearly identify clean water diversion/s in relation to the project or locality
b) Clearly identify project boundaries in relation to the clean water diversion
c) Clearly identify endangered ecological communities in relation to the clean water diversion
d) Clearly identify other exclusion or problematic areas in relation to the clean water diversion (e.g. ASS/PASS, PADs, contaminated soils)
e) Clearly identify natural watercourses in relation to the clean water diversion
f) Identify estimated flow directions (including inlet and outlet flows)

g) Identify approximate dirty water flows in relation to the clean water diversion
h) Identify approximate catchment area/s for the clean water diversion

5.4. Incorporate a work method risk assessment

The sequence of works is likely to vary between each clean water diversion on a project. It is often useful to use the sequence of works as a methodical framework for identifying potential environmental hazards associated with each work activity; ensuring risks can be assessed throughout the complete process of clean water diversion construction. Potential hazards then serve as basis for risk management and treatment options.

Risk treatment options shall be described in terms of measures to eliminate, reduce or mitigate risks.

In efforts to ensure risk treatment measures are undertaken as intended, allocation of responsibility shall be given to each risk treatment measure. Persons listed as responsible for risk treatment measures will ultimately be held accountable for proper implementation.

The work method risk assessment in Table 5.4, although not exhaustive, shall be used as a guide for preparation of this section of a clean water diversion EWMS. Table 5.4 has incorporated minimum requirements for risk treatment measures. These minimum requirements must be reflected in the chosen risk treatment measures for each EWMS. In addition example work activities and hazards have also been included in Table 5.4. It is important to note that the work activities and hazards listed are for illustrative purposes only and it will be necessary for each project to develop relevant activities and identify hazards in accordance with clean water diversion design, construction techniques and site conditions.

5.5. Incorporate induction register

All staff responsible for approval and/or execution of clean water diversion design and construction activities must be trained and inducted into the use of the EWMS. The EWMS should include an induction register as a record of staff that are approved to undertake or inspect clean water diversion construction, maintenance and removal activity including activities required to stabilise or revegetate.

For longer duration projects it is important that consideration is given to the requirements for a 'refresher induction'. This will aid in ensuring personnel remain familiar with the EWMS over time. In the event that inductions are required, systems should be in place to specify when they should be undertaken. An induction register should also be kept as a record of staff that are approved to continue to undertake or inspect clean water diversion construction and maintenance activity.

Table 5.4 – Example work method risk assessment for incorporation into clean water diversion EWMS

Sequence	Work Activity	Hazards	Risk Level	Risk Treatment Measures	Responsibility
1	Training of personnel	Non-compliance with EWMS	e.g. high	List all relevant treatment measures ***As a minimum listed measures must:*** • Ensure all relevant construction personnel are familiar with the EWMS • Ensure all personnel with allocated EWMS responsibilities are aware of responsibilities • Ensure records of EWMS training are continually maintained • Ensure personnel remain familiar with the EWMS, particularly over longer project durations. [e.g. mandated use of refresher induction/training, daily toolbox meetings each covering an aspect of the ESWMS]	e.g. site engineer, foreman
2	Construction approval	Works commencing without relevant approvals; stakeholders detrimentally impacted without sufficient notice		List all relevant construction approval measures ***As a minimum listed measures must:*** • Ensure all relevant approvals, permits and licenses are acquired prior to works commencing. [e.g. Permits to excavate, out-of-hours works approval, etc.] • Ensure erosion and sediment control plans have been documented and approved by relevant personnel • Ensure **ALL** relevant stakeholders have been consulted regarding works and receive appropriate levels of consultation. (This may include adjacent landholders, NSW Trade & Investment *Fisheries,* relevant Land Councils, etc.)	
3	Works within close proximity if exclusion zones (if applicable)	Inadvertent detrimental impact on sensitive areas		List all relevant treatment measures ***As a minimum listed measures must:*** • Ensure all relevant exclusion areas are clearly identifiable and locations known by **ALL** personnel involved in works. (Areas may include EECs, PADs, habitat trees etc.)[e.g. installation of buffer zones for high risk areas, signage, fenced delineation]	

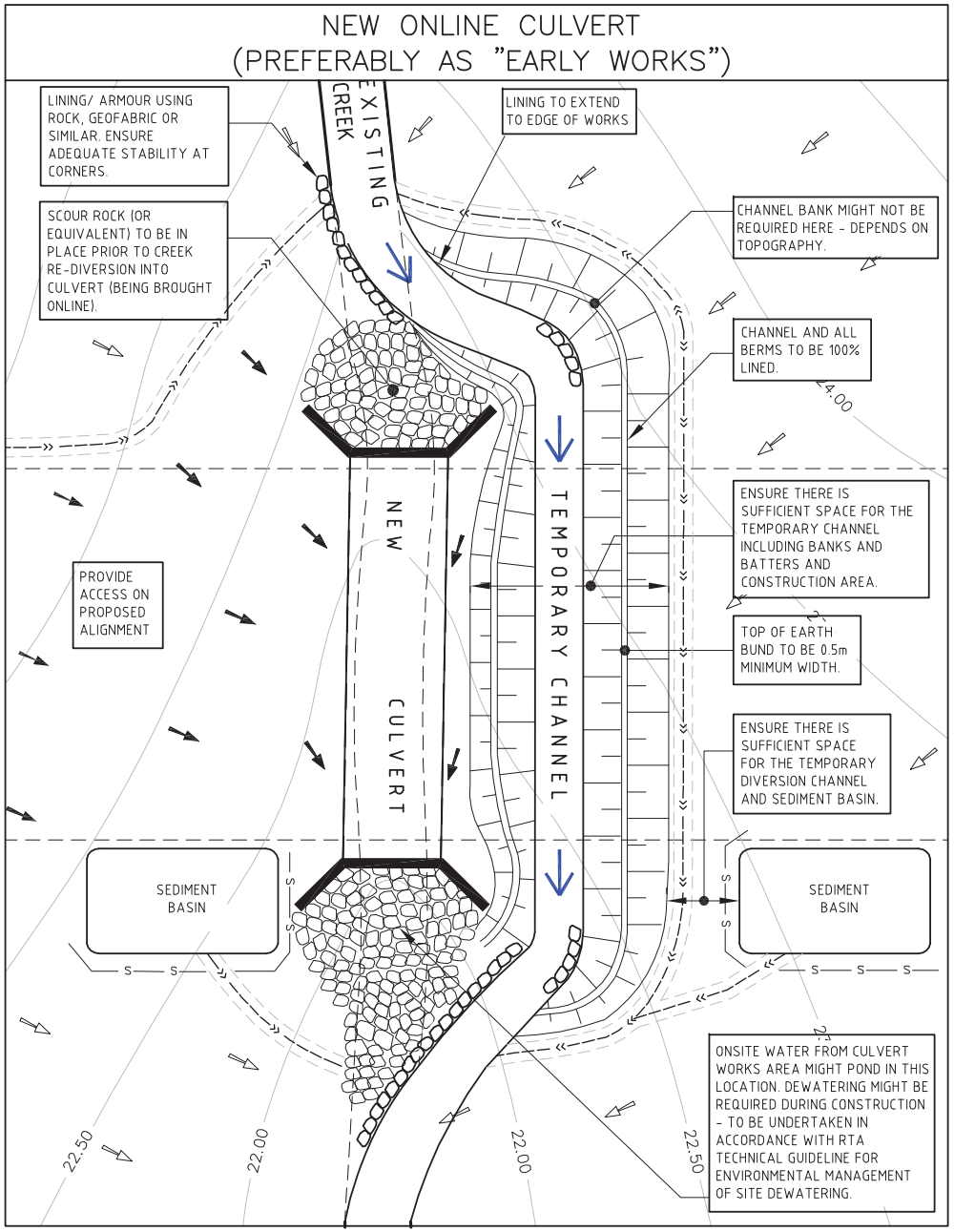
4	ERSED controls	Pollution of waterways		List all relevant treatment measures ***As a minimum listed measures must:*** • Ensure ERSED plans are developed by appropriately qualified personnel and approved prior to commencement of works • Ensure ERSED controls are in place, inspected and approved by relevant personnel before any ground disturbance • Ensure ERSED controls do not inhibit fish passage (where required) • Ensure ERSED controls are inspected and maintained at all times (particularly after rainfall events) • Ensure ERSED controls are in place until area stabilised or revegetated as required following completion of works to address erosion and sediment control risks and to prevent pollution of waters. • Where pipes are used for crossing ensure the pipes are of adequate strength for the weight of vehicles/plant intended to use the crossing so that the pipes are not damaged and cause clean water to be contaminated and require treatment. • List all relevant treatment measures for each corresponding work activity	
5	General works *variable dependent on design but may include the following:* clearing and grubbing; excavation and ground	General works *variable dependent on design*		List all relevant treatment measures for each corresponding work activity. ***As a minimum listed measures must:*** • Ensure water quality of diverted water is maintained at all stages throughout clean water diversion construction [e.g. mandatory activity sequencing, maintenance procedures for ERSED controls, water quality testing, etc.] • Ensure diversion inlets and outlets are protected from erosion at all times [e.g. mandatory activity sequencing,	

	disturbance; access construction; embankment construction; bedding installation; placement of concrete; placement of geofabric; placement of jute mesh; channel connection works			maintenance procedures, etc.] • Ensure works are undertaken in a manner that minimises dust generation and particulate emissions [e.g. mandatory activity sequencing, construction speed limits, dust suppression measures, plant maintenance regimes etc.] • Ensure works are undertaken in a manner that reduce the potential for erosion and sediment mobilisation [e.g. mandatory activity sequencing, maintenance of adjacent vegetation, removal of mud/dirt on sealed surfaces, minimising exposed surfaces, etc.] • Ensure works are undertaken in a manner that minimises noise to adjacent community [e.g. assess areas vulnerable to high noise levels; administer procedures to prevent needless noise, etc.] • Ensure protocols are in place in the event of unforeseen or problematic circumstances such as PASS/ASS, heritage item find, potential threatened fauna/flora species find, noxious weeds find, chemical spill. [e.g. Cease work, specialised procedures, etc.] • Ensure works are undertaken in a manner that minimises detrimental impacts on native flora and fauna, in particular movement of aquatic fauna is at no stage impeded [e.g. mandatory activity sequencing, use of exclusion zones, etc.] • Ensure **ALL** hazardous materials (including environmentally hazardous and wastes are stored, used and disposed of in safe and environmentally sound ways [e.g. designated storage areas, containment inspections, documented refuelling procedures, plant maintenance regimes, documented disposal procedures, etc.] • Ensure that natural resources obtained as a result of works are assessed for reuse, such as topsoil, loggable trees and native seed. • List all relevant treatment measures for each	

				corresponding work activity.	
6	Site Rehabilitation			List all relevant treatment measures for each corresponding work activity. ***As a minimum listed measures must:*** • Ensure ERSED controls are maintained and remain effective • Ensure rehabilitation, stabilisation and restoration work are undertaken as early as possible • Ensure vegetative rehabilitation is protected from erosion and weed infestation until established • Ensure ERSED controls are in place until area stabilised or revegetated as required following completion of works to address erosion and sediment control risks and to prevent pollution of waters.	
7	Records and documentation	Records insufficient to demonstrate compliance		List all relevant treatment measures for each corresponding documentation compliance activity.	

Appendix A: Standard Drawings

NEW ONLINE CULVERT (PREFERABLY AS "EARLY WORKS")



SWMP – ONLINE CULVERT CONSTRUCTION AND CREEK STABILISATION WORKS

NEW ONLINE CULVERT – CONSTRUCTION NOTES

THESE STEPS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW.

Stage 1: Temporary Channel Construction

- Establish diversion drains for offsite water.
- Construct and line the temporary channel including rock armouring at the existing creek and temporary channel junctions.
- Construct and line temporary earth bunds.
- Divert creek flows into this channel. Work downstream to upstream.

Stage 2: Culvert Construction Works

- Construct the new culvert including the stabilised culvert inlet and outlets.
- Stabilise the culvert construction works area once culvert construction works are complete.

Stage 3: Final diversion and Rehabilitation Works

- Divert creek flows into new culvert.
- Temporary channel and bunds to be decommissioned without allowing sediment downstream to creek and the disturbed area stabilised.
- Diversion drains for offsite water can be redirected to inlet of new culvert on upstream site or can be removed and rehabilitated.

OTHER NOTES

1. This design assumes that culvert construction is part of the 'early works' for the site.
2. Temporary channel to be sized and lined as per the requirements in Table 6.1 (DECC, 2008) and Table 5.2 (Landcom, 2004).
3. Ideally schedule works to periods when rainfall erosivity is low (Refer to Table 4.3 – Landcom, 2004)
4. Only undertake in-stream works (e.g. placement of rock) during periods of zero or very low flow and only when the 24 hour weather forecast suggests a significant rain event is not likely.
5. Ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils within in-stream locations if an unexpected rain or flow event occurs.
6. No culvert works are to occur until creek flows are successfully diverted into the stabilised temporary channel.
7. Culverts are to be completed before being allowed to convey flows. This includes all inlet and outlet protection, wingwalls etc.
8. Stabilisation, as defined by the Blue Book, means achieving:
   - For concentrated flows- At least 70% vegetation cover (or equivalent) within 10 days AND using only materials that are suitable in concentrated flow conditions (refer to Tables A3 and D1 in the Blue Book for suitability).
   - For all other areas- At least 60% vegetation cover (or equivalent) in 20 days AND 70% in 2 months.
9. A management regime should be in place to address the risk of these works creating a flooding issue due to constriction of the channel during construction.
10. If temporary access is required across the existing creek or a diversion channel, use a temporary water crossing – see standard drawing 5-1 in Blue Book Vol 1 (Landcom, 2004).
11. Minimise the time that soil is exposed to erosion.

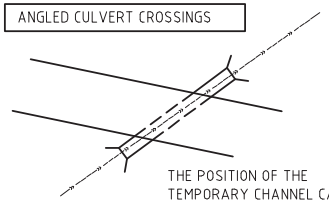
STANDARD DRAWINGS FROM VOL 1 OF THE BLUE BOOK (LANDCOM, 2004) USED HERE:

Sediment fence: SD 6-8
High flow earth bank (diversion drain): SD 5-6
Energy dissipater: SD 5-8
Temporary waterway crossing: SD 5-1

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

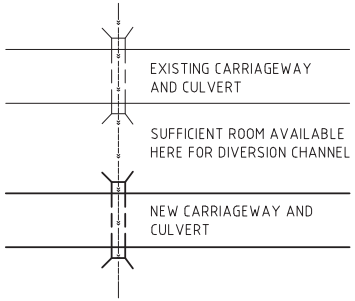
THIS SCENARIO ALSO APPLIES TO:

ANGLED CULVERT CROSSINGS



THE POSITION OF THE TEMPORARY CHANNEL CAN BE DETERMINED BY THE PREVAILING TOPOGRAPHY

DIVIDED CULVERT EXTENSION



THE APPLICATION OF THIS SCENARIO TO DIVIDED CULVERT EXTENSIONS IS DEPENDENT ON WHETHER THERE IS ENOUGH AVAILABLE SPACE. IF SPACE IS LIMITED PART OF THE TEMPORARY CHANNEL CAN BE CONSTRUCTED OUT OF SHEET PILING OR SIMILAR OR ALTERNATIVELY THE SITE SHOULD BE STABILISED AS FOR A CONTINUOUS ONLINE CULVERT EXTENSION

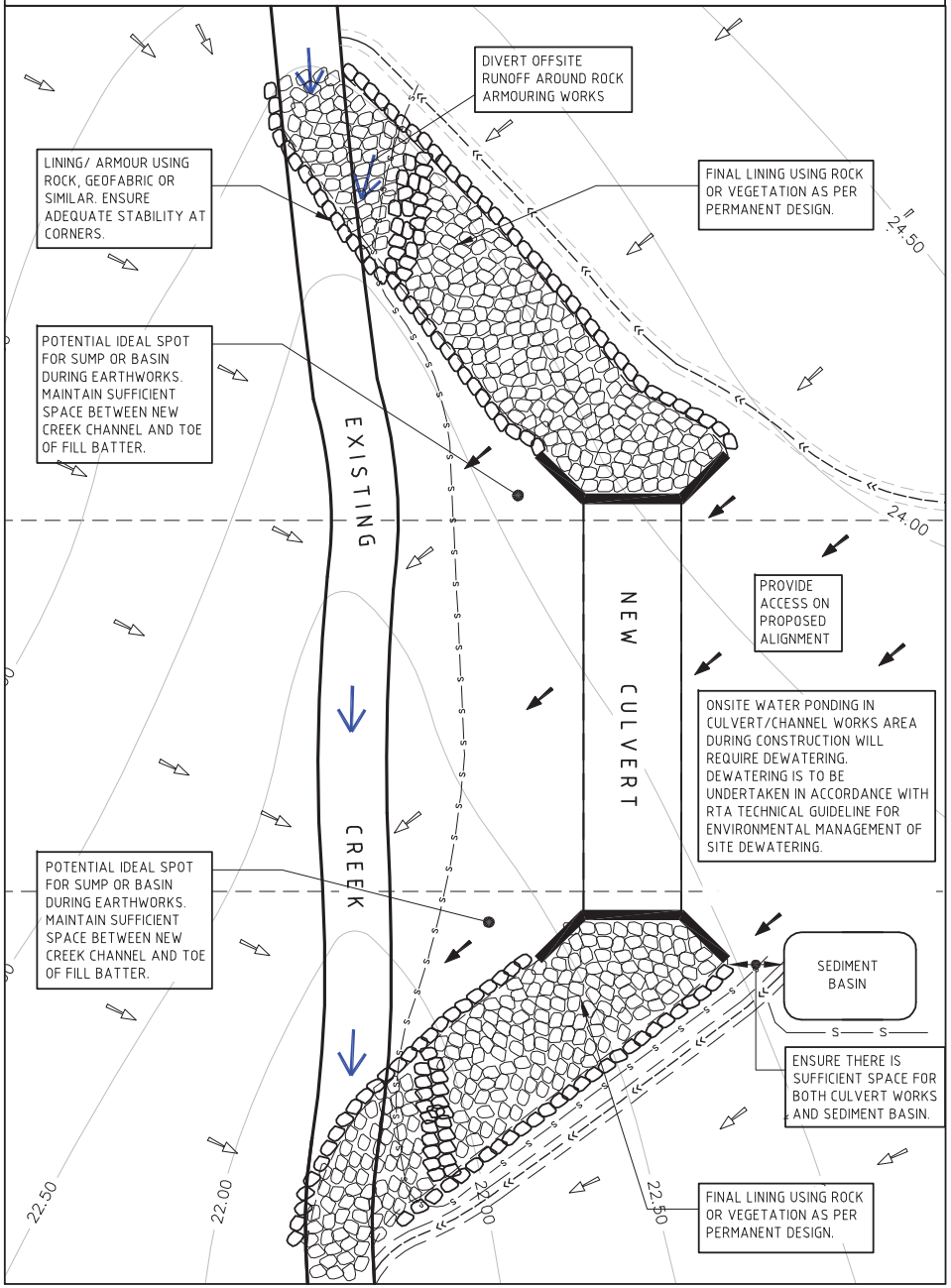
LEGEND

- S—— S—— S SEDIMENT FENCE (SD 6-8)
- DIVERSION DRAIN FOR 'OFFSITE' WATER (SD 5-6)
- SURFACE CONTOURS
- 'ONSITE' FLOWS
- 'OFFSITE' FLOWS
- CREEK/CHANNEL FLOWS
- CUT/FILL BATTER
- ROCK DISSIPATION/ STABILISATION STRUCTURES (SD 5-8)

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

DRAWING 1

NEW OFFLINE CULVERT (PREFERABLY AS "EARLY WORKS")



SWMP – OFFLINE CULVERT CONSTRUCTION AND CREEK STABILISATION WORKS

NEW OFFLINE CULVERT - CONSTRUCTION NOTES

THESE STEPS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW.

Stage 1: Site Preparation Works
- Establish diversion drains for offsite water.
- Install berms to block off new channel and ensure all works remain offline from the existing creek.

Stage 2: Culvert Construction Works
- Construct the new culvert including the stabilised culvert inlet and outlets.
- Stabilise the culvert construction works area.

Stage 3: Final Diversion and Rehabilitation Works
- Install in-stream (online) rock armouring at the locations where flows are turned into and out of the new channel.
- Remove berms used to block off new channel during construction works starting at downstream end.
- Divert creek flows into new culvert.
- Disturbed area to be stabilised.

STANDARD DRAWINGS FROM VOL 1 OF THE BLUE BOOK (LANDCOM, 2004) USED HERE:

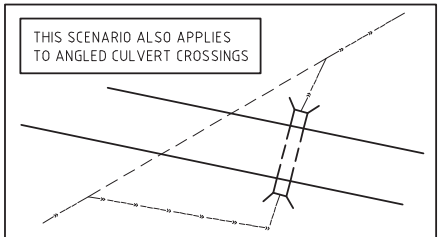
Sediment fence: SD 6-8
High flow earth bank (diversion drain): SD 5-6
Energy dissipater: SD 5-8
Temporary waterway crossing: SD 5-1

OTHER NOTES

1. This design assumes that culvert construction is part of the 'early works' for the site.
3. Ideally schedule works to periods when rainfall erosivity is low (Refer to Table 4.3 – Landcom, 2004)
4. Only undertake in-stream works (e.g. placement of rock) during periods of zero or very low flow and only when the 24 hour weather forecast suggests a significant rain event is not likely.
5. Ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils within in-stream locations if an unexpected rain or flow event occurs.
6. Culverts are to be completed before being allowed to convey flows. This includes all inlet and outlet protection, wingwalls etc.
7. Stabilisation, as defined by the Blue Book, means achieving:
- For concentrated flows- At least 70% vegetation cover (or equivalent) within 10 days AND using only materials that are suitable in concentrated flow conditions (refer to Tables A3 and D1 in the Blue Book for suitability).
- For all other areas- At least 60% vegetation cover (or equivalent) in 20 days AND 70% in 2 months.
8. If temporary access is required across the existing creek or a diversion channel, use a temporary water crossing (see standard drawing list).
9. Minimise the time that soil is exposed to erosion.

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

THIS SCENARIO ALSO APPLIES TO ANGLED CULVERT CROSSINGS



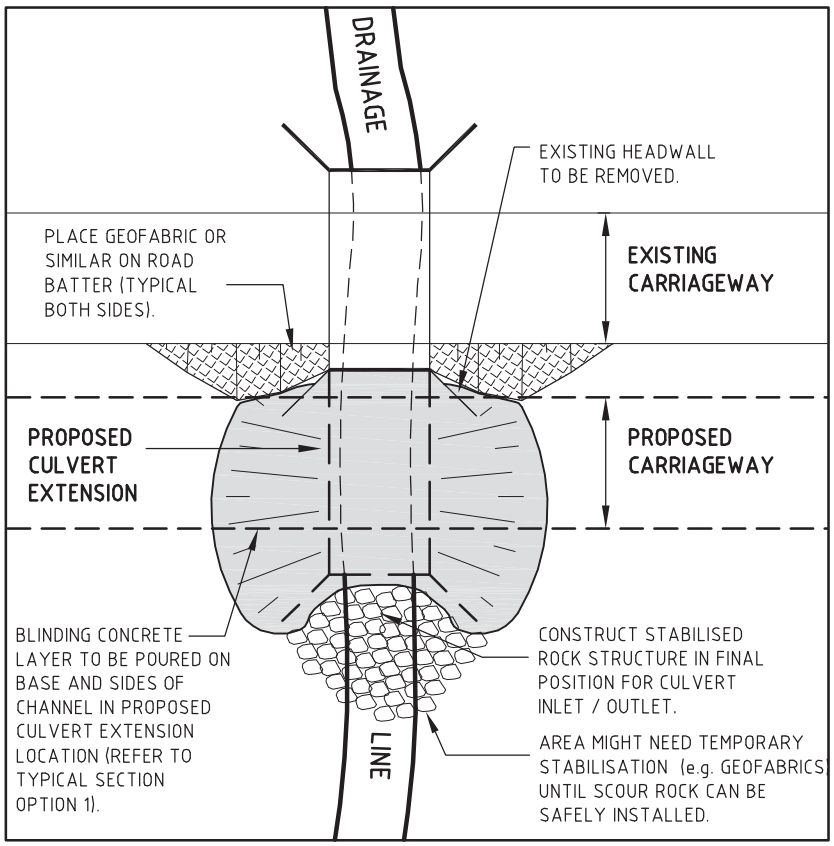
LEGEND

- SEDIMENT FENCE (SD 6-8)
- DIVERSION DRAIN FOR OFFSITE WATER (SD 5-6)
- SURFACE CONTOURS
- 'ONSITE' FLOWS
- 'OFFSITE' FLOWS
- CREEK/CHANNEL FLOWS
- CUT/FILL BATTER
- ROCK DISSIPATION/STABILISATION STRUCTURES (SD 5-8)
- DIVERSION BERMS (e.g. SANDBAG WALLS, LINED EARTH BUNDS, ROCK)

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

DRAWING 2

CONTINUOUS CULVERT EXTENSION (ONLINE)
OPTION 1



SITE STABILISATION PROCEDURE

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

Prior to undertaking any construction or earthworks ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils if an unexpected rain or flow event occurs.

1. Watch the weather forecast for a dry period (a period longer than the time required to complete earthworks up to the required level).
2. When a dry period is forecast, undertake earthworks quickly (preferably in less than three days).
3. Pour blinding concrete layer and lay rock inlet / outlet.
4. Lay geofabric (or similar) on existing road batter.

(Ensure steps 2, 3 and 4 occur within the forecast period of dry weather and no flow)

5. Complete culvert construction works over the top of the blinding concrete layer.
6. Maintain the blinding layer until the culvert extension is complete and stabilised. once flows are secure within the new culverts, excess blinding can be removed if desired.

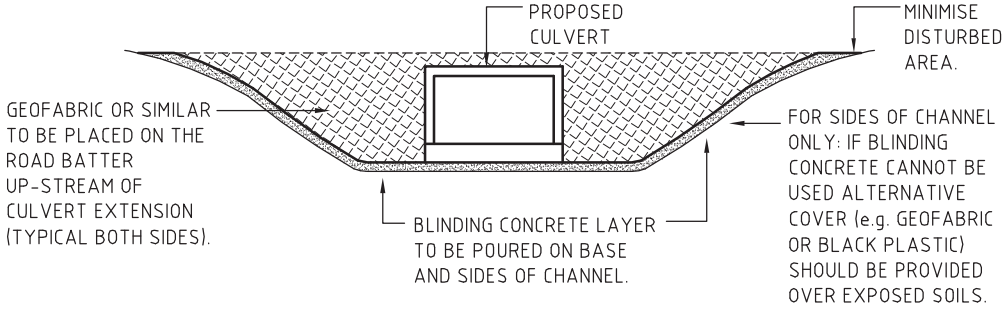
At any time during steps 1 - 4 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

OTHER NOTES

- For divided culvert extensions this stabilisation method could also be applied or alternatively the flows could be diverted as for a new online culvert.
- Note that this method is not suitable for perennial creeks unless additional measures (e.g. pumping or coffer dams) can be reliably included as well.
- This method might not be appropriate where there is a significant depth of unsuitable soil material to be removed.
- For systems with very minor flows in dry periods, temporary damming of flows might be required to hold water back for the nominated work period until the blinding concrete layer and rock is placed.
- Note that not all onsite water management and sediment controls are shown here.

ENSURE THAT 'OFFSITE' CREEK FLOWS DO NOT COME INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

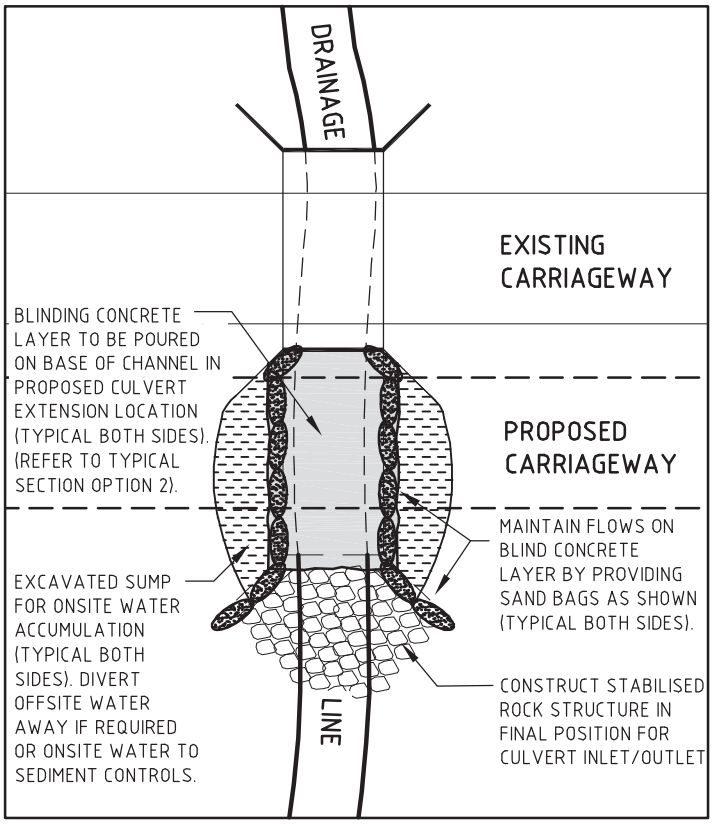
NOTE: MAINTAIN OR INSTALL TEMPORARY GROUND COVER THROUGH FLOW AREA ANYTIME FLOWS ARE IMMINENT.



TYPICAL SECTION – OPTION 1

DRAWING 3

CONTINUOUS CULVERT EXTENSION (ONLINE)
OPTION 2



SITE STABILISATION PROCEDURE

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

Prior to undertaking any construction or earthworks ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils if an unexpected rain or flow event occurs.

1. Watch the weather forecast for a dry period (a period longer than the time required to complete earthworks up to the required level).
2. When a dry period is forecast, undertake earthworks quickly (preferably in less than three days).
3. Pour blinding concrete layer and lay rock inlet / outlet.
4. Position sand bags on the blind concrete layer.

(Ensure steps 2, 3 and 4 occur within the forecast period of dry weather and no flow)

5. Complete culvert construction works over the top of the blinding concrete layer. Take care not to disturb the integrity of the blinding layer.
6. Maintain the sandbag walls on the base slab if a flow event occurs.

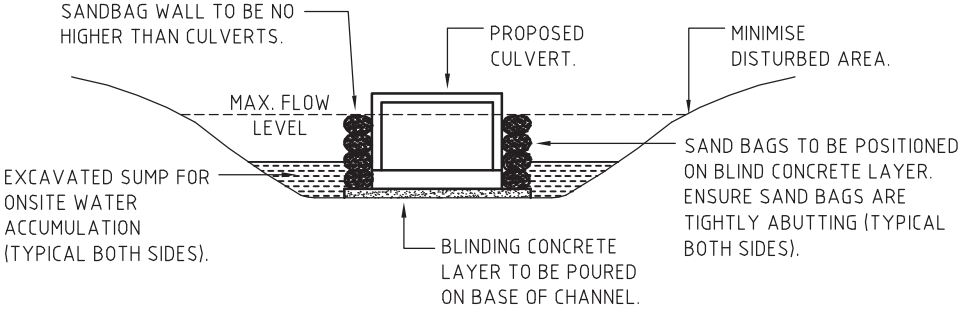
At any time during steps 1 – 4 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

OTHER NOTES

- For divided culvert extensions this stabilisation method could also be applied or alternatively the flows could be diverted as for a new online culvert.
- Note that this method is not suitable for perennial creeks unless additional measures (e.g. pumping or coffer dams) can be reliably included as well.
- This method might not be appropriate where there is a significant depth of unsuitable soil material to be removed.
- For systems with very minor flows in dry periods, temporary damming of flows might be required to hold water back for the nominated work period until the blinding concrete layer and rock is placed.
- Note that not all onsite water management measures and sediment controls are shown here.

ENSURE THAT 'OFFSITE' CREEK FLOWS DO NOT COME INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

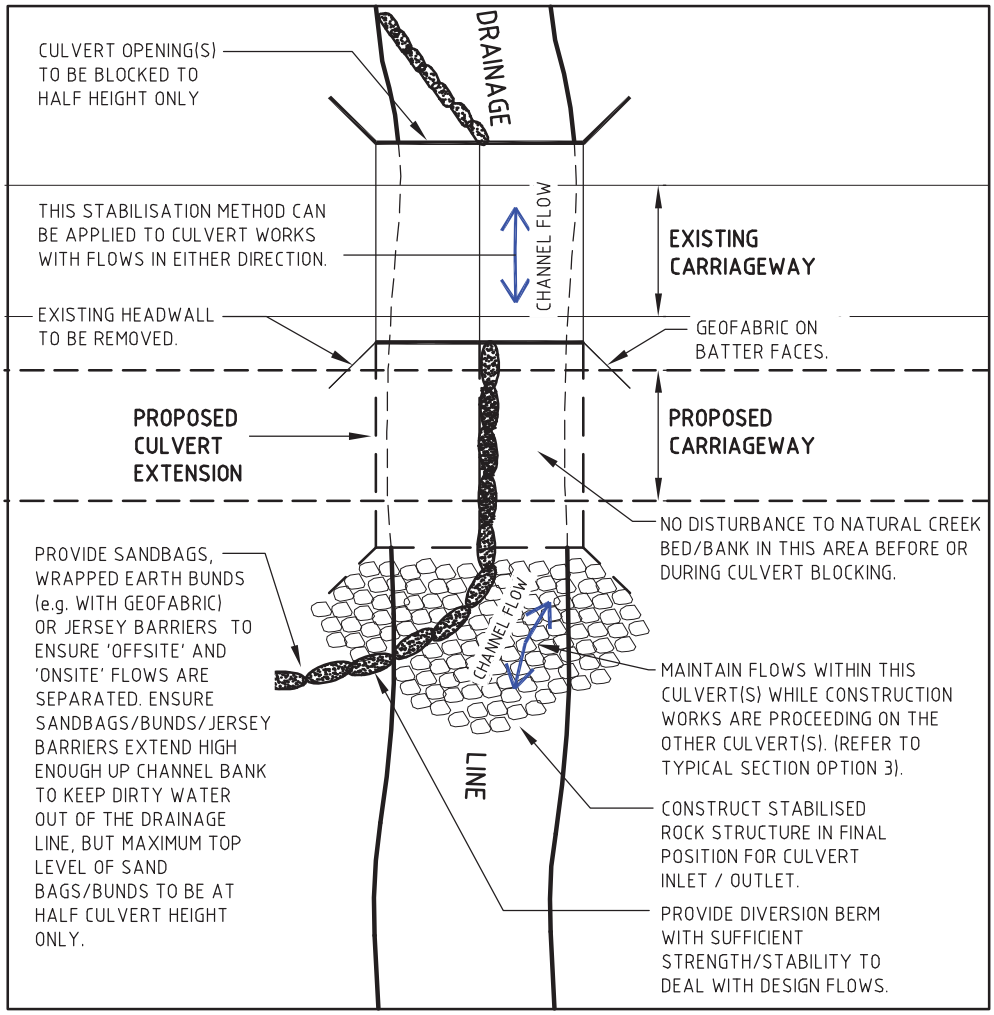
NOTE: MAINTAIN OR INSTALL TEMPORARY GROUND COVER THROUGH FLOW AREA ANYTIME FLOWS ARE IMMINENT.



TYPICAL SECTION – OPTION 2

DRAWING 4

CONTINUOUS CULVERT EXTENSION (ONLINE)
OPTION 3



SITE STABILISATION PROCEDURE

OTHER NOTES

- This option will only work when existing ground surface level can be maintained in at least one culvert cell. Therefore this method might not work for deep excavations requiring benching.
- Suitable for use in perennial streams providing in-stream works are conducted when flows are minimal.
- However, regardless of scheduling and timing the adopted controls need to be considerate of the risk of significant flows at any time.
- Note that not all water management and sediment controls are shown here.

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

Prior to undertaking any construction or earthworks ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils if an unexpected rain or flow event occurs.

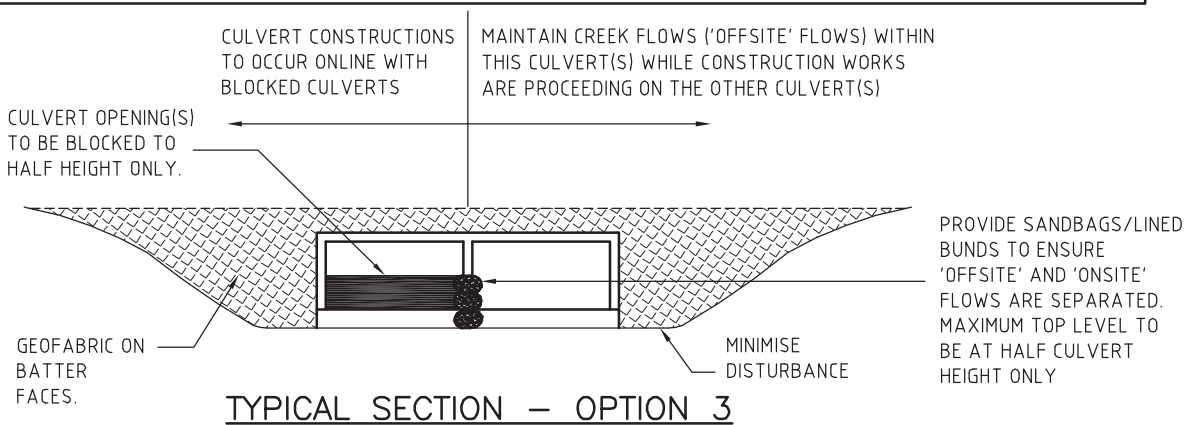
Stage 1.

1. Monitor creek flows ensuring flows levels are not too high.
2. Position sandbags/bunds around culvert works area and block existing culvert end to half culvert height only.
3. Undertake culvert extension construction works only on the blocked side of the culvert(s).
4. Complete inlet/outlet protections.

Stage 2

5. Divert the creek flows into the newly constructed culvert extension by blocking off the alternate side using a half-height wall/bund.
6. Complete the culvert extension on the other side including the stabilised inlet/outlet.

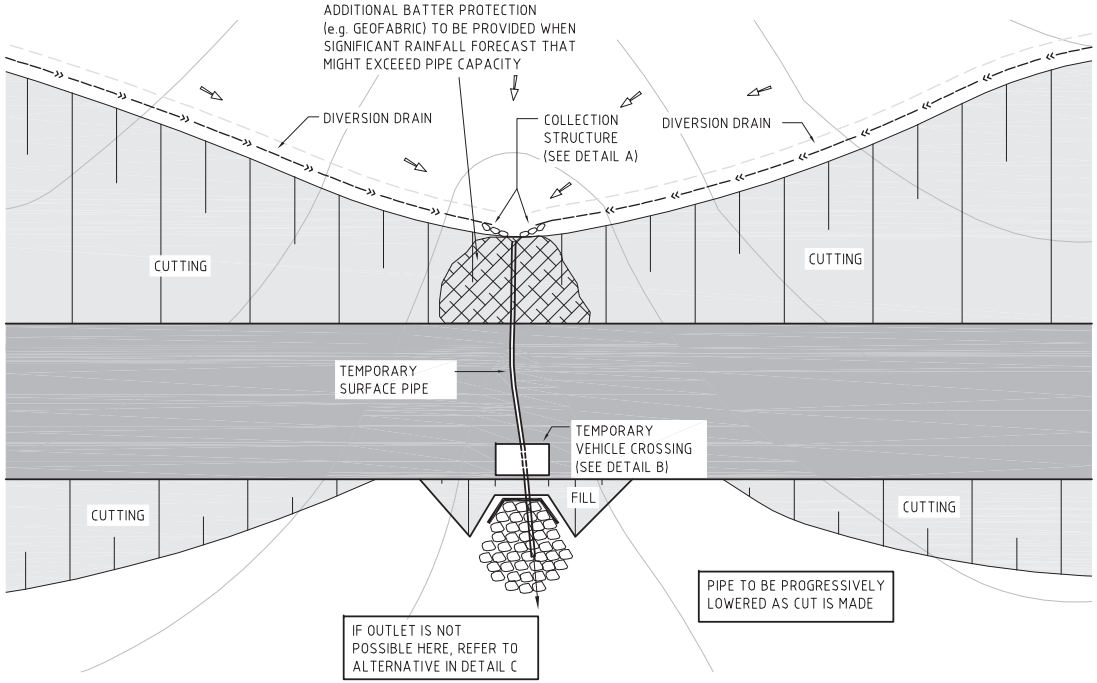
At any time where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.



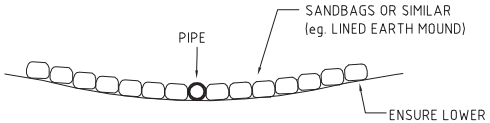
TYPICAL SECTION – OPTION 3

DRAWING 5

TEMPORARY 'OFFSITE' WATER CONTROLS FOR CONSTRUCTION WORKS IN ROAD CUTTINGS



AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER



SECTION THROUGH COLLECTION STRUCTURE (DETAIL A)

LEGEND

- DIVERSION DRAIN FOR 'OFFSITE' WATER (SD 5-6)
- SURFACE CONTOURS
- 'OFFSITE' FLOWS
- ROCK STABILISED OUTLET (SD 5-8)
- CUT / FILL BATTER

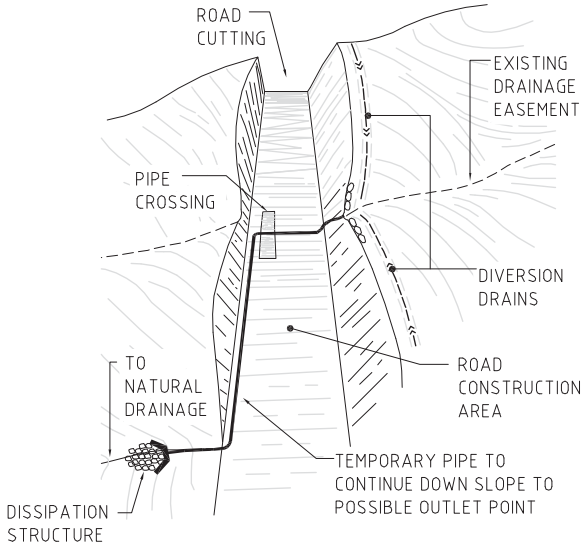
NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

CONSTRUCTION NOTES

1. Permanent diversion drains are to be used as 'offsite' diversion drains during construction works.
2. Ensure there is continuous fall on the temporary flexible pipe (or temporary sacrificial pipe).
3. The temporary pipe is to be progressively lowered as the cut is made.
4. It is not essential that the temporary pipe follows the invert of the depression, however, fall on the pipe must be maintained.
5. The inlet and outlets of the temporary pipe are to stabilised. They are to be located beyond the limit of works to ensure no onsite runoff is captured.
6. The collection structure used to direct 'offsite' flows into the temporary pipe is to be construction out of either rock or lined earth berms.

OTHER NOTES

7. This drawing only illustrates 'offsite' water controls. 'Onsite' water management controls will also be required.

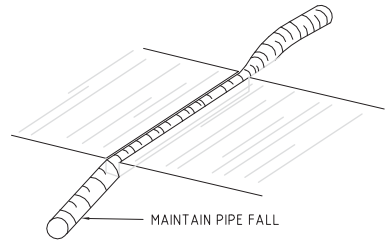


ALTERNATIVE SCENARIO (DETAIL C)

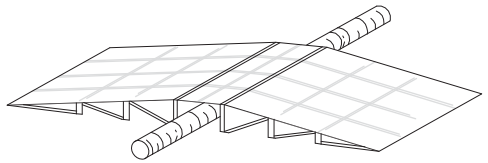
TYPICAL PIPE CROSSING DETAILS (DETAIL B)

OPTIONS INCLUDE:

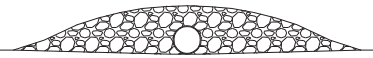
1. TRENCH PIPE AT CROSSING POINT



2. PRE-FABRICATED RAMP

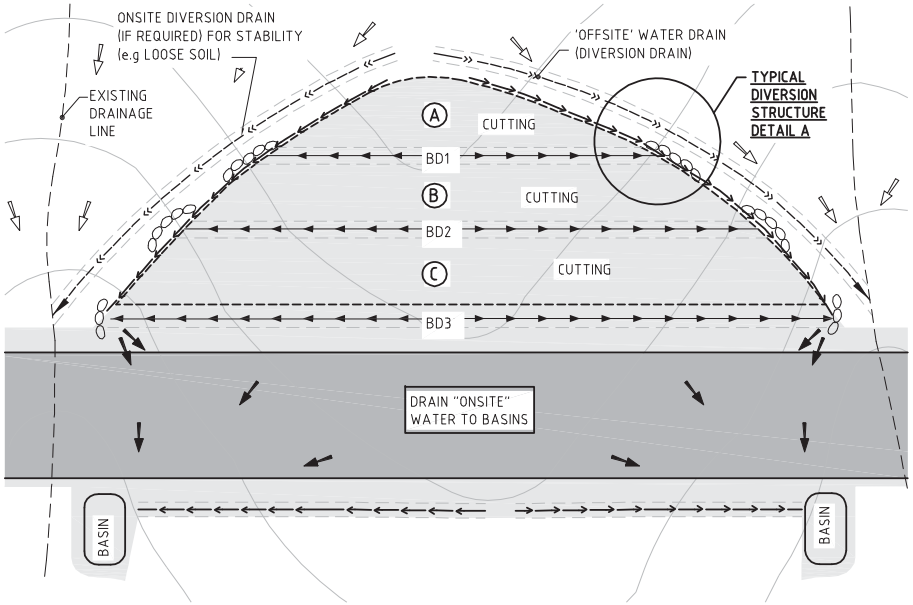


3. TEMPORARY RUBBLE CROSSING



DRAWING 6

TEMPORARY WATER MANAGEMENT ON A ROADSIDE CUTTING

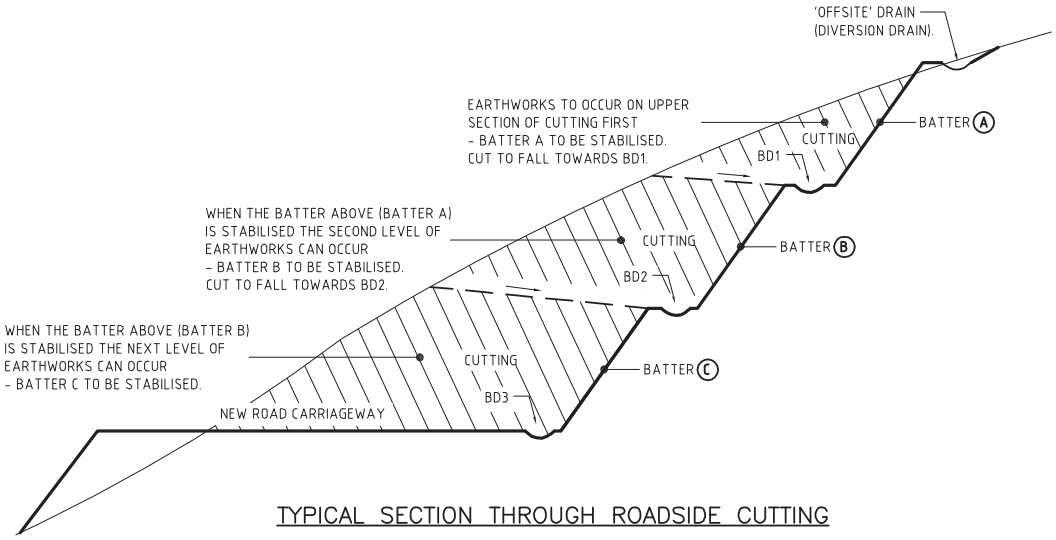


PROGRESSIVE STABILISATION OF BATTERS IS ESSENTIAL. EACH SECTION OF THE BATTER SHOULD BE SHAPED, TOPSOILED, AND REHABILITATED BEFORE PROCEEDING TO THE NEXT SECTION.

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

LEGEND

- DIVERSION DRAIN FOR 'OFFSITE' WATER (SD 5-6)
- DIVERSION DRAIN FOR 'ONSITE' WATER (SD 5-6)
- BERM DRAIN (BD)
- SURFACE CONTOURS
- 'OFFSITE' WATER FLOWS
- 'ONSITE' WATER FLOWS



TYPICAL SECTION THROUGH ROADSIDE CUTTING

GENERAL NOTES

1. Progressive stabilisation of batters is essential. Each section of the batter should be shaped, topsoiled, and rehabilitated before proceeding to the next section.
2. Permanent cut off drains used as 'offsite' drains during construction works.
3. Take care with mixing flows from 'offsite' (cut off) drains with flows from berm drains ('onsite' water until upslope batter is vegetated). Diversion structures should be used to ensure this (Refer to 'Typical Diversion Structure Detail A').
4. All 'onsite' water is to drain to a sediment trap/basin.
5. Outlet 'offsite' water drains to existing drainage line or culvert.
6. A suitable 'offsite' water management system is to be used for conveying 'offsite' flows from the drainage line through the worksite.
7. Note that not all onsite water management and sediment controls are shown here.

Stabilisation means achieving:

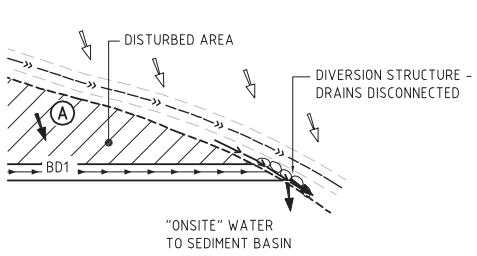
- For concentrated flows- At least 70% vegetation cover (or equivalent) within 10 days AND using only materials that are suitable in concentrated flow conditions (refer to Tables A3 and D1 in the Blue Book for suitability).
- For all other areas- At least 60% vegetation cover (or equivalent) in 20 days AND 70% in 2 months.

TYPICAL DIVERSION STRUCTURE DETAIL A

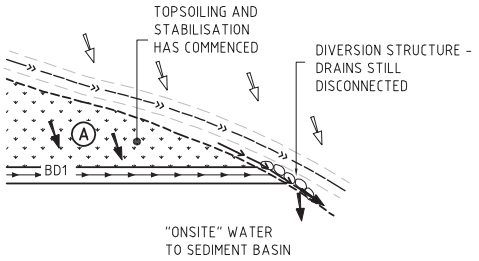
CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

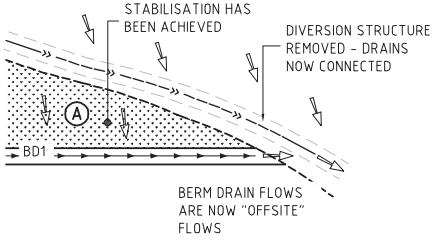
1. Permanent diversion drains ('offsite' water drains) to be established.
2. Earthworks on upper section of cutting (i.e. section A) to be undertaken including construction of BD1.
3. Construction of BD1 must include diversion structures as per Phase 1 detail.
4. Section A should be stabilised as per Phase 2 detail.
5. Once section A is successfully stabilised (i.e. at least 60% ground cover has been achieved), BD1 can be connected to the cut off drain as per Phase 3 detail.
6. Earthworks can now proceed on the next section down (i.e. section B) and the process above (2 to 4) should be again carried out.
7. This process should continue for the entire cutting (i.e. section C and any lower sections if present).



PHASE 1: EARTHWORKS



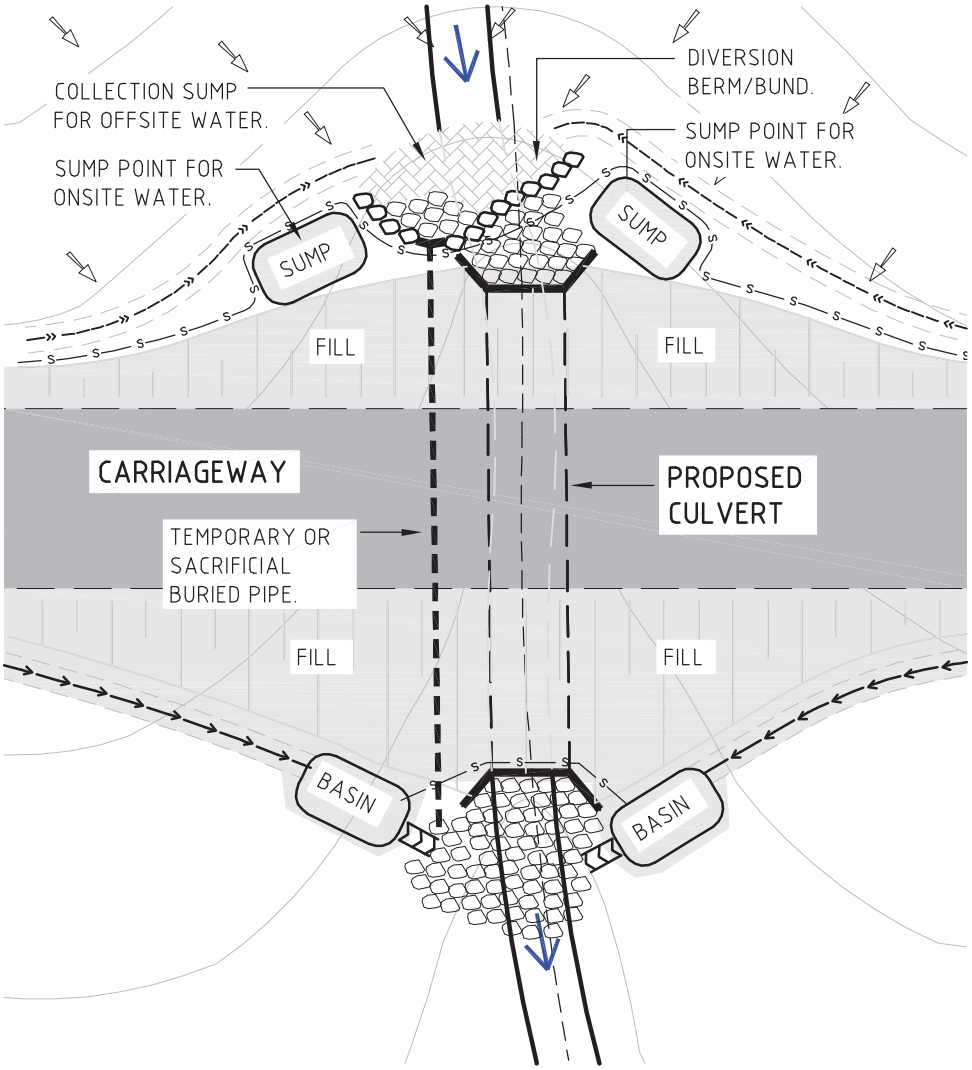
PHASE 2: COMMENCE STABILISING AREA A



PHASE 3: AREA A STABILISED

DRAWING 7

TEMPORARY WATER MANAGEMENT OF ROAD WORKS POSITIONED IN DEPRESSION



- **THIS SCENARIO IS ONLY APPLICABLE FOR DEPRESSIONS AND INTERMITTENT SMALL CREEKS NOT FOR PERENNIAL OR LARGER SYSTEMS.**
- **AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER.**
- **ADDITIONAL BATTER PROTECTION (e.g GEOFABRIC) TO BE PROVIDED WHEN SIGNIFICANT RAINFALL FORECAST THAT MIGHT EXCEED PIPE CAPACITY.**

LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-6)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET (SD)
- CUT/FILL BATTER
- DIVERSION BERM (SD)
- CREEK/PIPE FLOW ROUTE
- AREA TO BE LINED
- SPILLWAY
- SEDIMENT FENCE (SD 6-8)

CONSTRUCTION NOTES

THESE STEPS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW.

Stage 1: Establish Temporary Diversion

1. Monitor creek flows ensuring flow levels are not too high.
2. Establish diversion drains for offsite water.
3. Position the temporary pipe and construct the stabilised inlet and outlets for this pipe.
4. Establish the diversion berm (including lining where applicable) to direct water into the temporary pipe.
5. Line the collection sump up to the height of the top pipe level.
6. Flows to be diverted into the temporary pipe. This is to take place prior to undertaking any bulk earthworks, stripping or culvert constructions.

Stage 2: Culvert Construction Works

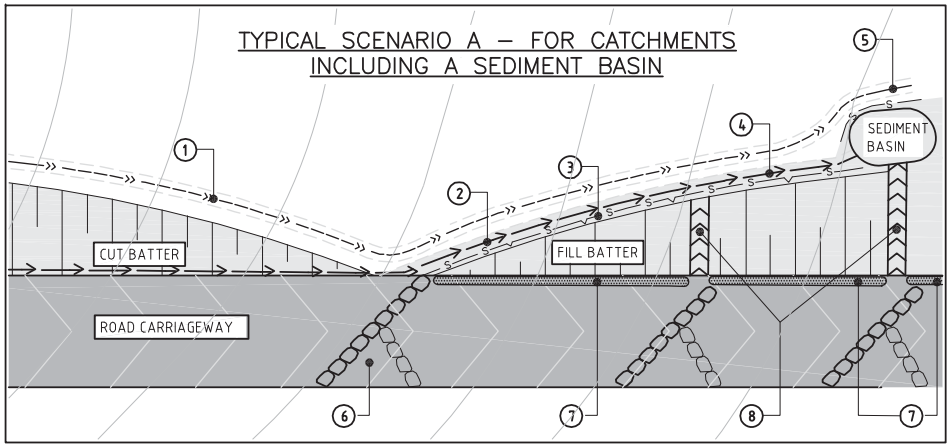
7. Prior to undertaking any stripping, earthworks or culvert construction works, 'onsite' soil and water management controls are to be established.
8. Complete bulk earthworks and construct the new culvert including the stabilised culvert inlet and outlets.
9. Once the bulk earthworks and the culvert constructions including stabilisation of culvert inlet / outlets have been completed, creek flows can be diverted into new culvert and temporary pipe removed or capped / sealed.

GENERAL NOTES

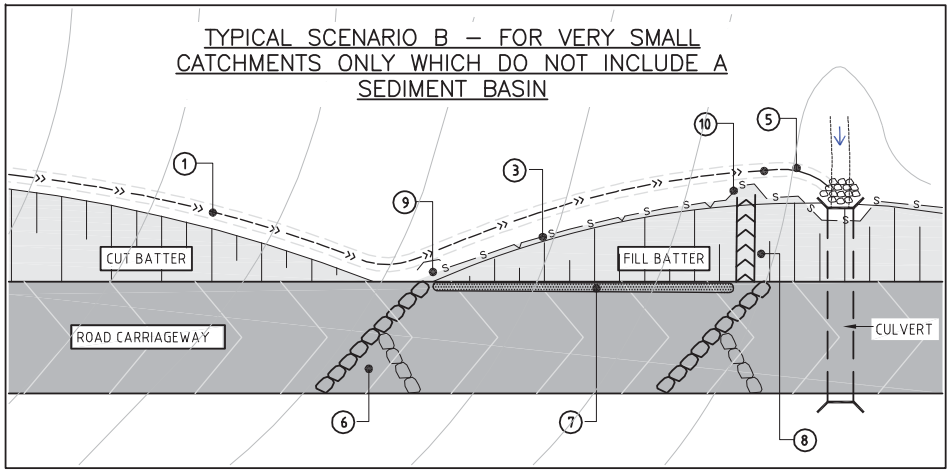
- An offset pipe is to be used where depressions are to be filled before culvert works (eg. to provide access during bulk earthworks).
- Ensure offsite flows are diverted into the temporary pipe prior to undertaking any stripping, bulk earthworks or culvert construction works.
- Include seepage collars on the temporary pipe.
- Temporary pipes are to include seepage collars.
- Water will pool in the collection sump up to the level of the temporary pipe invert. The area of the collection sump up to the height of the top of pipe level should be lined with rock, geofabric, plastic or similar (NOT BARE SOIL).
- The inlet and outlets of the temporary pipe are to stabilised with rock.
- The diversion berms used to direct 'offsite' flows into the temporary pipe are to be construction out of either rock or lined earth berms.
- Where sediment basins are not possible to construct in steep locations with space restrictions an alternative sediment device must be implemented (i.e. a sediment trap made out of sediment fence, sandbags or lined earth bunding). This is only suitable in very small catchments.
- Creek flows can only be re-diverted into the new culvert once culvert constructions have been completed and the culvert inlet and outlets have been rock lined and stabilised.
- If required, temporary pipes can be left in place after culvert works are completed.
- If temporary pipes are to remain in place, drain them, then cap or seal them to minimise the risk of water ingress.
- Note that not all onsite water management and sediment controls are shown here.

CUT / FILL BATTER WATER MANAGEMENT

TYPICAL SCENARIO A – FOR CATCHMENTS INCLUDING A SEDIMENT BASIN



TYPICAL SCENARIO B – FOR VERY SMALL CATCHMENTS ONLY WHICH DO NOT INCLUDE A SEDIMENT BASIN



LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-6)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET/INLET (SD 5-8)
- CUT / FILL BATTER
- DIVERSION BERM (SD 5-5)
- CREEK / PIPE FLOW ROUTE
- SPILLWAY
- SEDIMENT FENCE (SD 6-8)

CONSTRUCTION NOTES

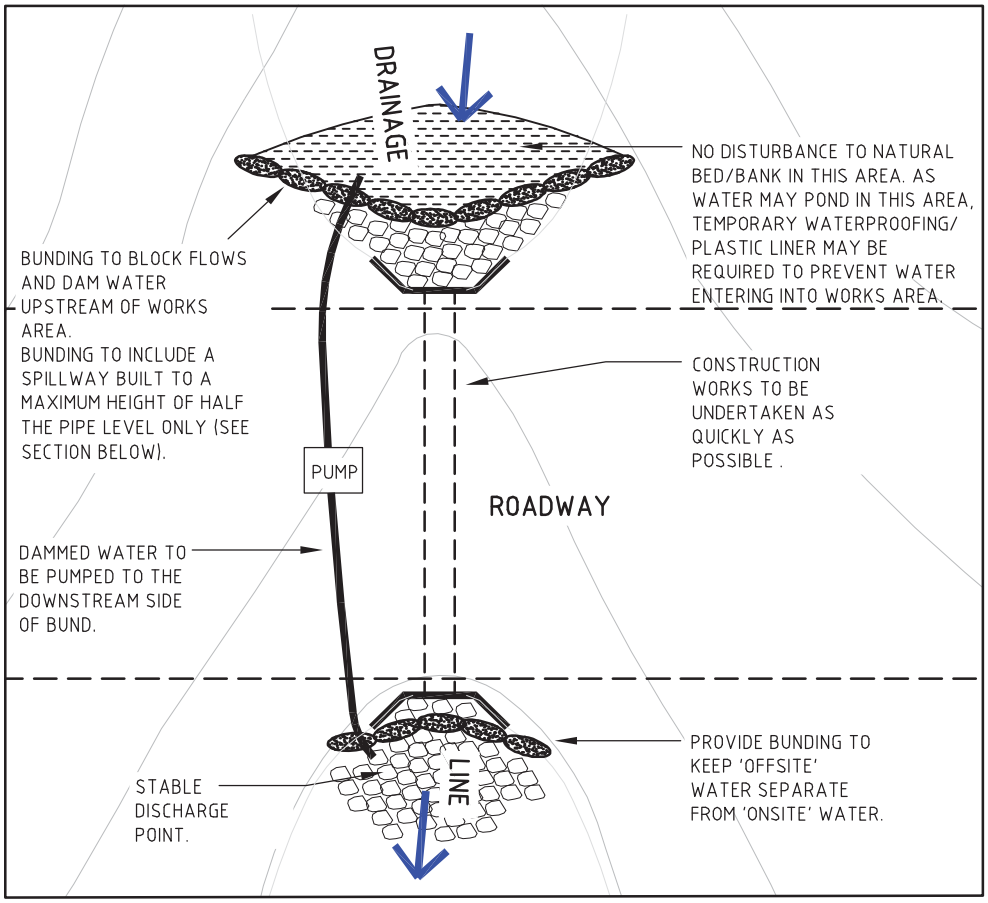
THE FOLLOWING WORKS ARE TO BE UNDERTAKEN AS SHOWN ON THE RELEVANT DIAGRAMS

1. Lined permanent diversion drains to be used as 'offsite' water drains during construction. Must convey water all the way to a watercourse or depression and onto a stabilised outlet point.
2. Provide sufficient room between toe of fill and 'offsite' water drain for management of 'onsite' water. 'Onsite' water diversion (temporary drain) - to drain to sediment basin.
3. Sediment fence at toe of batter. Include returns at 20m intervals.
4. 'Onsite' water diversion (temporary drain) - to drain to sediment basin.
5. Ensure 'offsite' water drain extends all the way to drainage line and onto a stabilised outlet point.
6. Use earth bank or sandbags to divert runoff at cut / fill line to onsite drain or sediment trap. Do not mix with 'offsite' water in cut-off drain. Use arrowhead shape if water is being shed from both sides of formation. It is only required at end of day or when rain is imminent.
7. Earth or sandbag windrow for directing water into drop-down flume. To be installed at end of day or when rain is imminent.
8. Lined drop-down chute to carry 'onsite' water to basin or trap. Only required when rain is imminent.
9. Install sediment trap at cut/fill line if runoff is not flowing to a basin.
10. Install sediment trap at base of drop-down flume if runoff is not flowing to a basin. This can simply be formed as a section of the sediment fence with returns both sides.

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

ONLINE PIPE REPLACEMENT/INSTALLATION – SMALL INTERMITTENT DEPRESSIONS ONLY (PUMP OPTION)



SITE STABILISATION

THIS METHOD IS ONLY SUITABLE FOR SIMPLE DEPRESSIONS WITH INTERMITTENT FLOWS. TO BE IN PLACE FOR NO MORE THAN 3 MONTHS.

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

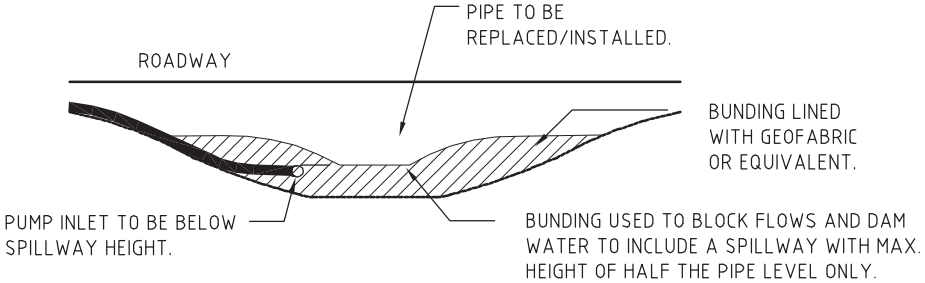
1. Ensure suitable temporary groundcover materials (e.g. geofabric, blankets) are located on site.
2. Ensure a suitable pump is available.
3. Watch the weather forecast to ensure rainfall is not forecast and monitor creek flows ensuring flows are minimal.
4. Position the bunding and line if required.
5. Undertake construction works (including inlet and outlet stabilisation) as quickly as possible. Drainage line to be blocked for no more than 3 months.

At any time during steps 4 - 5 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-6)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET (SD 5-8)
- CREEK/PIPE FLOW ROUTE
- SEDIMENT FENCE (SD 6-8)
- BUNDS

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

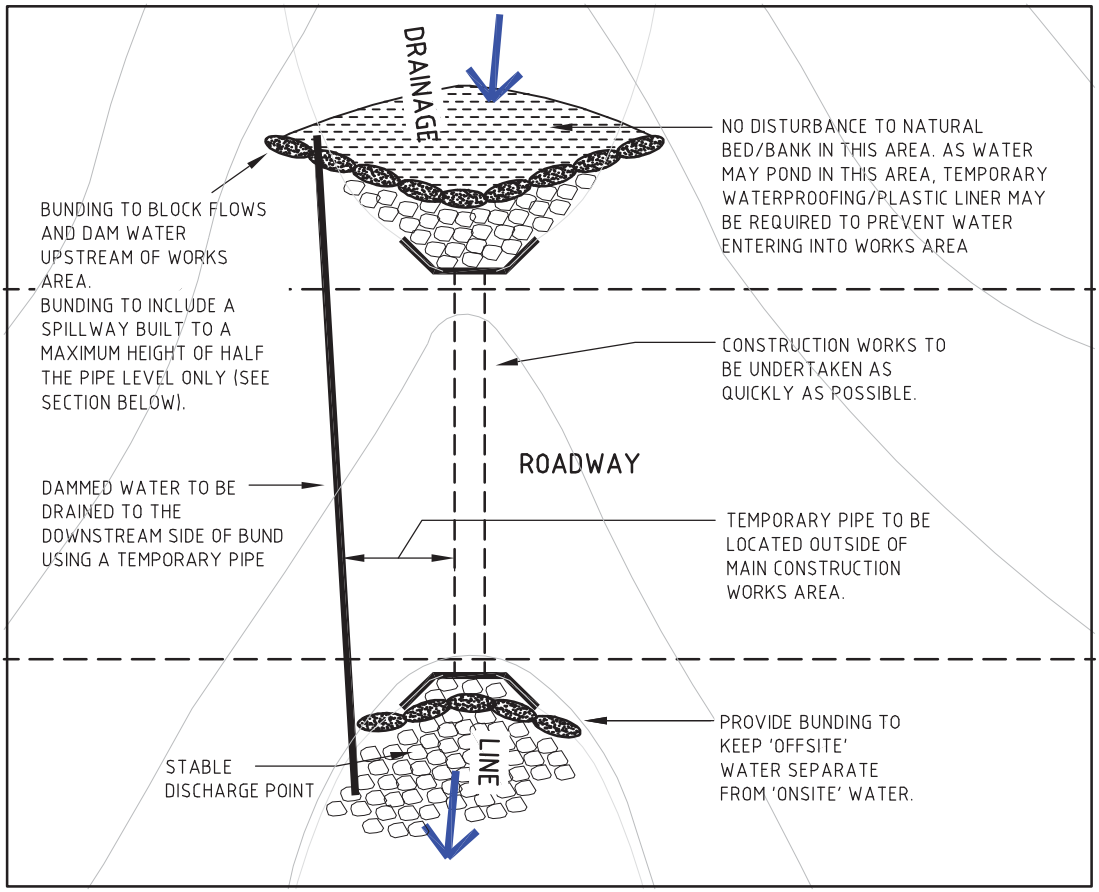


AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

SECTION THROUGH BUNDING LOCATION

DRAWING 10

ONLINE PIPE REPLACEMENT/INSTALLATION – SMALL INTERMITTENT DRAINAGE LINES (TEMPORARY PIPE OPTION)



SITE STABILISATION

THIS METHOD IS ONLY SUITABLE FOR SMALL CHANNELS WITH INTERMITTENT FLOWS.

TEMPORARY PIPE TO BE SIZED TO AT LEAST HALF THE PERMANENT PIPE.
e.g. – PERMANENT: 600ϕ
– TEMPORARY: MINIMUM 300ϕ

THIS METHOD (TEMPORARY PIPE SYSTEM) WILL NOT BE SUITABLE IN STEEP LOCATIONS WHERE TEMPORARY PIPE CANNOT BE LOCATED OUTSIDE OF WORKS AREA.

LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-6)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET (SD 5-8)
- CREEK/PIPE FLOW ROUTE
- SEDIMENT FENCE (SD 6-8)
- BUNDS

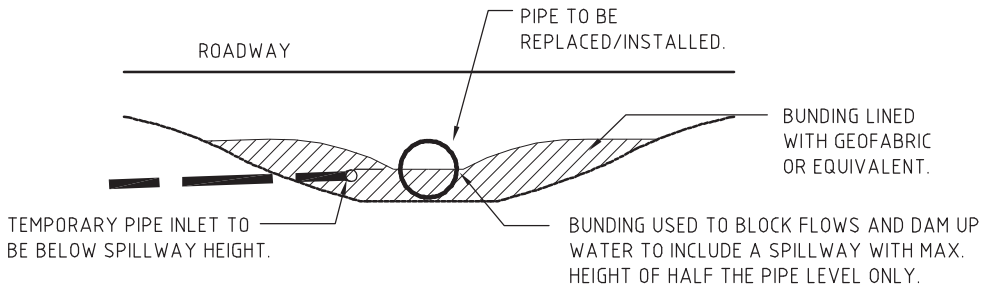
CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

1. Ensure suitable temporary groundcover materials (eg. geofabric, blankets) are located on site.
2. Ensure a temporary pipe is available. Install temporary pipe to ensure flow, preferably by providing continuous fall.
3. Watch the weather forecast to ensure rainfall is not forecast and monitor creek flows ensuring flows are minimal.
4. Position the bunding within the channel to secure the site.
5. Undertake construction works (including inlet outlet stabilisation) as quickly as possible.

At any time during steps 4 - 5 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.



AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

SECTION THROUGH BUNDING LOCATION

DRAWING 11

Appendix B: Additional Figures

Table 5.2 – Maximum Design Flow in Waterways (Landcom, 2004)

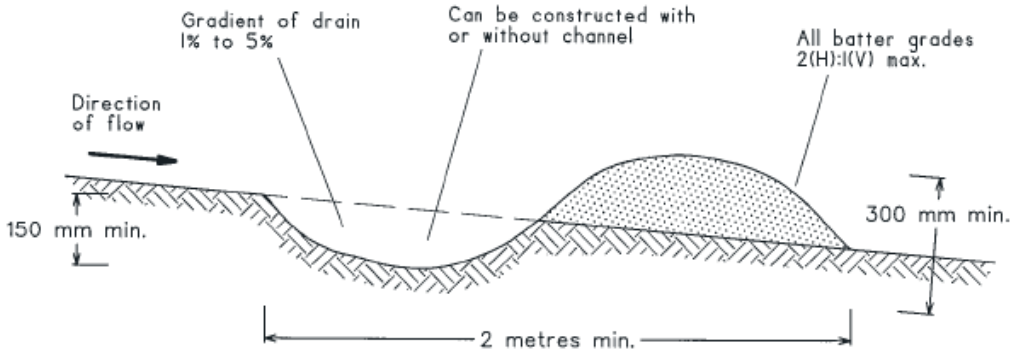
Material			Critical velocity (m/second)	
Type	Thickness (m)	Aggregate size (mm)		
Gabions and reno mattresses	0.50	120-250	6.4	
	0.50	100-200	5.8	
	0.30	100-150	5.0	
	0.30	70-120	4.2	
	0.25	70-100	3.6	
	0.17	70-100	3.5	
	Weight each (kg)		Turbulent flow	Normal flow
Loose rock (assume 100 percent soil cover)	1,000		4.8	6.6
	500		4.2	5.7
	100		3.3	4.5
	50		2.8	3.8
	10		2.3	3.0
	Form			
Revetment mattresses	Storm mattress		>6.0	
	200 mm fp		6.0	
	125 mm fp		4.0	
	100 mm fp		2.0	

Assume that all soils with 10 percent or more dispersible fines have high erodibilities. Of those with less, soils with *K*-factors below 0.02 have low erodibilities, those between 0.02 and 0.045 have moderate erodibilities, while those above 0.045 have high erodibilities.

In addition, the figures here assume slope gradients of less than 10 percent and, where appropriate, good (>80 percent) ground cover. If good ground cover is not expected to be maintained properly (might die back seasonally or during short periods of drought) and is critical to the system, reduce all velocities by 1.0 metre per second. Alternately, seek the manufacurer's advice if these conditions are unlikely to be met.

Material	Critical velocity (m/second)											
	Inundation <6 hours			Inundation <12 hours			Inundation <24 hours			Inundation <48 hours		
	Soil erodibility			Soil erodibility			Soil erodibility			Soil erodibility		
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
High performance bonded plastic fibres (vegetated)	7.0	7.0	7.0	6.0	6.0	6.0	5.0	5.0	5.0	4.0	4.0	4.0
Plastic fibres with netting	5.0	5.0	5.0	4.3	4.3.	4.3	3.6	3.6	3.6	3.0	3.0	3.0
Mesh reinforced pregrown turf	3.0	2.7	2.4	2.6	2.3	2.0	2.3	2.0	1.8	2.0	1.8	1.6
Kiku yu	2.5	2.2	1.9	2.1	1.9	1.6	1.9	1.7	1.4	1.6	1.4	1.2
Jute or coir mesh (close weave, bitumen sprayed)	2.3	2.0	1.7	1.9	1.7	1.5	1.7	1.5	1.3	1.5	1.3	1.1
Coconut/ jute fibre mats	2.3	2.0	1.7	1.9	1.7	1.5	1.7	1.5	1.3	1.5	1.3	1.1
Couch , carpet grass , Rhodes grass , etc.	2.0	1.8	1.4	1.7	1.5	1.2	1.5	1.4	1.1	1.3	1.2	0.9
Bare soil	0.7	0.5	0.3	0.6	0.4	0.3	0.5	0.4	0.2	0.4	0.3	0.2

Standard Drawing 5-5 (Landcom, 2004)



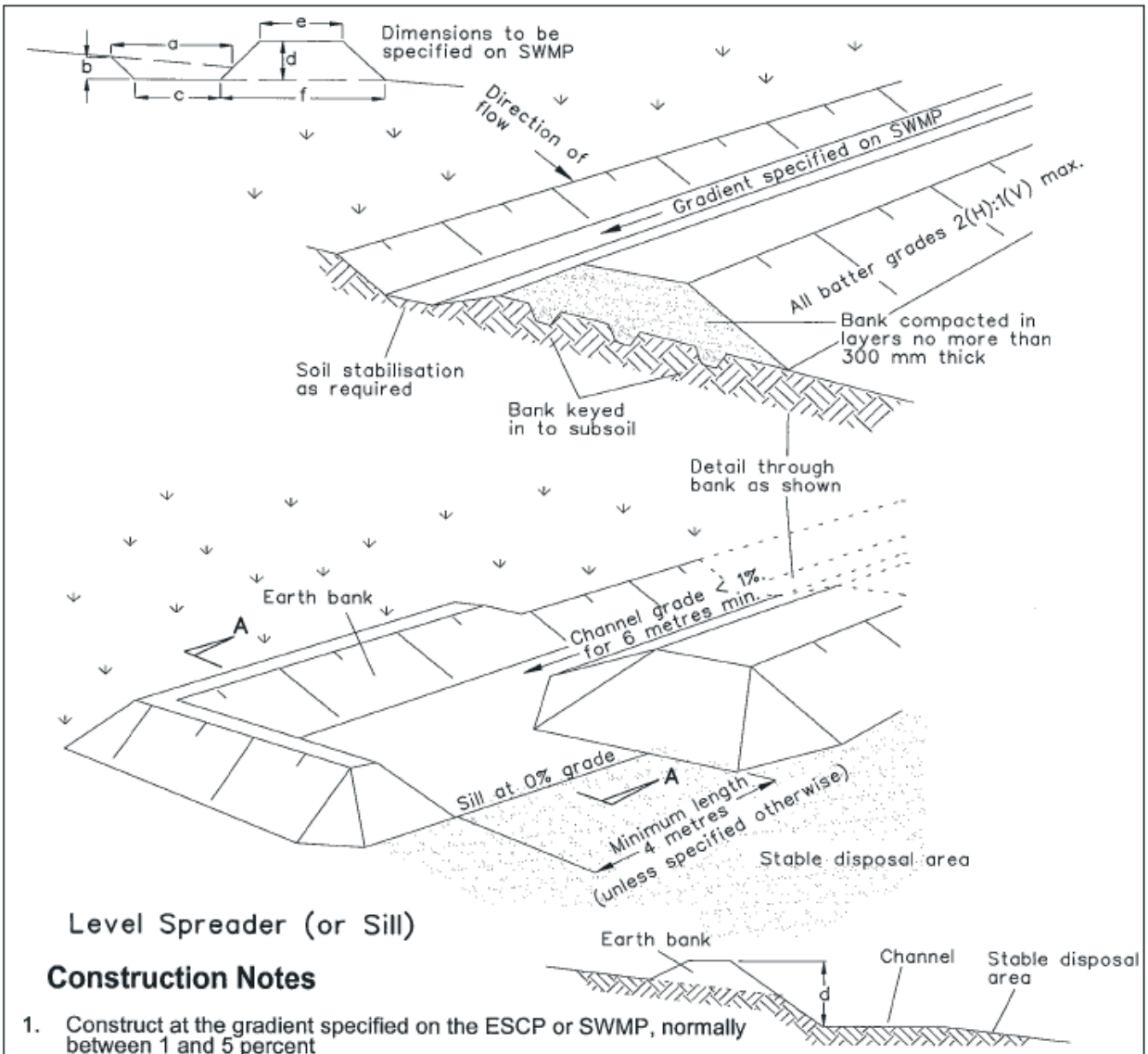
NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

EARTH BANK (LOW FLOW) SD 5-5

Standard Drawing 5-6 (Landcom, 2004)

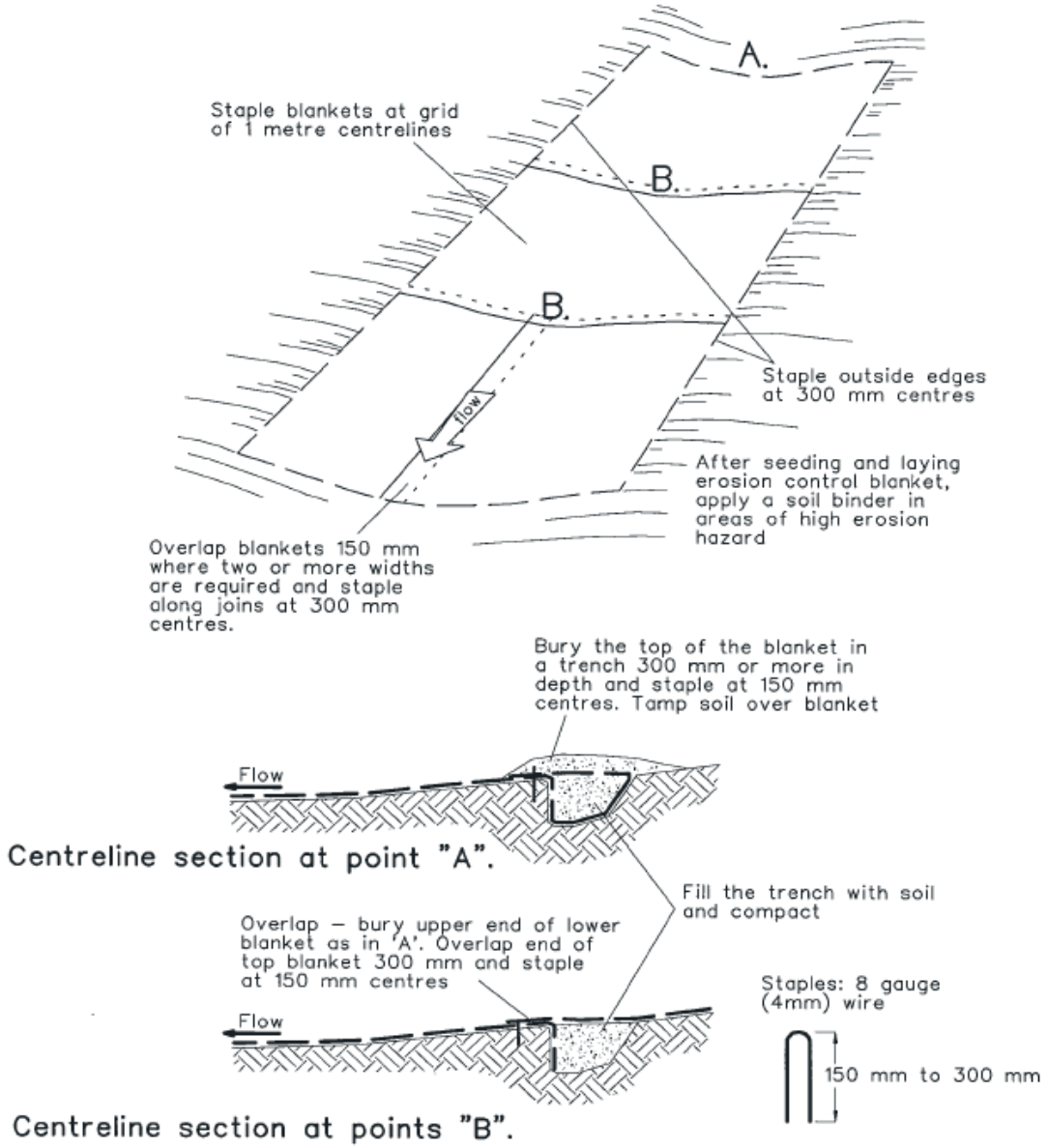


Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) SD 5-6

Standard Drawing 5-7 (Landcom, 2004)



Construction Notes

1. Remove any rocks, clods, sticks or grass from the surface before laying matting
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

RECP : CONCENTRATED FLOW **SD 5-7**

Appendix C: Photographs of Temporary Clean Water Diversions on RMS Projects

Figure 1. A vegetated temporary clean water diversion traversing a work zone during early works. Vegetation in the diversion will aid to capture any sediment that may enter into the channel and will assist in dissipating flow energy in low velocity flows. A pipe has been successfully used to allow the vehicle and plant movement over the diversion and a geofabric lining has prevented the generation of sediment as the water flows along the length of the diversion. Mulch bunds either side of the diversion place a crucial part in eliminating the movement of dirty water into the channel. Note that mulch used for bunds should be removed if it is observed to generate leachate which could contaminate clean water flows. And the use of aged mulch is encouraged to be used in appropriate volumes - refer RMS Environmental Direction – Management of Tannins from vegetation mulch (January 2012) for further information.

Figure 2. A geofabric lined temporary clean water diversion on the edge of a work zone. Geofabric has been anchored using wooden pegs and sand bags have been placed at intervals along the length of flow to dissipate flow energy and aid in capturing any sediment that may enter the channel. Areas surrounding the diversion are vegetated to prevent additional sediment entering the diversion and sediment fencing has been incorporated on the works side in accordance with the higher risk of sediment generation. It is important to also note sufficient space has been allocated in the clearing limits to allow for the diversion. Note that stones/rock used to dissipate flows should be clean and free of fines. Maintain work, health and safety constraints to minimise rock material being washed away,

Figure 3. A geofabric lined temporary clean water diversion traversing a work zone during installation of cross drainage. The geofabric has been anchored at the top with star pickets at regular intervals. The star pickets are also integral to sediment fencing preventing sediment from entering the channel along the length of the diversion. Within the channel larger rock is used to aid in energy dissipation. Orange safety fencing effectively delineates the diversion and allows.