APPENDIX B4

Construction Soil and Water Quality Management Plan

Woolgoolga to Ballina Pacific Highway Upgrade (sections 3 to 11)

OCTOBER 2015

Document control

File name	AppB4_CSWMP_Sect3-11_Rev5.docx
Report name	W2B Appendix B4 Soil and Water Quality Management Plan (sections 3-11)
Revision number	5

Revision history

Revision	Date	Description	Approval
1	11/8/15	Internal review	A Zambolt
2	2/9/15	Agency review	A Zambolt
3	01/10/15	Final draft	A Zambolt
4	02/10/15	Final for approval	A Zambolt
5	12/10/15	Rous Water comments	A Zambolt

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Glossary/abbreviations

ASS	Acid Sulfate Soils
CEMP	Construction Environmental Management Plan
CLMP	Contaminated Land Management Plan
CHCC	Coffs Harbour City Council
CVC	Clarence Valley Council
CoA	Condition of Approval
DECC	Former Department of Environment and Climate Change (NSW) now NSW Office of Environment and Heritage.
DP&E	NSW Department of Planning and Environment
DPI (Fisheries)	NSW Department of Primary Industries (Fishing and Aquaculture)
DPI (Water)	NSW Department of Primary Industries (Water) (Former Office of Water)
EEC	Endangered Ecological Community
EIS	Woolgoolga to Ballina Pacific Highway Upgrade Environmental Impact Statement (December, 2012)
EPA	NSW Environment Protection Authority
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act, 1999*
EPBC – CoA	Condition of approval by the Federal Minister for the Environment under the EPBC Act
EPL	NSW Environment Protection Licence under the *Protection of the Environment Operations Act 1997*.
ESCP	Erosion and Sediment Control Plan
EWMS	Environmental Work Method Statements
FM Act	*NSW Fisheries Management Act 1994*
FFMP	Flora and Fauna Management Plan
Minister, the	NSW Minister for Planning
MCoA	NSW Minister for Planning Condition of Approval
DPI Water	NSW Department of Primary Industries Water
PASS	Potential Acid Sulfate Soils
PIRMP	Pollution Incident Response Management Plan
PoEO Act	*NSW Protection of the Environment Operations Act 1997*
RMS	NSW Roads and Maritime Services
RUSLE	Revised Universal Soil Loss Equitation
Secretary	Secretary of the Department of Planning and Environment
SPIR	Woolgoolga to Ballina Pacific Highway Upgrade Submissions Preferred Infrastructure Report (November, 2013)
SWMP	Soil and Water Quality Management Plan
the project	Woolgoolga to Ballina Pacific Highway Upgrade project (Sections 3–11)
W2B	Woolgoolga to Ballina

1 Introduction

This document forms the soil and water quality management plan (SWMP) for the planned construction of the Woolgoolga to Ballina Pacific Highway Upgrade (sections 3 to 11).

1.1 Context

The SWMP forms part of the construction environmental management plan (CEMP). It describes applicable and relevant:

- Soil and water legislation and regulation
- Minister's Conditions of Approval (MCoA) issued by the NSW Minister of Planning
- Conditions of approval under the EPBC Act (EPBC-CoA) issued by the Federal Minister for the Environment
- Mitigation and management commitments contained in the combined response to submissions report and preferred infrastructure report (SPIR).

1.2 Background

Chapter 8 and chapter 9 of the environmental impact statement (EIS) (Roads and Maritime, 2012) assessed the project's likely potential soil, sediment and water quality impacts. Three associated working papers (technical assessments) were also produced to support the EIS; hydrology, water quality and groundwater.

The working papers and EIS confirmed the likely potential for direct and indirect soil and water quality impacts to occur during the project's construction. However, both concluded that providing that identified mitigation measures are implemented under the SWMP, any residual impacts would not be environmentally significant.

1.3 Environmental management systems overview

The CEMP describes the overall system for environmental management. That system forms part of the environmental management framework being delivered by Pacific Complete (PC) in partnership with Roads and Maritime.

The SWMP has been developed as part of the CEMP in consultation with:

- NSW Department of Primary Industries (Fisheries Branch) (DPI (Fisheries))
- NSW Department of Primary Industries (Water) (DPI (Water)) (previously NSW Office of Water (NOW))
- NSW Environment Protection Authority (EPA)
- Rous Water (in relation to the Woodburn borefield)
- Commonwealth Department of Environment
- Coffs Harbour Council, Clarence Valley Council, Ballina Council and Richmond Valley Council.

The relevant SWMP environmental control measures will be incorporated into location or activity-specific environmental work method statements (EWMS). EWMS will be developed in accordance with Section 4.1.3 of the CEMP. Additionally, NSW EPA and NSW DPI (Fisheries) will be provided with EWMSs for review for high-risk activities (ie working platforms in or over waterways).

High risk activities in known Oxlyean Pygmy Perch habitat is defined in the MCoA as:

Includes but is not limited to the following construction activities adjacent to or in known Oxleyan Pygmy Perch habitat:

- Piling in the waterway and within the bed and banks;
- Construction of temporary work platforms within the waterway;
- Installation and removal of temporary waterway crossings;
- Concreting of bridge abutments, deck, and parapets;
- Vegetation clearing within 50 metres of Oxleyan Pygmy Perch habitat waterways;
- Placing fill (bulk earthworks) on the floodplain within 50 metres of Oxleyan Pygmy Perch habitat waterways;
- Lime stabilisation work within 50 metres of Oxleyan Pygmy Perch habitat waterways; and
- Underboring of Oxleyan Pygmy Perch habitat waterways.

In addition erosion and sediment control plans (ESCPs) will be developed in consultation with an appointed project soil conservationist. They will be progressively updated throughout construction following:

- Construction activity or work location changes
- Site condition changes
- Flow path changes
- Other management plan changes that could impact on soil and water quality conservation.

This plan will be reviewed as part of the CEMP (refer to section 9 and section 10 of the CEMP).

2 Purpose and objectives

2.1 Purpose

The purpose of this SWMP is to describe how construction impacts on soil and water will be minimised and managed.

2.2 Objectives

The key objective of the SWMP is to ensure that impacts on water quality are minimised and within the scope permitted by the planning approval. To achieve this objective, Pacific Complete will undertake the following:

- Ensure appropriate measures are implemented to address the relevant CoA outlined in Table 3-1 and the safeguards detailed in the EIS and Submission / Preferred Infrastructure Report (SPIR).
- 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.
- Document the procedures to manage construction work activities to avoid or minimise their soil, water and groundwater impacts
- Ensure that work activities are managed so as not to cause a flood risk.

2.3 Targets

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

- Ensure full compliance with the relevant legislative requirements and Commonwealth and State CoA.
- Meet environmental protection licence water quality discharge parameters for all planned basin discharges (ie those within design capacity)
- Manage downstream water quality impacts attributable to the project (ie maintain water waterway health by avoiding the introduction of nutrients, sediment and chemicals outside of that permitted by the environmental protection licence and/or ANZECC guidelines)
- Ensure training on best practice soil and water management is provided to all construction personnel through site inductions
- Groundwater and aquifer protection to ensure no impact on potable water supplies, groundwater dependent ecosystems, licenced abstractions or overlying soils
- Manage potential or actual acid sulfate soils to prevent oxidation and any subsequent engineering, landscape, agricultural, ecological, aquacultural, ecotoxicological or human health impacts.

3 Environmental requirements

Soil and water management protection is governed and provisioned by associated legislation, regulation and guidelines as well as the committed mitigation measures and relevant Commonwealth and State conditions of approval.

3.1 Relevant legislation and guidelines

Appendix A1 of the CEMP contains details of the legislation, regulation, guidelines and standards that are relevant to this management plan.

3.1.1 Legislation and regulation

Table 3-1 lists the principal legislation and regulation that applies to soil and water quality management and conservation.

Table 3-1 Principal legislation and regulation

Legislation and regulation	Relevance
Commonwealth	
National Environmental Protection Measure Act 1994	Provides the basis for establishing national environmental protection measures (NEPMs) for ambient water quality.
National Environmental Protection (National Pollution Inventory) Measure 1998 (as amended)	Establishes the requirement to report the use of toxic substances and their emission to water.
National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended)	Describes the assessment stages in investigating contaminated land.
Environment Protection and Biodiversity Conservation Act 1999	Provides for the protection of matters of national environmental significance including species, populations, communities and their habitat that could be impacted by contamination or pollution.
Environment Protection and Biodiversity Conservation Regulation 2000 (as amended).	Provides for the protection of world heritage sites (including the Gondawana Rainforests) and wetlands of international importance (i.e. Ramsar sites).
State	
Water Act 1912	Provides for the protection of groundwater in the few areas in NSW where water-sharing plans have not come into effect.
Soil Conservation Act 1938	Establishes controls to prevent soil erosion and land degradation.
Environmental Planning and Assessment Act 1979	Establishes the requirement to consider environmental impacts. Confirms that 'water authorisation approval' or 'controlled activity approval' is not required for SSI projects.
Fisheries Management Act 1995	Provides for the conservation of fish stocks, habitat, threatened fish species, populations and communities. Promotes ecologically sustainable development. Promotes commercial and recreational fishing and aquaculture.

Legislation and regulation	Relevance
	Promotes the sharing of fishery resources. Provides for social and economic benefits for the wider community in terms of fish management.
Contaminated Land Management Act 1997	Provides for the investigation and remediation of contaminated land considered to post a significant risk to human health of the environment.
Protection of the Environment Operations Act 1997	Establishes the process for issuing environmental protection licences for certain scheduled activities. Places responsibility on the part of developers to prevent noise, water and air pollution while also controlling waste during construction.
Protection of the Environment (General) Regulation 2009 (as amended)	Defines water and land pollution and the circumstances when pollution has been caused.
Water Management Act 2000	Provides for the protection, enhancement and restoration of water sources and ecosystems, ecological processes and biological diversity.
Water Management Amendment Act 2014	Defines the conditions where a 'water access licence' is required.
Water Management (General) Regulation 2011	Defines the conditions when 'water use approval', a 'water access licence' and 'controlled activity approval' is required and the instances when they are not required.
Aquifer Interference Regulation 2011	Defines the conditions where 'aquifer interference approval' is needed and clarifies the difference between 'minimal impacts' and major 'dewatering' activities.
Aquifer interference policy.	

3.1.2 Guidelines and standards

Table 3-2 lists the non-statutory guidelines and standards that provide for soil and water quality management.

Table 3-2 Guidelines and standards

Guidelines and standards
Quality assurance specifications
Quality Assurance Specification G36: Environmental Protection (Roads and Maritime, 2014)
Quality Assurance Specification G38: Soil & Water Management (Roads and Maritime, 2014)
Quality Assurance Specification G40: Clearing and Grubbing (Roads and Maritime, 2014)
Dewatering
Technical Guideline: Environmental Management of Construction Site Dewatering (EMS-TG-011) (Roads and Maritime, 2011)
Pacific Highway Practice Note for Dewatering (Roads and Maritime, 2014)
Acid sulfate soil management
Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock

Guidelines and standards
and Monosulphidic Black Ooze (Roads and Maritime, 2005)
Acid Sulfate Soils Assessment Guidelines (Acid Sulfate Soil Management Advisory Committee, 1998)
Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998)
Acid Sulfate Soil and Rock Publication 655.1 (Environment Protection Authority Victoria (EPA Victoria), July 2009)
Waste Classification Guidelines Part 4: Acid Sulfate Soils (EPA. 2014)
Saline soil management
Roads and Salinity (Department of Infrastructure, Planning and Natural Resources, 2003)
Introduction to Urban Salinity (Department of Natural Resources (DNR), 2006)
Building in a Saline Environment (DNR, 2006)
Salinity Management Guidelines (Blacktown City Council and Landcom, 2008)
Water quality management
Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 1 – The Guidelines (ANZECC, 2000)
Australian Drinking Water Guidelines (Natural Resource Management Ministerial Council (NRMMC), 2011)
Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (NSW Environment Protection Authority, 2004).
Floodplain management
Floodplain Risk Management Guideline: Practical Consideration of Climate Change (Department of Environment and Climate Change (DECC), 2007)
Contaminated land and groundwater management
Guideline for the Management of Contaminated Land (Roads and Maritime, 2013)
Guidelines for Assessment and Management of Contaminated Groundwater (Department of Environment and Conservation (DEC), 2007)
Watercourse crossings
Department of Primary Industries Guidelines for Controlled Activities (2012)
Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries, Cronulla, 16 pp (Fairfull, S. and Witheridge, G. (2003))
Erosion and sediment control (including stormwater, stockpile and spill management)
Code of Practice for Water Management: Roads and Development Management (Roads and Maritime, 1999)
Environmental Direction: Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012)
Technical Guideline: Temporary Stormwater Drainage for Road Construction (Roads and Maritime, 2011)
Guidelines for Construction Water Quality Monitoring (Roads and Maritime, 2003)
Stockpile Site Management Guidelines (Roads and Maritime, 2008)
The Blue Book: Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2 (Landcom, 2004)

Guidelines and standards
Bunding and Spill Management: Insert to the Environmental Protection Manual for Authorised Officers (Technical Section) (NSW Department of Environment and Conservation (DEC), 1997)
Guidelines for Treatment of Stormwater Runoff from the Road Infrastructure (AP- R232) (AusRoads, 2003)
Australian Standard: AS1940 - 2004, The Storage and Handling of Flammable and Combustible Liquids (Standards Australia, 2004)
Environmental Best Management Practice Guideline for Concreting Contractors (DEC, 2004)
Waste Classification Guidelines
Waste Classification Guidelines Part 1: Classifying waste (NSW EPA, 2014)
Waste classification guidelines Part 2: Immobilisation of waste (NSW EPA, 2014)
Waste classification guidelines Part 4: Acid sulfate soils (NSW EPA, 2014)

3.2 Minister's Conditions of approval

The MCoA relevant to this SWMP are listed Table 3-3. A cross reference is also included to indicate where the condition is addressed in this SWMP or other project management documents.

Table 3-3 Minister's Conditions of approval relevant to the SWMP

CoA	Condition requirements	Associated management procedure
State Conditions of Approval		
Oxleyan Pygmy Perch Habitat		
B7	High risk construction activities in known Oxleyan Pygmy Perch habitat shall not be undertaken during the Oxleyan Pygmy Perch spawning period, or on days when the relevant Bureau of Meteorology site predicts a 90% change of 10 mm or rain or more, unless otherwise agreed by DPI (Fisheries).	Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)
B8	Temporary bridge or arch structures in known Oxleyan Pygmy Perch habitat shall be used if the crossing is intended to be in place for more than 3 months.	Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)
B9	Where temporary crossings in known Oxleyan Pygmy Perch habitat are proposed with culverts or pipes, the Applicant shall, in consultation with DPI (Fisheries): a) Determine the size of the culverts or pipes to facilitate fish passage; and b) Identify the minimum size of clean rock to be used to ensure that rock material will not wash into the waterway in periods of high flows. Temporary culvert or pipe crossings shall be removed prior to the start of the Oxleyan Pygmy Perch spawning period.	Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)

CoA	Condition requirements	Associated management procedure
Water quality		
B30	Except as may be expressly provided by an EPL, the Applicant shall comply with section 120 of the *Protection of the Environment Operations Act 1997.*	This SWMP
Construction soil and water management		
B34	**Construction Soil and Water Management** Soil and water management measures consistent with *Managing Urban Stormwater - Soils and Construction Vols 1 and 2, 4th Edition* (Landcom, 2004) and *Managing Urban Stormwater Soil and Construction Vols 2A and 2D Main Road Construction* (Department of Environment and Climate Change, 2008) 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 waters.	Chapter 6
B35	Where available, and of appropriate chemical and biological quality, stormwater, recycled water or other water sources shall be used in preference to potable water for construction activities, including concrete mixing and dust control.	Chapter 6
B36	All surface water and groundwater shall be adequately treated as far as is practicable, prior to entering the stormwater system to protect the receiving water source quality.	Chapter 6
Land contamination		
B37	Prior to the commencement of site preparation and excavation activities, or as otherwise agreed by the Secretary, in areas identified as having a moderate to high risk of contamination, a site audit shall be carried out by a suitably accredited contaminated site auditor. A **Site Audit Report** is to be prepared by the site auditor detailing the outcomes of Phase 2 contamination investigations within these areas. The Site Audit Report shall detail, where relevant, whether the land is suitable (for the intended land use) or can be made suitable through remediation. Where the investigations identify that the site is suitable for the intended operations and that there is no need for a specific remediation strategy, measures to identify, handle and manage potential contaminated soils, materials and groundwater shall be identified in the Site Audit Report and incorporated into the Construction Environmental Management Plan. Where the investigations identify that the site is suitable for the intended operations and that a remediation strategy is required, the Site Audit Report shall include a remediation strategy for addressing the site contamination, and how the environmental and human health risks will be managed during the disturbance, remediation and/or removal of contaminated soil or groundwater, and be incorporated into the Construction Environmental Management Plan.	Construction Contaminated Land Management Plan (CEMP Appendix B8)

CoA	Condition requirements	Associated management procedure
	Where remediation is required, a **Site Audit Statement(s)** shall be prepared verifying that the site has been remediated to a standard consistent with the intended land use. *Note: Terms used in this condition have the same meaning as in the Contaminated Land Management Act 1997.*	
Watercourse crossings		
B38	**Watercourse crossings** Watercourse crossings shall be designed in consultation with the DPI (Fisheries NSW), EPA, NOW and DoE, and where feasible and reasonable, be consistent with the *Guidelines for Controlled Activities Watercourse Crossings* (Department of Water and Energy, February 2008*)*, *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003), *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW Fisheries, February 2004*),* and *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI Fisheries, 2013). Where multiple cell culverts are proposed for crossings of fish habitat streams, at least one cell shall be provided for fish passage, with an invert or bed level that mimics watercourse flows.	Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)
B42	The Applicant shall ensure that the SSI does not increase the afflux of waterways with known Oxleyan Pygmy Perch habitat by more than the relevant flood management objective in the documents referred to in condition **Error! Reference source not found.** for flood events up to the 1 in 100 year event.	Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)
Water quality monitoring program		
D12	The Applicant shall prepare and implement a **Water Quality Monitoring Program**, to monitor the construction and operation impacts of the SSI on surface and groundwater quality and resources and wetlands, prior to construction. The Program shall be prepared in consultation with the OEH, EPA, DPI (Fisheries), NOW, DoE and Rous Water (in relation to the Woodburn borefields), to the satisfaction of the Secretary, and shall include but not necessarily be limited to:	Water Quality Management Plan Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)
(a)	identification of surface and groundwater quality monitoring locations (including watercourses, waterbodies and SEPP14 wetlands) which are representative of the potential extent of impacts from the SSI;	
(b)	the results of any groundwater modelling undertaken;	
(c)	identification of works and activities during construction and operation of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways and known Oxleyan Pygmy Perch habitat;	
(d)	development and presentation of parameters and standards against which any changes to water quality will be assessed, having regard to the *Australian and New Zealand Guidelines for*	

CoA	Condition requirements	Associated management procedure
	Fresh and Marine Water Quality 2000 (Australian and New Zealand Environment Conservation Council, 2000) or relevant baseline data;	
(e)	representative background monitoring of surface and groundwater quality parameters for a minimum of twelve months (considering seasonality) prior to the commencement of construction, to establish baseline water conditions, unless otherwise agreed by the Secretary;	
(f)	a minimum monitoring period of three years following the completion of construction or until the affected waterways and/or groundwater resources are certified by an independent expert as being rehabilitated to an acceptable condition. The monitoring shall also confirm the establishment of operational water control measures (such as sedimentation basins and vegetation swales);	
(g)	contingency and ameliorative measures in the event that adverse impacts to water quality are identified; and	
(h)	reporting of the monitoring results to Department of Planning and Environment, OEH, EPA, DPI (Fisheries), NOW, DoE and Rous Water (in relation to the Woodburn borefields).	
Construction environmental management		
D25	The need to prepare and implement a **Construction Environmental Management Plan** that includes an environmental risk analysis of environmental performance relating to:	Stockpile Management Protocol (Appendix C)
(vi)	Measures to minimise **hydrology** impacts, including measures to stabilise bed and bank structures as required	
(ix)	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**.	
Construction soil and water management plan		
D26(c)	a **Construction Soil and Water Quality Management Plan** to manage surface and groundwater impacts during construction of the SSI. The Plan shall be developed in consultation with the EPA, DPI (Fisheries), NOW, Rous Water (in relation to the Woodburn borefield), DoE and the relevant council and include, but not necessarily be limited to:	This SWMP
(i)	Details the location of construction activities that have the potential to impact on water courses, storage facilities, stormwater flows, and groundwater;	Chapter 5
(ii)	surface water and ground water impact assessment criteria consistent with Australian and New Zealand Environment Conservation Council (ANZECC) guidelines or relevant site specific baseline data collected for known Oxleyan Pygmy Perch waterways;	Chapter 4 and Oxleyan Pygmy Perch habitat waterway management

CoA	Condition requirements	Associated management procedure
		framework (Appendix B)
(iii)	management measures to be used to minimise surface and groundwater impacts, including details of how spoil and fill material required by the SSI will be sourced, handled, stockpiled, reused and managed; erosion and sediment control measures; salinity control measures and the consideration of flood events;	Chapter 6
(iv)	a **Groundwater and Soil Salinity report** should geotechnical investigations determine the presence, extent and severity of soil salinity within the SSI boundary, The report shall detail the outcomes of geotechnical investigations and identify and mitigate impacts to groundwater resources;	Groundwater and soil salinity report (Appendix E)
(v)	an **Acid Sulfate Soils contingency plan**, consistent with the *Acid Sulfate Soils Manual*, to deal with the unexpected discovery of actual or potential acid sulfate soils, including procedures for the investigation, handling, treatment and management of such soils and water seepage;	Acid sulfate soil contingency and management controls (Appendix A)
(vi)	a **tannin leachate management protocol** to manage the stockpiling of mulch and use of cleared vegetation and mulch filters for erosion and sediment control;	Tannin leachate management controls (Appendix D)
(vii)	an **Oxleyan Pygmy Perch habitat waterway management framework** to detail the measures and construction methods that will be employed to avoid direct discharge of construction water to known Oxleyan Pygmy Perch habitat waterways and downstream impacts to suitable habitat;	Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)
(viii)	management measures for contaminated material and a contingency plan to be implemented in the case of unanticipated discovery of contaminated material during construction;	Construction Contaminated Land Management Plan (CEMP Appendix B8)
(ix)	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 mechanisms for the monitoring, review and amendment of this plan.	Chapter 7
Commonwealth Conditions of Approval		
Avoidance and mitigation of impacts		
14	The need to develop and implement frameworks, strategies, plans, and program in accordance with the requirements of the following NSW conditions:	

CoA	Condition requirements	Associated management procedure
(d)	The need to prepare and implement a **Construction Soil and Water Quality Management Plan**	This SWMP
(g)	The need to prepare and implement a **Water Quality Monitoring Program**	Water Quality Monitoring Program

4 Existing environment

The soil and water quality environment within the work footprint and its environs is described below. This information is a summary of chapter 8 (hydrology and flooding) and chapter 9 (soils, sediments and water quality) of the EIS as well as the complementary working papers on hydrology, water quality and groundwater.

4.1 Soils, sediments and water quality

This section summarises Section 9.2 of the EIS.

4.1.1 Topography

The work footprint is predominantly located on lowland, where in several locations the land is at or below sea level. This reflects why the area is flood-prone. Lowland areas are predominately associated with the Clarence and Richmond river floodplains and occur within sections 4 to 5 and 8 to 11 where elevations are less than about 15 metres AHD. Elevated areas are mainly confined to the southern and central parts of the project boundary, occurring in section 3, 6 and 7, and rise to a maximum elevation of about 135 metres AHD on the Coast Range and footslopes of the Pillar and Richmond ranges. These sections are located on gently undulating higher ground. As such, there is a potential for associated slope stability issues within these sections.

4.1.2 Geology

The topography reflects the underlying geology. A sedimentary geology underlies the low-lying areas, with the main exception being around project section 11 (Ballina), which is underlain by an outcrop of the New England fold belt.

The central sections of the work footprint, around project section 4 and project section 5, are underlain by coal measures, which are more resistant to erosion and weathering compared to the sedimentary geology found elsewhere. This accounts for the topographical differences described above and also gives rise to the potential for leaching and contaminant migration.

4.1.3 Soil landscape

The most common soil landscapes within the project boundary are the erosional, transferal and alluvial types. Soils within these landscapes are generally highly erodible and have low bearing strength. Soft soils occur in low-lying areas, including the Clarence and Richmond River floodplains.

Table 4-1 summarises the eight broad soil landscapes that occur within the proposal footprint.

Table 4-1 Mapped soil landscapes within the work footprint

Soil landscape	Typical characteristics
Section 3	
Disturbed	Comprising fill material of varying quality. As such, there is a residual risk of **subsidence**, **poor drainage**, low fertility, the presence of **contaminants** and **erodibility**.
Other issues	**Soft soils**
Section 4	
Erosional	Highly **erodible** (when cleared) while presenting a low foundation risk.
Alluvial	Highly **acidic**, highly **erodible**, **flood prone** and of low-bearing strength due to water erosion.

Soil landscape	Typical characteristics
Swamp	Highly **acidic**, highly **sodic**, highly **saline**, and of low-bearing strength due water erosion.
Other issues	**Soft soils** throughout the Clarence River floodplain.
Section 5	
Estuarine	**Saline**, **flood prone** and of low-bearing strength due to seasonal water erosion.
Disturbed	Comprising fill material of varying quality. As such, there is a residual risk of **subsidence**, **poor drainage**, low fertility, the presence of **contaminants** and **erodibility**.
Section 6 and section 7	
Erosional	Highly **erodible** (when cleared) while presenting a low foundation risk.
Transferral	Highly **acidic**, highly **sodic**, **erodible** and of low-bearing strength due to seasonal waterlogging.
Stagnant alluvial	Moderately **erodible** and of low-bearing strength due to seasonal waterlogging.
Section 8	
Erosional	Highly **erodible** (when cleared) while presenting a low foundation risk.
Alluvial	Highly **acidic**, highly **erodible**, **flood prone** and of low-bearing strength due to water erosion.
Aeolian	Non-cohesive, highly **erodible** and highly **permeable**.
Section 9	
Alluvial	Highly **acidic**, highly **erodible**, **flood prone** and of low-bearing strength due to water erosion.
Aeolian	Non-cohesive, highly **erodible** and highly **permeable**.
Disturbed	Comprising fill material of varying quality. As such, there is a residual risk of **subsidence**, **poor drainage**, low fertility, the presence of **contaminants** and **erodibility**.
Other issues	**Soft soils** throughout the Clarence River floodplain.
Section 10	
Transferral	Highly **acidic**, highly **sodic**, **erodible** and of low-bearing strength due to seasonal **waterlogging**.
Alluvial	Highly **acidic**, highly **erodible**, **flood prone** and of low-bearing strength due to water erosion.
Disturbed	Comprising fill material of varying quality. As such, there is a residual risk of **subsidence**, **poor drainage**, low fertility, the presence of **contaminants** and erodibility.
Section 11	
Alluvial	Highly **acidic**, highly **erodible**, **flood prone** and of low-bearing strength due to water erosion.
Estuarine	**Saline**, **flood prone** and of low-bearing strength due to seasonal water erosion.

Soil landscape	Typical characteristics
Aeolian	Non-cohesive, highly **erodible** and highly **permeable**.

4.1.4 Acid sulfate soils

Soils that are rich in naturally occurring iron sulfides are referred to as 'acid sulfate soils'. Iron sulfide is relatively unstable. Exposure to the air causes the soils to undergo a chemical reaction, the end result of which is the generation of sulphuric acid. Sulphuric acid can cause significant environmental damage. Directly, it can have ecological effects and it can also harm humans if it is discharged into a potable water supply. It can also cause the release of heavy metals into the soil at concentrations that are toxic to humans and animals. Ground excavation and dewatering activities are the most common construction activities by which sulphuric acid can be generated.

As summarised in Table 4-3, several of the soil landscape types are moderately or highly acidic. While this is the case, there are other local variances and factors that determine whether the soils are at risk of generating sulphuric acid. These factors have been considered at a regional scale. Published acid sulfate soil mapping was used in the EIS to confirm the probability of encountering acid sulfate soils within the work footprint.

4.1.5 Soft soils

The alluvial soils within the work footprint are typically soft and waterlogged. While presenting limited environmental risk they are a significant issue when it comes to settlement. As such, these areas need engineering before constructing the final formation. This would involve the construction of embankments that are up to 12 metres high. This work will involve substantial earthworks, including the movement and management of spoil, its stabilisation and its subsequent compaction and settlement.

4.1.6 Contamination

There are 46 identified 'areas of potential concern' within the work footprint and its environs. They relate to current and historic land uses that have associated contamination risks (i.e. service stations, sawmills, farms, cattle dip sites, landfills, agricultural and forestry uses). Each land use has a typical associated contaminant profile. Broadly however, there is a risk of encountering heavy metals, hydrocarbons (and their derivatives), organic compounds (associated with pesticide use), asbestos, high nutrient loadings, microbiological compounds and sulphuric acid (from acid sulfate soils). There is also a risk of encountering unexploded ordnance due to the alignment covering land that was used for military training (refer to State Condition of Approval SSW64). All mitigation measures listed in table 6-1 under contamination have been addressed in the Construction Contaminated Land Management Plan.

Table 4-2 Areas of potential concern

No. of locations	Issues and activities	Potential contaminants of concern
Section 3		
4	Former sawmill; Tucabia landfill, south of Firth Heinz Road; Property off Upper Coldstream Road, Tucabia; Old Maclean Shire Council landfill – Coldstream Road	Hydrocarbons, heavy metals, asbestos, volatile organic compounds, ammonia and microbiological contaminants.
Section 4		

No. of locations	Issues and activities	Potential contaminants of concern
9	Three cattle dips, RMS stockpile Two agricultural land; Service station; Former fuel depot; Townsend sewage treatment plant	Pesticides, heavy metals, nutrients and microbiological contaminants.
Section 5		
5	Harwood Bridge – signage manufacturer; Harwood Bridge; United service station – eastern side of highway; Mills truck depot – western side of highway; Mororo Bridge	Hydrocarbons, heavy metals and volatile organic compounds.
Section 6		
3	RMS stockpile; Two cattle dip sites.	Hydrocarbons, pesticides, heavy metals and asbestos.
Section 7		
10	Two cattle dips, six stockpile sites, old storage tanks and an agricultural property.	Hydrocarbons, heavy metals, pesticides, asbestos and volatile organic compounds.
Section 8		
5	Garage / junk yard; Electrical substation; RMS Woodburn Depot; Unknown material / structure; Agriculture	Hydrocarbons, heavy metals, pesticides, asbestos and PCBs.
Section 9		
8	Evans Head Air Weapons Range; Agricultural land; Council Landfill – Broadwater; Evans Head Air Weapons Range; NSW Sugar Mill Co-Op – Sugar Cane stockpile area and processing plant; Quarry, Quarry Road, Broadwater	Hydrocarbons, heavy metals, microbiological, nutrients and potential contaminants associated with unexploded ordnance.
Section 10		
3	General observation – between existing quarries; Quarries – northern section of the Project, Old Bagotville Road; Sewage Treatment Works	Hydrocarbons, heavy metals, pesticides, solvents, asbestos, microbiological contaminants and nutrients.
Section 11		
1	Agricultural property.	Hydrocarbons, pesticides and asbestos.

Source: Pacific Highway Upgrade Woolgoolga to Ballina EIS (RMS 2012)

4.1.7 Saline soils

Saline soils occur where there is a build-up of salts in the soil surface and groundwater in non-irrigated areas. While naturally occurring, the build-up of excess salt can affect the soil quality, native vegetation, biodiversity, crops and water quality. Termed ‘dryland salinity’ this typically

occurs where brackish groundwater rises to the surface. The water is either taken up by plants or evaporates and leaves the salt deposits behind. While the work footprint is located across areas of extensive shallow groundwater that would cause the build-up of salts deposits in the upper layers, the EIS concluded that this is unlikely to be a significant issue given the high rainfall in the region, as this would dilute and disburse any saline build-up.

4.1.8 Receiving waters and sensitive receiving environments

As described in Table 4-2, there are 27 watercourses that are either crossed or pass close to the work footprint that flow into the Coffs Harbour waterway, the Clarence River or the Richmond River catchments. The water environment of the area is important in supporting a range of sensitive aquatic and riparian (river corridor) environments that contain diverse ecological values and threatened ecosystems. They also form potable water sources and irrigation for crops such as sugar cane. They include the:

- Upper Coldstream wetlands (project section 3)
- Tabbimoble Swamp nature reserve (project section 7)
- Rous Water Woodburn Sands aquifer catchment (project section 8)
- Broadwater National Park and associated wetlands (project section 9)
- Wardell Heath (project section 10).

There are a number of cane drains that occur within the project boundary. These will be treated as a water course and the same protections/mitigations will be put in place.

The project will also involve working on waterfront land (ie within 40 metres of a watercourse) and discharging to, or within the vicinity of, known or potential threatened species aquatic habitat. In addition to the five high-risk sites, there are a number of other values and features that contain sensitive water quality environments. They include:

- Key fish habitat (as designated by DPI (Fisheries))
- Oxleyan Pygmy Perch habitat (as designated by DPI (Fisheries) or identified through targeted surveys)
- Nationally important wetlands (as designated under State Environmental Planning Policy 14: Coastal Wetlands).

Table 4-3 lists where these features occur within each section of the work footprint.

Table 4-3 Sensitive water environments

Receiving watercourse	Description	Sensitive aquatic receiving environments
Section 3		
• Pheasant Creek • Coldstream River • Black Snake Creek • Pillar Valley Creek • Chaffin Creek • Champions Creek • Clarence River	The waterways are primarily lowland freshwater systems. Coldstream Creek, Chaffin Creek and Champions Creek have estuarine properties downstream, and lowland river characteristics upstream.	• **Crow's Nest Swamp:** Located adjacent to the project • **SEPP 14 coastal wetland:** Site 287 is located about 600 metres downstream of proposed crossing of Champions Creek • **SEPP 14 coastal wetland:** Site 289 is associated with Chaffin Creek and is located above 450 metres to the west of the project • **SEPP 14 coastal wetland:** Site 292 is part of the Upper Coldstream Wetlands, associated with Coldstream River and Pillar Valley Creek. It is located downstream and to the west of the alignment • **Key fish habitat**: In all named waterways plus: an unnamed tributary of Glenugie Creek at station 39.7; an unnamed tributary of Pillar Valley Creek at station 48.0; and an unnamed tributary of Chaffin Creek at station 54.6 • **Known and potential threatened aquatic species habitat:** Present in Coldstream River, Black Snake Creek, Pillar Valley Creek, and Chaffin Creek.
Section 4		
• South Arm (Clarence River) • Edwards Creek • Shark Creek	These are tidally influenced estuarine systems dominated by saline conditions, although the upstream reaches of Shark Creek are considered to be a lowland freshwater ecosystem.	• **SEPP 14 coastal wetland:** The alignment is near Shark Creek, close to site 232. It is located on the eastern side of the upstream reaches of Shark Creek, upstream of the work footprint. • **Key fish habitat**: In South Arm (Clarence River) and Shark Creek.
Section 5		
• James Creek • Nyrang Creek	The Clarence River is the largest river on the NSW coast. Waterways in this section are mainly tidally influenced	• **SEPP 14 coastal wetland**: Site 220a is located to the south-east of the work footprint and extends into the Yaegl Nature Reserve. James Creek flows through the wetland into the nature reserve.

Receiving watercourse	Description	Sensitive aquatic receiving environments
• Clarence River • Serpentine Channel • North Arm (Clarence River) • Mororo Creek	estuarine systems dominated by saline conditions with estuarine water quality characteristics	• **SEPP 14 coastal wetland**: Site 153c is located about 400 metres west of the crossing of North Arm • **Key fish habitat**: In all named and unnamed waterways including the tributary of James Creek at station 84.4. • **Threatened aquatic species habitat**: Present in the Clarence River.
Section 6		
• Mororo Creek • Tabbimoble Creek	Tabbimoble Creek is estuarine downstream of the weir and freshwater upstream.	• **SEPP 14 coastal wetland**: Site 153a is located on Tabbimoble Creek about 1 km to the east of the work footprint • **SEPP 14 coastal wetland**: Site 153 is located about 4.5 km to the east of the work footprint, mostly within Bundjalung National Park and Devils Pulpit State Forest, and extends between North Arm, in the south, and the Evans River in the north • **Key fish habitat and threatened aquatic species habitat**: Located in all named and unnamed waterbodies.
Section 7		
• Tabbimoble (Floodway No.1) • Nortons Gully • Oaky Creek	The waterways are typically freshwater. Many are ephemeral, flowing only after heavy or prolonged rainfall.	• **SEPP 14 coastal wetland**: Site 161 is located about 260 m to the east of the work footprint • **Oxleyan Pygmy Perch habitat:** Associated with Tabbimoble Swamp Nature Reserve, crossing the work footprint and located within Broadwater National Park • **Key fish habitat and threatened aquatic species habitat**: All named and unnamed waterbodies including waterways at station 114.0, 121.7 to 122.4 and 124.5.
Section 8		
• Tuckombil Canal (becomes Evans River) • Rocky Mouth Creek • MacDonalds Creek	The waterways are typically freshwater. Many are ephemeral and flow only after heavy or prolonged rainfall. Tuckombil Canal is a flood	• **SEPP 14 coastal wetland**: The project will be adjacent to Broadwater National Park (containing several coastal wetland areas)

Receiving watercourse	Description	Sensitive aquatic receiving environments
• Richmond River	control structure (directing waters from the Richmond floodplain to the Evans River) and is subject to tidal influences.	• **Oxleyan Pygmy Perch habitat:** Two tributaries of the Richmond River that are crossed by the work footprint plus additional sites associated with Broadwater National Park to the east • **Key fish habitat:** Tuckombil Canal, Rocky Mouth Creek, Macdonalds Creek and the unnamed waterways at station 134.7 and 136.5 • **Water bores:** The Rous Water bore fields are located in this section to the east of Woodburn.
Section 9		
• Montis Gully • Eversons Creek • Richmond River	Waterways are typically small freshwater streams, with the exception of Richmond River (which is a large tidal river).	• **SEPP 14 coastal wetland**: The project will be adjacent to Broadwater National Park (containing site 121) • **Oxleyan Pygmy Perch habitat:** Various sites associated with Broadwater National Park including one location that is crossed by the proposal footprint • **Key fish habitat and threatened aquatic species habitat**: Present in all named and unnamed waterbodies, including the unnamed tributary of Montis Gully at station 141.9.
Section 10		
• Tuckean Swamp • Tuckean Broadwater (upstream of Richmond River) • Richmond River • Saltwater Creek • Randals Creek	This section will cross the Richmond River floodplain. Tuckean Swamp and Randals Creek are located on the floodplain.	• **SEPP 14 coastal wetland:** Site 119 contains mangroves and is located at Tuckean Broadwater 700 metres upstream of the Richmond River crossing) • **SEPP 14 coastal wetland:** Site 118 and site 118a are located on the northern banks of the Richmond River, either side of the work footprint boundary • **Key fish habitat:** In Tuckean Swamp and Tuckean Broadwater (upstream of Richmond River), Richmond River, and unnamed tributaries of Bingal Creek at stations 149.3, 150.6 and 153.9. • **Threatened aquatic species habitat:** Present in Tuckean Swamp, Tuckean Broadwater and Richmond River.

Receiving watercourse	Description	Sensitive aquatic receiving environments
Section 11		
• Duck Creek • Emigrant Creek	The creeks are located on the Richmond River floodplain. The upstream sections of the creeks are freshwater, while the downstream reaches adjacent to the work footprint are estuarine.	• **SEPP 14 coastal wetland:** Site 108 and site 95 are located around Duck Creek and Emigrant Creek, respectively. Both waterways are key fish habitats, with the potential for threatened aquatic species habitat.

4.1.9 Surface water quality

The project crosses a large number of waterways, including the major Clarence and Richmond river systems. These include freshwater systems and estuarine systems and some of the receiving waters drain to or support sensitive aquatic and riparian environments including key fish habitats and wetlands listed under SEPP 14.

The high risk sensitive environments that may result in the most significant impacts from changes to water quality are the Solitary Islands Marine Park, the Upper Coldstream Wetlands, the Tabbimoble Swamp Nature Reserve, the Rous Water regional water supply catchment, Broadwater National Park, Wardell Heath and habitats of threatened aquatic fish. Major waterways are outlined in Table 4-6 and are shown on the sensitive area maps attached at Appendix A5 of the CEMP.

The EIS confirmed that many of the waterways within the work footprint and its environs have a history of water quality problems, with conditions commonly found to be below the standards required for aquatic ecosystem protection. The problems were assessed as being caused by factors including channel structure modification, aquatic plant and weed growth, soil erosion, sulphuric acid discharge (due to acid sulfate soils), and nutrient enrichment as a result of agricultural land runoff. Table 4-4 summarises the water quality of the key creeks and watercourse in the work footprint.

Table 4-4 Water quality summary

Watercourse	Water quality summary
Section 3	
• Pheasant Creek • Coldstream River • Pillar Valley Creek • Chaffin Creek • Champions Creek	• Generally poor • Low flow (often with no flow) • Low dissolved oxygen (potentially due to sulphuric acid) • Low pH (potentially due to sulphuric acid) • High turbidity • Blackwater events (breakdown of organic material) in Coldstream River • Failed the ANZECC aquatic health water quality guideline criteria
Section 4	
• South Arm (Clarence River) • Edwards Creek • Shark Creek	• Generally poor • Failed the ANZECC aquatic health water quality guideline criteria
Section 5	
• James Creek • Nyrang Creek • Clarence River • Mororo Creek	• Generally good • Passed the ANZECC aquatic health water quality guideline criteria
• Serpentine Channel	• Failed the ANZECC aquatic health water quality guideline criteria with regards to turbidity and pH

Watercourse	Water quality summary
• North Arm (Clarence River)	• Generally good • High turbidity during wet weather
Section 6	
• Nyrang Creek	• Failed the ANZECC aquatic health water quality guideline criteria with regards to turbidity, dissolved oxygen and electrical conductivity
• Tabbimoble Creek	• Failed the ANZECC aquatic health water quality guideline criteria with regards to dissolved oxygen and electrical conductivity
Section 7	
• Tabbimoble (Floodway No.1) • Nortons Gully • Oaky Creek	• Failed the ANZECC aquatic health water quality guideline criteria with regards to pH, dissolved oxygen and total nitrogen. • Low levels of total suspended solids indicative of low catchment runoff • Observed oil/grease sheen.
Section 8	
• Tuckombil Canal (becomes Evans River) • Rocky Mouth Creek	• Variable water quality • Subject to sulphuric acid influx from acid sulfate soils • Evidence of historic fish kill • Failed the ANZECC aquatic health water quality guideline criteria with regards to pH, dissolved oxygen and total nitrogen. • High salinity (restricted to the Tuckombil Canal) • Elevated electrical conductivity (restricted to the Tuckombil Canal) • High prosperous levels (restricted to the Tuckombil Canal)
Section 10	
• Tuckean Broadwater	• Failed the ANZECC aquatic health water quality guideline criteria with regards to (very low) pH, (extremely low) dissolved oxygen and (high) turbidity.
• Tuckean Swamp	• Low salinity • Low dissolved oxygen • Low pH
• Richmond River	• Low pH • Low dissolved oxygen • Subject to sulphuric acid influx from acid sulfate soils.
Section 11	
• Duck Creek • Emigrant Creek	• Generally poor • Low pH • Low dissolved oxygen • High turbidity.

4.1.10 Groundwater

Alluvial deposits occur throughout the area within the project boundary, laid down by the numerous rivers emanating from the Great Dividing Range. The most significant of these are the Clarence River and Richmond River alluvial floodplain sequences, which underlie the northern half of the project boundary. The groundwater and surface watercourses are connected except occasionally where clay layers have formed around the floodplains and hardpan areas. In these locations the surface sediments (and surface waters) are separated from the groundwater. The water table is recharged by rainwater and floodwater infiltration.

Existing water table levels

The low-lying topography means that over one third of the work footprint is located in floodplain where the water table is within three metres of the surface and even as shallow as two metres from surface around the Clarence River and Richmond River. Following heavy rainfall, groundwater levels in low-lying and floodplain areas can be at the surface, potentially even resulting in localised pooling and flooding. In the higher areas of the work footprint, project section 6 and project section 7, the water table is located between eight and 45 metres below the surface.

Groundwater flow characteristics

There is a south-north division in groundwater flow characteristics:

- Project section 3 to section 5: The groundwater flow is characterised by the overlying alluvial system of fractured rocks and porous rock aquifers. These systems are viably connected and responses tend to be rapid and seasonally driven. These systems are easily disturbed however respond rapidly to mitigation and management
- Project section 8 to section 11: The groundwater flow is characterised by floodplains on coastal sand aquifers. These systems store significant groundwater. They can require ongoing intervention as the water table is very close to the surface.

Groundwater flow transitions in within project section 6 and project section 7 however it is unlikely to be impacted by the project given the increased depth to the water table in this region.

Groundwater use

Groundwater is not widely used in the area, as surface water supplies are adequate for most operations. 10,000 boreholes were investigated in preparing the EIS. Table 4-5 summarises their use.

Table 4-5 Groundwater borehole use summary

Borehole use (of boreholes investigated)	Amount	Annual water removal rate
• Irrigation • Commercial use	• Less than 3% • Less than 1%	• 30 gigalitres (licenced) • 8.5 gigalitres (estimated use in 2010)
• Stock and domestic use	• About 85%	• Typically between 8,500 and 25,500 gigalitres (licenced) • However some boreholes are licenced to abstract more water (up to 14 gigalitres per year)
• Lapsed or cancelled	• 10%	• N/A

Rous Water (Woodburn site)

Project section 8 crosses an area where the groundwater is used as a reserve drinking water supply to service the township of Woodburn. The licence allows up to 242 gigalitres to be taken from the groundwater each year. The groundwater quality in this area is rated as 'good' despite containing elevated levels of iron and aluminium. The water is aerated, filtered and disinfected with sodium hypochlorite.

The groundwater body is partially protected by between 0.8 to 2 metres of clay.

A study was undertaken of the effects on the Woodburn aquifer and the results of the investigation are included in a report published by Southern Cross University *Assessing groundwater recharge and flow paths in the Woodburn Sand Aquifer using modelling and geochemical approaches* (November 2014). The outcomes of the investigations show that some recharge may occur in the area of the highway and this would require management of water runoff from the highway.

Groundwater dependent ecosystems

The following are groundwater dependent ecosystems, meaning that their ecosystems rely on a groundwater supply for their maintenance and existence:

- Upper Coldstream Wetland (Section 3)
- Clarence River Estuary (Section 5)
- Bundjalung National Park Wetlands (Section 6)
- wetland cluster on Tabbimoble Creek (Section 6)

They are supplemented by other nationally important groundwater dependent ecosystems in the local area. The majority of the groundwater dependent systems rely on the shallowness of the water table. However, they also rely on surface water supplies.

4.1.11 Rainfall

The rainfall records from Grafton Olympic Pool, Yamba Pilot Station and Ballina Airport have been selected to reflect the potential rainfall conditions along the Project alignment. These locations have the most up to date weather data and are hence the most representative information available. A summary of the rainfall records from the Bureau of Meteorology is provided in Table 4-6.

Table 4-6 Summary of rainfall records

		Summer / Autumn						Winter / Spring						
		Dec	Jan	Feb	Mar	Apr	Ma	Jun	July	Aug	Sep	Oct	Nov	Year
Grafton Olympic Pool	*Mean rainfall (mm)*	121.5	141.3	150.8	129.4	88.4	80.4	69.2	38.1	40.9	37.9	76.5	104.5	1079.8
	Mean rain days	10.2	10.4	10.9	11.2	8.0	7.5	5.8	4.6	4.3	5.2	7.2	9.2	94.5
Yamba Pilot Station	*Mean rainfall (mm)*	117.2	139.2	159.3	182.9	162.8	156.5	134.8	101.6	75.5	59.0	78.9	93.8	1461.8
	Mean rain days	9.0	10.2	11.0	13.3	11.4	10.5	8.8	7.6	6.7	6.4	7.7	8.2	110.8
Ballina Airport	*Mean rainfall (mm)*	138.3	182.3	204.3	209.7	194.6	168.4	197.6	119.5	85.0	61.3	99.3	122.4	1782.1
	Mean rain days	9.7	10.8	12.3	14.0	12.0	11.8	10.5	9.0	7.2	5.8	8.5	9.7	121.3

Rainfall is typically higher during summer and autumn. Winter and spring are typically drier periods during the year. There is also a general trend that rainfall is higher at the northern end of the Project, this may be a reflection of the northern end having a closer proximity to the coast compared with the southern end.

Weather stations will be established along the project alignment to monitoring weather and climatic conditions. At least 4 weather stations will be established, one for each portion, with the possibility of additional stations where required. The locations for weather stations will consider the proximity to the Project boundary, ease of access and the requirements set out in the relevant Australian Standards. Options for electronic data collection are currently being investigated.

4.2 Hydrology and flood risk

This section summarises Section 8.2 of the EIS.

4.2.1 General catchment description

The work footprint falls within three main catchments, as summarised in Table 4-7. The catchments include significant areas of coastal floodplain.

Table 4-7 Main water catchments

Catchment	General description	Project sections
Coffs Harbour waterways	Comprising 13 sub-catchments covering an area of about 500 km^2.	Section 3
Clarence River	Comprising 56 sub-catchments covering an area of about 22,000 km^2.	Section 3 to section 7
Richmond River	Comprising 23 sub-catchments covering an area of about 7,000 km^2.	Section 7 to section 11

4.2.2 Watercourses crossed by the project

The work footprint crosses 27 watercourses as summarised in Table 4-8.

Table 4-8 Watercourses crossed by the project

Catchment	**Watercourse**	**Section**
Coffs Harbour waterways	Pheasant Creek	Section 3
Clarence River	Coldstream Creek	Section 3
	Pillar Valley Creek	
	Black Snake Creek	
	Chaffin Creek (and a nearby un-named creek near Mitchell Road and Bostock Road)	
	Champions Creek (and a nearby un-named creek north of Champions Creek)	
	Clarence River	Sections 3, 4 and 5
	Shark Creek	Section 4
	Edwards Creek	
	James Creek	Section 5
	Nyrang Creek	
	Mororo Creek	Section 6

Catchment	Watercourse	Section
	Tabbimoble Creek	
	Tabbimoble Floodway No.1	Section 7
	Nortons Gully	
Richmond River	Oakey Creek	Section 7
	Tuckombil Canal	Section 8
	Rocky Mouth Creek	
	MacDonalds Creek	
	Richmond River	Sections 8 to 10
	Montis Gully	Sections 9
	Eversons Creek	
	Tuckean Swamp	Section 10
	Tuckean Broadwater (upstream of Richmond River)	
	Saltwater Creek	
	Randals Creek	
	Duck Creek	Section 11
	Emigrant Creek	

4.2.3 Flooding

The work footprint and its environs frequently flood as a result of the combined effects of rainfall and ocean swells (king tides). Typically, the coastal areas flood for a number of weeks as water is slow to drain and/or evaporate from each (sub) catchment. While local authorities have installed a range of coastal and river flood protection measures to service the main towns there are several hundred properties local to the work footprint that remain unprotected.

4.2.4 Flood immunity of the existing highway

There is some level of flood immunity associated with the existing Pacific Highway. The:

- Southern project sections (section 3 and section 4) are protected against storms that typically occur once every five to 20 years
- Central project sections (section 4 to section 8) have greater protection against storms that typically occur only once every 50 to over 100 years
- Northern projects sections (section 9 to section 11) are protected to a level consistent with section 3 and section 4.

4.2.5 Construction impacts in relation to hydrology and flooding

Chapter 8.3 of the EIS includes an assessment of construction impacts in relation to hydrology and flooding. This includes the following;

- Ancillary sites (Chapter 8.3.1). Ninety potential sites for ancillary facilities have been identified for the project, including sites outside of the project boundary. Forty-one of these sites are located outside floodplain areas and are unlikely to have any impact on hydrology or flooding, or be affected by flooding. However, 49 of these sites are located either on floodplains or below the level of the 20 year ARI flood and could therefore be affected by flooding and have hydrology and flooding impacts on upstream areas. These sites would

need to be built up on embankments to provide sufficient flood immunity. Early construction of road embankments at soft soil treatment sites (8.3.2). At ten sites, embankments would be constructed at the start of road construction to accelerate the settlement of soft soils. These sites are referred to as 'soft soil sites' and are located on the Clarence River and Richmond River floodplains.

- Clarence River soft soil sites (Chapter 8.3.2)
- Richmond River soft soil sites (Chapter 8.3.2)
- Construction of temporary connections to existing highway (Chapter 8.3.3)
- Construction of sites and haul roads – impacts on cane drains (Chapter 8.3.4).

Conditions of approval specifically relating to flooding have been received for the project. These CoA are to be addressed outside of the scope of this SMWP. They consist of the following:

- **B31.** The hydrological and flooding impacts resulting from the SSI are to be assessed during detailed design against the 'Design Objectives for Flood Management' described in Section 2.1 of the EIS's ' Working Paper – Hydrology and Flooding'. This shall include assessment against the 'Flood Management Objectives' and the 'Other Flood Impact Considerations' as well as the other requirements of this section of the EIS. This hydrology assessment shall include the refinement of or development of new flood models (where required) for the 14 catchments investigated during the EIS. These models shall be operated for the same design floods considered in the EIS, as well as the 2000 year ARI and the probable maximum flood (PMF) design events.
- **B32.** For the Corindi, Shark Creek and Farlows Flat areas, flooding and hydrological impacts resulting from existing highway infrastructure shall be assessed. As part of this assessment, flood models shall assess the impacts of recent highway upgrades in this area. Where the existing highway in these areas has resulted in adverse flooding and/or hydrological impacts, opportunities to reduce the quantum of these impacts shall be considered during the detailed design of the SSI, where it is feasible and reasonable to do so.
- **B33.** Where the objectives and considerations referred to in condition B31 cannot be complied with, the Applicant shall:

  a) achieve compliance through modified embankment or drainage design. This might include new or duplicated drainage structures designed to minimise afflux and other impacts to waterways that traverse the road alignment, to the greatest extent practicable; or

  b) achieve an acceptable level of mitigation of impacts through alternative design measures (e.g. raised access tracks) in consultation with the affected land-owner; or

  c) reach agreement with affected landowners on impacts to property.

Conditions of approval relating to the Hydrological Mitigation Report (CoA D13, CoA D14, CoA D15, CoA D16), hydrological expert and changes to flood modeling are included in Table 3.1.

5 Environmental aspects and impacts

This Chapter describes the construction activities that will need managing and controlling to limit soil and water impacts.

5.1 Construction activities

Table 5-1 summarises the construction activities identified as likely to have a potential impact on hydrology, flooding, soils, sediment and water quality.

Table 5-1 Impacting construction activities (soil and water)

Environmental issue	Construction activity
Hydrology and flood risk	
• Catchment values **All project sections**	• Temporary waterway crossings • In-stream work platforms • Culvert and drainage work • Bridge construction
• Flood risk **Project sections 3, 4, 9, 10 and 11**	• Temporary waterway crossings • Culvert and drainage work • Bridge construction • Paving (increase the permeable area)
Soils, sediments and water quality	
• Topography (slope stability) **Project section 6 and 7**	• Earthworks (including borrow site work) • Soft soil work • Drilling and piling
• Geology (permeability and leaching) **Project section 3, 6, 7, 8, 9 and 10**	• Earthworks (including borrow site work) • Soft soil work • Drilling and piling
• Soil landscape (erosion and sedimentation) **All project sections**	• Vegetation clearance • Mulching • Topsoil stripping • Earthworks (including borrow site work) • Soil movement and transfer • Embankment construction • Culvert and drainage work • In-stream work platforms • Bridge construction • Stockpiling • Drilling and piling
• Acid sulfate soils (acid generation) **Project sections 4, 5, 8, 9 and 11 (high probability)**	• Topsoil stripping • Culvert and drainage work • Dewatering and clearing

Environmental issue	Construction activity
Project section 10 (low probability)	• Earthworks (including borrow site work) • Stockpiling • Drilling and piling
• Soft soils **Project section 3, 4, 5 and 6.**	• Topsoil stripping • Excavation • Demolition • Road cutting work • Earthworks (including borrow site work) • Stockpiling • Drilling and piling
• Encountering contamination/pollution **All project sections**	• Topsoil stripping • Excavation • Demolition • Road cutting work • Earthworks (including borrow site work) • Stockpiling • Drilling and piling
• Causing contamination/ pollution **All project sections**	• Topsoil stripping • Earthworks (including borrow site work) • Stockpiling (leaching and tannins) • Chemical and fuel storage, handling, use and disposal • Ancillary facility operations • Concrete batching • Noxious weed and pathogen management • Drilling and piling
• Receiving waters and sensitive environments **All project sections (SEPP 14 coastal wetlands)** **Project section 3, 4, 5, 7, 8, 9, 10 and 11 (key fish habitat)** **Project section 7, 8 and (Oxleyan Pygmy Perch habitat).**	• Temporary waterway crossings • Culvert and drainage work • In-stream work platforms • Bridge construction • Topsoil stripping • Earthworks (including borrow site work) • Stockpiling • Chemical and fuel storage, handling, use and disposal • Ancillary facility operations • Concrete batching • Noxious weed and pathogen management • Drilling and piling
• Surface water quality **All project sections**	• Temporary waterway crossings • Culvert (diversions) and drainage work • In-stream work platforms

Environmental issue	Construction activity
	• Bridge construction • Bank work • Vegetation removal (riparian vegetation) • Chemical and fuel storage, handling, use and disposal • Earthworks • Stockpiling • Materials transport • Topsoil stripping • Ancillary facility operations (chemical storage, earthworks, construction material processing, concrete batching, vehicle wash down, vehicle refuelling and high frequency vehicle movements) • Noxious weed and pathogen management • Drilling and piling
• Groundwater (water table) **Project sections 3, 4, 5, 8, 9, 10 and 11 (shallow groundwater)** **Project sections 3, 4 and 5 (pollutant dispersion and migration)**	• Water use and extraction • Earthworks (including borrow site work) • Dewatering • Earthworks (construction of cuttings) • Drilling and piling
• Groundwater (use) **All project sections**	• Chemical and fuel storage, handling, use and disposal • Ancillary facility operations • Water use and extraction • Concrete batching • Noxious weed and pathogen management • Dewatering • Earthworks (construction of cuttings) • Drilling and piling
• Groundwater (drinking water) **Project section 8**	• Chemical and fuel storage, handling, use and disposal • Ancillary facility operations (chemical storage, earthworks, construction material processing, concrete batching, vehicle wash down, vehicle refuelling and high frequency vehicle movements) • Water use and extraction • Noxious weed and pathogen management • Dewatering • Earthworks (construction of cuttings) • Drilling and piling
• Groundwater (dependent ecosystems) **All project sections**	• Chemical and fuel storage, handling, use and disposal • Ancillary facility operations (chemical storage, earthworks, construction material processing, concrete

Environmental issue	Construction activity
	batching, vehicle wash down, vehicle refuelling and high frequency vehicle movements) • Water use and extraction • Noxious weed and pathogen management • Dewatering • Earthworks (construction of cuttings) • Drilling and piling

5.2 Potential impacts

The potential for impacts on soil and water will depend on a number of factors. Primarily impacts will be dependent on the nature, extent and magnitude of construction activities and their interaction with the natural environment. Table 5-2 summarises the associated soil and water impacts that may result from the above activities.

Table 5-2 Impacting construction activities (soil and water)

Environmental issue	Action/impact
Hydrology and flood risk	
• Catchment values **All project sections**	• Compromised catchment values (including loss of environmental values and resources that contribute to the integration of values) • Catchment water quality degradation or pollution • Catchment supply change/loss (as a result of blocking supply waterways).
• Flood risk **Project sections 3, 4, 9, 10 and 11**	• Increased flood risk and influx • Work footprint inundation (including worker risk and increased chemical spill risk) • Site compound inundation (including worker exposure risk) and increased chemical spill risk) • Waterlogging (including worker risk and increased chemical spill risk) • Impacts on sugar cane crop (due to the blockage of cane drains as a result of construction sites, haul roads, soft soil embankments and other work).
Soils, sediments and water quality	
• Topography (slope stability) **Project section 6 and 7**	• Loss of slope stability (leading to erosion and sedimentation).
• Geology (permeability and leaching) **Project section 3, 6, 7, 8, 9 and 10**	• Altered permeability (leading to groundwater movement and contaminant migration) • Increased risk for leaching and contaminant migration (caused by contaminant release or disturbance of existing contaminants).
• Soil landscape (erosion and sedimentation) **All project sections**	• Soil erosion • Nutrient mobilisation and release (leading to water quality degradation or pollution) • Dust propagation (refer to the Construction Air Quality Management Plan) • Contamination (release of contaminants or encountering contaminants leading to soil quality degradation or contamination) • Waterlogging (leading to worker exposure risk and increased chemical spill risk) • Soft soil settlement.

Environmental issue	Action/impact
• Acid sulfate soils (acid generation) **Project sections 4, 5, 8, 9 and 11 (high probability)** **Project section 10 (low probability)**	• Potential and actual acid sulfate soil disturbance (sulphuric acid generation leading to heavy metal leaching both of which have terrestrial and aquatic ecological impacts, including fish disease, kills, loss of food resource, reduced fish migration and recruitment potential, disturbance to water plant communities and secondary effects on water quality, and potential human health risks (especially close to the Rous Water Regional Supply Boreholes) • Agricultural impacts and land quality degradation • Ecological impacts • Surface water quality degradation and pollution • Groundwater quality degradation and pollution • Soil structure degradation and loss (including infrastructure instability) • Loss of infrastructure integrity (i.e. corrosion) • Socioeconomic impacts (Government and community perception).
• Soft soils **Project section 3, 4, 5 and 6.**	• Erosion and sediment risks • Dust propagation (refer to the Construction Air Quality Management Plan) • Visual impacts due to the construction of major earthworks (refer to the Urban Design and Landscape Management Plan) • Water quality degradation or pollution • Temporary increased flood risk.
• Contamination/pollution (encountering) **All project sections**	• Contaminant mobilisation leading to soil degradation or contamination • Contaminant mobilisation leading to water quality degradation or pollution • Contaminant mobilisation leading to aquatic and terrestrial ecology degradation • Contaminant mobilisation leading to human health impacts including worker exposure.
• Contamination/pollution (causing) **All project sections**	• Contaminant release leading to soil degradation or contamination • Water quality degradation or pollution • Aquatic and terrestrial ecology degradation • Human health impacts (including worker exposure) • Ordnance handling risk.
• Receiving waters and sensitive environments **All project sections (SEPP 14 coastal wetlands)**	• Dust settlement (smothering) and sedimentation and siltation (loss of ecological function) (via soil erosion, runoff and dust propagation) • Wetland degradation (as a result of sediment, contaminant and/or pollutant release and migration)

Environmental issue	Action/impact
Project section 3, 4, 5, 7, 8, 9, 10 and 11 (key fish habitat) **Project section 7, 8 and (Oxleyan Pygmy Perch habitat).**	• Fish habitat degradation/loss (as a result of sediment, contaminant and/or pollutant release and migration) • Oxleyan Pygmy Perch habitat degradation/loss (as a result of bank and watercourse impacts, sediment loading, and/or contaminant or pollutant release and migration).
• Surface water quality **All project sections**	• Siltation (leading to loss of ecological function) (via soil exposure, erosion, runoff, dust propagation and (riparian) vegetation removal) • Nutrient, metal, organic material and pollutant loading (leading to loss of aquatic values and ecological function) • Water quality degradation (as a result of sediment, contaminant, tannin or pollutant release and migration) (with reduced tolerance due to existing poor water quality) • Aquatic ecology degradation (as a result of sediment, contaminant and/or pollutant release and migration) • Recreational use degradation (ie loss of swimming) (due to water quality impacts).
• Groundwater (water table) **Project sections 3, 4, 5, 8, 9, 10 and 11 (shallow groundwater)** **Project sections 3, 4 and 5 (pollutant dispersion and migration)**	• Loss of groundwater supply • Change in flow dynamics and characteristics (including changes below ground and at the surface) • Secondary impacts on vegetation and ecosystem health (due to loss of supply) • Groundwater quality degradation or pollution • Rapid pollution dispersion and migration (with secondary impacts) • Cumulative changes in the water table around the Clarence River floodplain and the Richmond River floodplain.
• Groundwater (use) **All project sections**	• Loss of supply (due to groundwater quality degradation, pollution, siltation, flow changes and/or water table depression). • Impacts to the Rous Water Woodburn Borefield.
• Groundwater (drinking water) **Project section 8**	• Loss of supply (due to groundwater quality degradation, pollution, siltation, flow changes and/or water table depression). • Impacts to the Rous Water Woodburn Borefield.
• Groundwater (dependent ecosystems) **All project sections**	• Ecological degradation, loss of habitat and ecosystem health impacts (due to flow changes, water table depression, and/or groundwater pollution).

Appendix A2 and section 3.4 of the CEMP rate the unmitigated risk associated with the above impacts by considering the combined likelihood for the impacts to occur and the magnitude of the impact should it occur. Appendix A2 also assesses the residual risk accounting for the committed mitigation measures that will be implemented as described in the SPIR and summarised below in Chapter 6.

6 Environmental control measures

6.1 Mitigation measures

A range of environmental requirements and control measures are identified in the various environmental documents, including the EIS, supplementary assessments, Conditions of Approval and RMS documents, and from recent experience on similar road projects. Specific measures and requirements to address impacts on soil and water are outlined in Table 6-1.

Table 6-1 Soil and water management and mitigation measures

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
GENERAL					
SW1	Training will be provided to all project personnel, including relevant sub-contractors on sound erosion and sediment control practices and the requirements from this plan through inductions, toolboxes and targeted training.		Pre-construction / Construction	Pacific Complete Environment Manager Project Contractor's Environmental Representative	G38/G36, Good practice
SW2	A Project Soil Conservationist will be engaged during detailed design to develop an erosion and sedimentation management report to inform the soils and water management plan and will be regularly consulted throughout construction to provide advice on erosion and sediment control design, installation and maintenance.		Pre-construction / Construction	Pacific Complete Environment Manager	G38, Good practice, Submissions / PIR (SSW5)
SW3	An environmental protection scheduled activity licence will be obtained for the Project. All relevant conditions relating to soil and water management will be implemented as required by the licence.		Construction / Post construction	Pacific Complete Environment Manager	POEO Act 1997
PROCEDURES AND PLANS					
SW4	Erosion and Sediment Control Plans (ESCPs) will be prepared and implemented in advance of construction, including earthworks and stockpiling. ESCPs and will be updated as required.		Pre-construction / Construction	Pacific Complete Environment Manager Project Contractor's Environmental Representative	Managing Urban Stormwater: Soils and Construction Volume 1 and Volume 2D, EIS (SSW4)
SW5	All ASS or PASS disturbed during the construction process will be managed in accordance with RMS Acid Sulfate Soil Management Procedure (incorporating an Acid Sulfate Soils contingency plan as required under CoA D26(c)v) attached at Appendix A. The requirements will be incorporated into the EWMS for "Management of Acid Sulfate Materials" referred to in SW2.		Pre-construction / Construction	Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	Submissions / PIR (SSW25) CoA D26(c) v

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW6	The following EWMS will be prepared and implemented to manage soil and water impacts. EWMS for activities identified as having high environmental risk will undergo a period of consultation with EPA, DPI (Fisheries), and DPI (Water). Those marked with an asterisk below are those likely to be subject to consultation: • Activities that impact on environmentally sensitive areas* • Working platforms in or adjacent to waterways* • Sediment basin construction and maintenance* • Concreting activities • Batch plant operation* • Management of Acid Sulfate Materials* • Dewatering* • Managing tannin leachate* • Vegetation clearing and grubbing* • Topsoil stripping*		Construction	Pacific Complete Environment Manager Project Contractor's Environmental Representative	G36 and G40
SW7	Dewatering will be undertaken and managed in accordance with the Pacific Highway Projects Dewatering Guidelines. A specific EWMS for dewatering will be prepared and will consider and/or incorporate the following detail: • Areas of the site that will require dewatering. • Dewatering methods that will minimise potential environmental impacts. • Opportunities for reuse. • The limitations for any proposed reuse methods. • Discharge locations and adequate energy dissipation. • Water quality criteria for discharge and/or reuse. • Treatment techniques required to meet the water quality criteria. • Water sampling and testing requirements.		Construction	Pacific Complete Environment Manager Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	G38 (Section3.5)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW8	Dewatering for the purpose of aquatic fauna relocation will be undertaken in accordance with the Fauna Handling and Rescue Procedure (Appendix M in the Construction Flora and Fauna Management Plan).		Construction	Pacific Complete Environment Manager Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	
SOIL EROSION AND SEDIMENTATION CONTROL					
SSW9	Flow discharge points will be designed with erosion controls to manage the flow velocities.		Pre-construction	Project Contractor Project Engineer Project Contractor's Environment Representative	Submissions / PIR (SSW28)
SW10	Works will be programmed to minimise the extent and duration of disturbance to vegetation. This will include leaving clearing (undertaken by manual means) and initial earthworks in intermittent and permanent watercourses until subsequent works are about to commence.		Pre-construction / Construction	Pacific Complete Environment Manager Project Contractor's Project Engineer	G38
SW11	Hardstand material, rumble grids or similar will be provided at exit points from construction areas onto public roads to minimise the tracking of soil and particulates onto public roads.		Pre-construction / Construction	Project Contractor Project Engineer/Foreman	G38
SW12	Vehicle movements from site will be minimised during wet weather if the tracking of mud may become an issue.		Pre-construction / Construction	Project Contractor Project Engineer/Foreman	Good practice
SW13	Loose rock, soil, debris etc will be removed from road surfaces (including sweeping of the road) at the end of each work shift.		Pre-construction / Construction	Project Contractor Project Engineer/Foreman	G38

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW14	Erosion and sediment control plans will be developed in line with current Roads and Maritime specifications and as detailed in the Working paper – Water quality.		Pre-construction and construction	Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	Submissions / PIR (SSW4)
SW15	Sedimentation basins and water quality ponds will be sized and located in accordance with the principles identified in the Working paper – Water quality.		Pre-construction and construction	Pacific Complete Engineering and Design Lead Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	Submissions / PIR (SSW6)
SW16	Appropriate erosion and sediment controls, following the guidelines of the 'Blue Books' (Landcom, 2004 and DECC, 2008), will be established before the start of construction and maintained in effective working order for the duration of the construction period until site stabilisation.		Construction	Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	CoA B34 Submissions / PIR (SSW26)
SW17	Exposed areas will be progressively rehabilitated. Methods will include permanent revegetation, or temporary protection with spray mulching or cover crops.		Construction	Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	Submissions / PIR (SSW7)
SW18	Any necessary approvals will be obtained in accordance with Roads and Maritime specification G36 for permanent and temporary waterway crossings.		Construction	Pacific Complete Environment Manager Project Contractor Project Engineer Project Contractor's Environmental Representative	Submissions / PIR (SSW8)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW19	All work potentially affecting wetlands will be undertaken in consideration of the requirements outlined in the NSW Wetlands Management Policy 2010.		Construction	Pacific Complete Environment Manager Project Contractor Project Engineer Project Contractor's Environmental Representative	Submissions / PIR (SSW9)
SW20	Wastewater or "dirty" water generated during the construction process will, wherever possible, be collected, treated and disposed of by appropriate means, including the installation of sediment barriers downslope of all disturbed areas. In areas where it is not possible to direct dirty water to sediment basins, other sediment controls will be implemented in accordance with "Blue book" best practice.		Construction	Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	G38
SW21	Clean and dirty water runoff will be adequately separated to avoid mixing where possible through the use of diversions, clean water drains, and the early installation of permanent drainage infrastructure.		Construction	Project Contractor Project Engineer/Foreman Project Contractor's Environmental Representative	G38
SW22	Active work areas will be stabilised at the end of each day's work and/or just prior to inclement weather, by means such as grading or smooth drum rolling to create a smooth surface and by installing of temporary "catch" drains to prevent / minimise transport of sediment.		Construction	Project Contractor Project Engineer/Foreman	G38
SW23	Catch drains, contour and diversion drains across exposed areas will be installed immediately following clearing, and re-established and maintained during topsoil removal and earthwork operations.		Construction	Project Contractor Project Engineer/Foreman	G38
SW24	All required sediment basins and associated drainage will be installed and commissioned prior to the commencement of clearing and grubbing works in that catchment that could cause sediment to leave site. (Except where clearing is required for basin installation).		Construction	Pacific Complete Site Environment Officer Project Contractor Project Engineer/Foreman	Good practice

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW25	Works within waterways will consider the need to maintain fish passage, in consultation with the Department of Primary Industries (Fisheries).		Construction	Pacific Complete Environment Manager Project Contractor Project Engineer Project Contractor's Environment Representative	Submissions / PIR (SSW27)
DESIGN OF CUT AND FILL BATTERS					
SW26	Batter slope gradients will be designed to minimise erosion of select topsoil.		Pre-construction	Project Contractor Project Engineer Project Contractor's Environment Representative	Submissions / PIR (SSW1)
SW27	Where feasible, bench cuttings will be diverted onto contours and surface flow drainage paths designed to spread flow at the source in preference to concentrating the flow and treating it further downstream.		Pre-construction	Project Contractor Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW2)
CONSTRUCTION SEDIMENT BASINS					
SW28	Where appropriate, construction phase sedimentations basins will be designed so they could be retained and used as permanent operational water quality ponds, where required for operational purposes.		Pre-construction	Pacific Complete Engineering and Design Lead Pacific Complete Environment Manager	Submissions / PIR (SSW29)
SW29	Sizing of sedimentation basins that drain into the Solitary Islands Marine Park will be reviewed to consider the use of 90th percentile sedimentation basins.		Pre-construction	Pacific Complete Engineering and Design Lead Pacific Complete Environment Manager	Submissions / PIR (SSW30)
SW30	Sedimentation basins will be inspected at regular intervals and following significant rainfall events to assess available		Construction	Pacific Complete Site Environment Officer	Submissions / PIR (SSW31)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	water storage capacity, water quality, structural integrity and debris levels.			Project Contractor's Environment Representative	
SW31	Where appropriate, an approved flocculent will be applied to sedimentation basins as early as possible so that early mixing of flocculants occurs. Water quality in the sediment basins will be tested prior to discharge in accordance with any licence requirements and the receiving waters quality criteria as defined in the RMS Dewatering Practise Note and detailed in the surface water quality results in the EIS.		Construction	Pacific Complete Site Environment Officer Project Contractor's Environment Representative	Submissions / PIR (SSW32)
SW32	Where sediment has built up in a basin to a point where the total sediment storage zone has reached capacity, sediment will be removed and appropriately disposed of.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW33)
SW33	Water from sedimentation basins will be used for construction purposes, such as dust suppression, where feasible.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW34)
SW34	When sedimentation basins require pumping out rather than discharge via a flow outlet, a float will be attached to the suction hose or the hose will be located inside a bucket to prevent sediment from the basin floor from being discharged.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW35)
SW35	Records will be kept of water quality monitoring and erosion and sediment control inspections, including details of rain events, use of flocculants, discharge, sediment removal and dewatering activities.		Construction	Pacific Complete Site Environment Officer Project Contractor's Project Engineer Project Contractor's Environment Representative	Submissions / PIR (SSW36)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW36	Discharges from the sediment basins during construction that do not meet the water quality parameters for Oxleyan Pygmy Perch habitat will not be discharged into the waterways that are known habitat for Oxleyan Pygmy Perch. Strategies will be implemented during construction to manage discharge of basin water, so that water depth and physico-chemical conditions are not changed in areas of Oxleyan Pygmy Perch habitat. Discharge protocols and criteria will be developed in consultation with Department of Primary Industries (Fisheries) and Office of Environment and Heritage during detailed design.		Construction	Pacific Complete Environment Manager Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW40)
ANCILLARY FACILITY AND STOCKPILE MANAGEMENT					
SW37	Stockpiles and ancillary facilities will be located to minimise erosion and in accordance with the criteria outlined in Appendix C Stockpile Management Protocol. Ancillary facilities assessed in the SPIR would be subject to the locational criteria specified in the SPIR. New ancillary facilities would be subject to the criteria in CoA B73. All ancillary facilities are required to be covered by the Ancillary Facilities Management Plan required by CoA D21.		Pre-construction / Construction	Pacific Complete Portion Lead Project Contractor's Project Engineer Project Contractor's Environment Representative	CoA D21, CoA D25(d)ix, CoA G38, Submissions / PIR (SSW11 – SSW13)
SW38	Physical controls to address the potential risks associated with the use and storage of chemicals on site will include: • Use of appropriately bunded storage facilities for chemicals and fuels. • Use of appropriately bunded areas for refuelling and washdown. • Availability of effective spill kits at all construction sites.		Construction	Pacific Complete Site Environment Officer Project Contractor's Project Engineer Project Contractor's Environment Representative	Submissions / PIR (SSW37)
SW39	At ancillary facilities, management of runoff and spills will include: • Restricting vehicle movements to designated pathways where feasible. • Paving areas that will be exposed for extended periods, such as car parks and main access roads, where reasonable and feasible.		Construction	Pacific Complete Portion Project Manager Project Contractor's Project Engineer Project Contractor's Environment Representative	Submissions / PIR (SSW38)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	• Diverting off-site runoff around sites where required. • Locating chemical or other hazardous material storage areas away from areas of known near-surface groundwater supplies, in areas where the water table is more than five metres below the surface; otherwise, areas be lined if they are to be located over a shallow groundwater source less than two metres deep.				
SW40	Soil and water management at borrow source sites will be in accordance with Volume 2E of the Blue Book which covers water management of mines and quarries and the Borrow Sites Management Plan required by CoA D22.		Construction	Project Contractor's Project Engineer Project Contractor's Environment Representative	Submissions / PIR (SSW39) CoA D22
SW41	Topsoil, earthworks and other excess spoil material will be stockpiled and managed in accordance with Roads and Maritime Stockpile Management Guidelines (Roads and Maritime, 2011a), the "Management of Surplus Material" in Section 3.9 of the Submissions / Preferred Infrastructure Report and the Stockpile Management Protocol in Appendix C of this CSWMP.		Construction	Pacific Complete Portion Project Manager Project Contractor's Project Engineer/Forman Project Contractor's Environment Representative	Submissions / PIR (SSW10)
SW42	Where reasonable and feasible, stockpiles will: • Not require removal of areas of native vegetation. • Be located outside of known areas of weed infestation. • Be located such that waterways and drainage lines are not directly or indirectly impacted.		Construction	Pacific Complete Portion Project Manager Project Contractor's Project Engineer/Forman Project Contractor's Environment Representative	Submissions / PIR (SSW11)
SW43	Where practicable, stockpiles will be located away from areas subject to concentrated overland flow. Stockpiles located on a floodplain be finished and contoured so as to minimise loss of material in flood or rainfall events.		Construction	Pacific Complete Portion Project Manager Project Contractor's Project Engineer/Forman	Submissions / PIR (SSW12)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
				Project Contractor's Environment Representative	
SW44	Topsoil will be stockpiled separately and inspected for noxious weed seedlings at six monthly intervals and controlled with herbicide as required.		Construction	Pacific Complete Site Environment Officer Project Contractor's Project Engineer/Forman Project Contractor's Environment Representative	Submissions / PIR (SSW13)
SW45	All construction stockpiles will comply with the requirements of the *Protection of the Environment Operations Act 1997* and *NSW Waste Avoidance and Resource Recovery Strategy 2007* for any waste activities that involve the generation, storage and/or disposal of waste and also consider the NSW Resource Recovery Exemptions as applying the storage of stockpiled material. All construction waste would be subject to the Construction Waste and Energy Management Plan.		Construction	Pacific Complete Portion Project Manager Project Contractor's Project Engineer/Forman Project Contractor's Environment Representative	Submissions / PIR (SSW14)
SW46	Stockpiles containing potential acid sulfate soils will be lined, bunded and covered in accordance with relevant guidelines.		Construction	Pacific Complete Portion Project Manager Project Contractor's Project Engineer/Forman Project Contractor's Environment Representative	Submissions / PIR (SSW15)
SW47	Management of tannin leaching from vegetation mulch will be in accordance with Roads and Maritime' Environmental Direction – Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012) and the Tannin Leachate Management Controls in Appendix D of the CSWMP.		Construction	Pacific Complete Site Environment Officer Project Contractor's Project Engineer/Forman	Submissions / PIR (SSW16)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
				Project Contractor's Environment Representative	
DRAINAGE AND WATERWAY					
SW48	The EWMS for working platforms in or adjacent to waterways will detail how the works are to be undertaken to reduce erosion and minimise impacts on water quality and riparian fauna and flora. Considerations will include: • Ensuring that where possible earth and/or rock platforms for driving piles are constructed to minimise impacts on the direct water channel. • Keeping vegetation clearing to a minimum. • Constructing rock platforms for driving piles / girder erection only where necessary. • Selecting the optimum rock size for platforms/ haul roads to account for all issues including safety and environment. • Using larger rock size and grades on the lower side of the works to assist in reducing failure risks. • Addressing stormwater overflow design and pipe capacity. • Enclosing platforms in geotextile fabric and appropriate erosion and sediment controls before clearance commences. The EWMS will be prepared in consultation with EPA and DPI (Fisheries Conservation and Aquaculture).		Pre-construction / Construction	Pacific Complete Environment Manager Project Contractor's Project Engineer Project Contractor's Environment Representative	G36, Good practice
SW49	Watercourse crossings will be designed in consultation with the DPI (Fisheries), EPA, DPI (Water) and DoE, and where feasible and reasonable, be consistent with the *Guidelines for Controlled Activities Watercourse Crossings* (Department of Water and Energy, February 2008), *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003), *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW Fisheries, February 2004), and *Policy and Guidelines*		Construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead Project Contractor's Project Engineer	CoA B38 G36, PIR(B21)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	for Fish Habitat Conservation and Management (DPI Fisheries, 2013). Where multiple cell culverts are proposed for crossings of fish habitat streams, at least one cell shall be provided for fish passage, with an invert or bed level that mimics watercourse flows. Where temporary crossings are required, these will be designed, constructed and maintained in accordance with *Managing Urban Stormwater Soils and Construction* Volumes 2A and 2D *Main Road Construction* (DECC 2008) and section 5.3.4 of the guideline *Managing Urban Stormwater 4th edition Volume 1 Soils and Construction* and subject to the preparation of an EWMS identified in SW2 and SW31. Temporary crossings will: • Be 'fish friendly' with a lower section of the temporary crossing provided to act as an emergency spillway. • Be used for the shortest time required to complete their designed operational function. • Use material that will not result in fine sediment material entering the waterway. • Where rock crossings are used, the rock will be of suitable size to prevent / reduce the likelihood of the material being washed away in a storm or flood event, with large sized rock on the lower side of crossings where water velocity increases.				
SW50	Scour protection will be installed at the base of permanent and temporary drainage outlets, and will be integrated where feasible into current banks to minimise impacts.		Construction	Pacific Complete Engineering and Design Lead Pacific Complete Site Environment Officer Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	G36, G38

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW51	Drainage works will be stabilised against erosion by appropriate selection of channel dimensions, slope and lining, and the inclusion, if necessary, of drop structures and energy dissipaters.		Construction	Pacific Complete Engineering and Design Lead Project Contractor's Project Engineer	Good practice
SW52	Culverts and permanent stream protection measures will be installed as early as possible in the construction program to facilitate transverse drainage during the early stages of construction.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Good practice
MANAGEMENT OF GROUNDWATER INTERSECTION					
SW53	Further assessment involving geotechnical boreholes, monitoring boreholes and water quality testing at cutting sites will be undertaken at Type A cutting sites to monitor impacts on local groundwater reserves.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW41)
SW54	If recharging is not possible or suitable, then discharging groundwater will be collected via the sedimentation basins before discharge into natural waterways. If discharging to downstream groundwater, then the potential effects of mounding will be mitigated.		Pre-construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW43)
SW55	Further investigations will be undertaken to identify any impacts from contaminated groundwater from the former landfill sites at Firth Heinz Road and Crowleys Road.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW45)
SW56	Where groundwater is released, recharge of the water table is the preferred option of managing groundwater. This will be facilitated by collecting groundwater in grassed swales for infiltration back to the groundwater source. Where possible, these swales will divert the groundwater around the construction area so that the groundwater does not further mix with construction runoff.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW42)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW57	Dewatering of excavations will be undertaken in line with Roads and Maritime' Technical Guideline – *Environmental Management of Construction Site Dewatering* (Roads and Maritime, 2011c), and in accordance with any licence conditions.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW44)
GROUNDWATER					
SW58	Measures to manage high-risk groundwater impact areas will continue to be considered through the detailed design process. In identified areas, the design of water quality controls will be reviewed and the need for additional controls may be identified.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW50)
SW59	The proposed management strategy to address potential impacts at type A cuttings includes: • Pre-works investigations – geotechnical investigations to determine groundwater condition (quality parameters: electrical conductivity, groundwater depth, geological information), presence of actual or potential acid sulfate soils, presence or potential of salinisation, establishing groundwater monitoring sites, and gathering of other pertinent information. • Assessment – including the EIS assessment, the pre-works investigations carried out, groundwater modelling of cuts (and the Rous Water Woodburn borefield site), and predictions made from those results. • Monitoring – to assess whether the investigation and its predictions are accurate and to instigate early intervention in the unlikely case/s that the actual outcomes deviate from predictions. Monitoring start before construction, and continue during construction. Monitoring also continue into the operation phase of the project. • Mitigation – implement environmental and engineering management measures where predictions and/or modelling and monitoring suggest that these are required to minimise impacts on groundwater.		Pre-construction and construction	Pacific Complete Environment Manager	Submissions / PIR (SSW46)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW60	The monitoring of locations in the vicinity of type B cuttings and major embankments will commence before construction to identify the need to implement any mitigation measure.		Pre-construction, construction	Pacific Complete Environment Manager	Submissions / PIR (SSW47)
SW61	If required to manage groundwater impacts at type A and type B cuttings and major embankments, the following engineering mitigation measures will be considered: • Engineering measures that transfer the seepage water downstream. Standard practice will be to collect the seepage from the cut face in the drainage system for the highway, which will be diverted into water quality basins before being released back into the creek or natural drainage system at some point downstream. • Engineering impact mitigation measures that transfer the seepage water (where present) into the groundwater ecosystem immediately downslope of the cutting or embankments.		Pre-construction and construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (SSW48)
SW62	Major embankments will be designed to enable distributed flow of surface waters.		Pre-construction and construction	Pacific Complete Engineering and Design Lead	Submissions / PIR (SSW49)
SW63	Implement mitigation measures contained in the *Groundwater and Soil Salinity Report* attached as Appendix E.		Pre-construction / Construction	Pacific Complete Environment Manager Project Contractor's Project Engineer Project Contractor's Environment Representative	
SW64	Where reasonable and feasible, sites used for batch plants, refuelling and chemical storage will be managed so that no groundwater intrusion occurs.		Pre-construction and construction	Pacific Complete Site Environment Officer Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW51)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW65	All construction runoff to the Rous Water bore fields will be diverted to appropriate sedimentation controls basins. No runoff will bypass the basins untreated, regardless of the size of the footprint of the work. In addition, all basins in the bore fields will be clay lined to prevent seepage. If required, the depth of the basins will be reduced from the standard depth of two metres to one metre in these areas to avoid penetration of the natural clay layer, with the volume of the basins maintained by increasing their footprint where reasonable and feasible.		Construction	Pacific Complete Site Environment Officer Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW52)
SW66	Sizing of sedimentation basins in the Rous Water bore fields will be reviewed to consider the use of 90th percentile basins.		Construction	Pacific Complete Engineering and Design Lead	Submissions / PIR (SSW53)
PROTECTION OF IMPACTS ON ROUS WATER BORE FIELDS					
SW67	Water quality ponds will be designed to be shallower between stations 131.1 and 134.0 (namely one metre compared to two metres) to avoid penetration of the natural clay layer, where possible. Alternatively, where not feasible, clay capping/ lining of the basin will be undertaken or appropriately designed swales will be considered.		Pre-construction	Pacific Complete Engineering and Design Lead Pacific Complete Environment Manager	Submissions / PIR (SSW55)
SW68	Alternative operational water quality management measures such as the use of biofilters, sand filters or measures used in the Tintenbar to Ewingsdale Pacific Highway upgrade project will be considered during detailed design.		Pre-construction	Pacific Complete Engineering and Design Lead Pacific Complete Environment Manager	Submissions / PIR (SSW56)
SW69	Consultation will be undertaken with Rous Water to co-ordinate mitigation actions including the definition of appropriate buffer zones between the project and bores.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW57)
SW70	Consultation will be undertaken with Rous Water to address the 12 elements of the Australian Drinking Water Guidelines Management Framework.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW58)
SW71	The following construction activities will not be permitted within the Rous Water bore field catchment without additional control measures to reduce risk of impact to the borefield and groundwater:		Construction	Project Contractor's Project Engineer	Submissions / PIR (SSW54)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	• Refuelling. • Washdown. • Storage of chemicals or other hazardous substances. • Installation of concrete batch plants.			Project Contractor's Environment Representative	
WATER QUALITY AND USE					
SW72	For water quality treatment in floodplains and other locations with minimal changes in gradient, grassed swales will be considered during detailed design.		Pre-construction	Pacific Complete Engineering and Design Lead Pacific Complete Environment Manager	Submissions / PIR (SSW60)
SW73	Except as may be expressly provided by an EPL, section 120 of the *Protection of the Environment Operations Act* 1997 will be complied with. Water will be used during construction for a number of purposes, including, but not limited to: • Concrete and asphalt batching. • Dust control. • Washing of plant and equipment. • Drinking water. • Amenities. • Landscaping and re-vegetation. Prior to and during construction, water needs will be identified and water sources assessed to determine the most appropriate water source(s). When determining the most appropriate water source(s), the use of non-potable water sources will be considered in preference to potable water where appropriate. The water sources likely to be considered for construction include: • Creeks. • Groundwater. • Farm dams.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	CoA B30, Good practice

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	• Sediment basins. • Rainwater collection. • Potable water. • Effluent reuse where available and meeting suitable standards. Appropriate licences and/or permits will be sought for each water source as required.				
SW74	Where available, and of appropriate chemical and biological quality, stormwater, recycled water or other water sources will be used in preference to potable water for construction activities, including concrete mixing and dust control.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	CoA B35
SW75	All surface water and groundwater will be adequately treated as far as is practicable, prior to entering the stormwater system to protect the receiving water source quality.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	CoA B36
SW76	Appropriate scour protection for drainage measures will be determined during detailed design.		Operation	Pacific Complete Engineering and Design Lead Pacific Complete Environment Manager	Submissions / PIR (SSW61)
SW77	All permanent water quality basins will incorporate measures to contain accidental fuel and chemical spills resulting from vehicle accidents on the highway. Basins will be designed to accommodate a spill volume of up to 40,000 litres.		Operation	Pacific Complete Engineering and Design Lead Pacific Complete Environment Manager	Submissions / PIR (SSW59)
MATERIAL STORAGE AND MANAGEMENT					
SW78	Concrete pumping or concreting activities will be undertaken in accordance with *Environmental Best Management*		Construction	Project Contractor's Project Engineer/Foreman	G38

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	Practice Guideline for Concreting Contractors 2002 to prevent and/or minimise spillages.				
SW79	Designated impervious bunded facilities will be provided for washout of concrete trucks and cleaning and/or maintenance of other vehicles, plant or equipment. These facilities will be located at least 40 metres away from natural and built drainage lines.		Construction	Pacific Complete Portion Manager Project Contractor's Project Engineer/Foreman	G38
SW70	An EWMS for managing tannin leachate (tannin leachate management protocol) will be prepared in accordance with the RMS *Environmental Direction for the Management of Tannins from Vegetation Mulch*. The requirements include detail on: • Planning and staging vegetation processing activities. • Stockpile location and management to minimise the production and release of tannins. • Monitoring the stockpiles for the production of tannins. • Response to tannin production.		Construction	Pacific Complete Environment Manager Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	RMS Environmental Direction for the Management of Tannins from Vegetation Mulch CoA D26(c)vi
SW71	Where refuelling on site is required, the following management practices will be implemented: • Refuelling will be undertaken on level ground and at least 20 metres from drainage lines, waterways and/or environmentally sensitive areas. • Refueling will be undertaken within the designated refueling areas with appropriate bunding and/or absorbent material. • Refuelling will not be undertaken on or in the vicinity vegetated areas (even roadside grasses). • Refuelling will be attended at all times. • Spill kits will be readily available and personnel trained in their use. A spill kit will be kept on the refueling truck at all times. Hand tools will be refueled within lined trays of site vehicles wherever possible.		Construction	Project Contractor's Foreman	Good practice

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW72	Physical controls to address the potential risks associated with the use and storage of chemicals on site will include: • Use of appropriately bunded storage facilities for chemicals and fuels. • Use of appropriately bunded areas for refueling and washdown. • Availability of effective spill kits at all construction sites.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW37)
CONTAMINATION					
SW73	A Stage 1 Preliminary Site Investigation will be conducted to verify past and present potentially contaminating activities, potential contaminants of concern and the need for further investigation. This will include a review of past highway crashes and spills and the associated contamination risks.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW17)
SW74	If necessary, a Stage 2 Detailed Site Investigation will be undertaken to: • Provide information on the type, nature, extent and concentrations of contamination present, and the corresponding risks to human health and the environment. • Examine pathways of contaminant dispersal and exposure, the potential for off-site impacts and the management requirements and options.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW18)
SW75	If required, a Stage 3 Remedial Action Plan will be produced, detailing the remediation goals, environmental safeguards, and any necessary approval and licence requirements in accordance with NSW Office of Environment and Heritage guidelines.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW19)
SW76	Where further assessment indicates that further action is not required, Roads and Maritime' *Contaminated Land Management Guideline* (RTA, 2005a) will be applied to address any contamination issues and prevent any associated adverse impacts.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW20)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW77	Consultation will be undertaken with Department of Defence regarding the potential for unexploded ordnance to be encountered east of Broadwater.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (SSW64)
SW78	A hazardous materials buildings assessment will be carried out before the demolition of any structures or buildings to identify the issues of concern and the management requirements. This is required under Clause 1.6 of Australian Standard AS 2601 – 2001 The Demolition of Structures.		Construction	Pacific Complete Environment and Sustainability Manager	Submissions / PIR (SSW21)
SW79	An emergency spill response plan will be developed and incorporated into the soils and water management plan. This plan will detail measures for the prevention, containment and clean-up of accidental spills of fuels and chemicals.		Construction	Pacific Complete Environment and Sustainability Manager	Submissions / PIR (SSW22)
SW80	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).		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW23)
ACID SULFATE SOILS					
SW81	Strategies to remove / reduce risks associated with acid sulfate soils will be identified.		Pre-construction and Construction	Pacific Complete Environment Manager	Submissions / PIR (SSW24)
SW82	An acid sulfate soils management plan will be implemented in accordance with *Guidelines for the Management of Acid Sulfate Materials* (Roads and Maritime 2005) and *Waste Classification Guidelines Part 4: Acid Sulfate Soils* (DECC 2008), where there is a probability of encountering acid sulfate soils during construction.		Construction	Pacific Complete Environment Manager Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (SSW25)
REHABILITATION AND LANDSCAPING					

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW83	Disturbed areas will be progressively stabilised during the construction phase e.g. with a cover crop, hydromulch, hydroseeding, topsoil and/or mulch. Wherever possible, permanent landscaping and revegetation works will take place progressively in accordance with the Urban Design and Landscape Plan.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	G38, Submissions / PIR (SSW7)
MONITORING					
SW84	Surface water quality monitoring will be undertaken in accordance with Roads and Maritime' *Guideline for Construction Water quality Monitoring* (RTA, 2003), as per the framework outlined in the Working paper – Water quality and in accordance with the Water Quality Monitoring Program Sections 3 to 11 approved on 24 August 2015..		Pre-construction	Pacific Complete Site Environment Officer Project Contractor's Environment Representative	Submissions / PIR (SSW62)
SW85	A project soil conservation specialist will inspect the work areas, typically on a fortnightly basis, or as required where high-risk activities are proposed, or where sensitive areas have the potential to be affected e.g. SEPP 14 wetland, heritage sites.		Pre-construction / Construction	Pacific Complete Portion Environment Lead Soil Conservation Specialist	Good practice
SW86	Groundwater monitoring will be undertaken in accordance with the framework outlined in the Working paper – Groundwater (Section 5.2) and the Water Quality Monitoring Program Sections 3 to 11 approved on 24 August 2015.		Construction	Pacific Complete Site Environment Officer Project Contractor's Environment Representative	Submissions / PIR (SSW63)
SW87	Rainfall forecasts and onsite weather stations will be monitored daily and the site managed to avoid erosion and sedimentation, and to minimise the impact of heavy rainfall and flood events.		Construction	Pacific Complete Site Environment Officer Project Contractor's Environment Representative	G38
SW88	Erosion and sediment controls will be inspected at least daily (with maintenance and/or modifications made as necessary). Inspections and/or maintenance during wet-weather maybe increased where necessary.		Construction	Project Contractor's Foreman	Good practice
RECORDS					

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
SW89	Records of dewatering activities will be maintained. Details will include: i. A copy of the work method statement(s). ii. Date, time and estimated volume released at each discharge location. iii. Water quality test results for each discharge. iv. The personnel approving the dewatering activities. v. Evidence of discharge monitoring, or risk assessment and mitigation measures used to eliminate the risks of pollution.		Construction	Pacific Complete Site Environment Officer Project Contractor's Environment Representative	G36
HYDROLOGY AND FLOODING					
HF1	Flood models for the areas of the project that are in the Clarence, mid Richmond and lower Richmond rivers will be updated to inform detailed design.		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (HF1)
HF2	Roads and Maritime will update the bathymetrical data at the relevant crossing of the Clarence River to inform detailed design of the crossing.		Pre-construction	RMS	Submissions / PIR (HF2)
HF4	Any permanent fencing at culvert and bridge crossings will consider the potential for blockage and be designed and operated to maintain the existing flood regime.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF4)
HF5	Detailed design for permanent road fencing will consider hydrology and flooding impacts.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF5)
HF6	Additional culverts north of Chaffin Creek at the overflow channel around station 52.6, will be hydraulically modelled and confirmed during the detailed design to manage potential flood impacts, to meet the flood management objectives detailed in the EIS.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF26)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
HF7	Roads and Maritime, in consultation with Clarence Valley Council and the relevant landowner, will consider opportunities to improve the drainage system performance in the Shark Creek area, where feasible and reasonable, during the detailed design phase.		Pre-construction	RMS Pacific Complete Environment Manager	Submissions / PIR (HF27)
HF8	The detailed design of the bridges over Shark Creek and Tyndale cane drain 1 and 2 (Crackers and Lee drain) will consider fauna connectivity in addition to the hydraulic function of these structures.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF28)
HF9	Detailed design will investigate viable options to maintain the existing flood behaviour in James Creek.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF29)
HF10	The removal of the proposed embankment at CH145.2 and its replacement with an extension of the Richmond River bridge will be investigated. The investigation will consider issues around hydrology and flooding (including meeting the flooding objectives for bridges), constructability, cost, funding arrangements and visual impacts. The investigation will include consideration of other relevant environmental impacts (noise, heritage, biodiversity, traffic etc.) and consider any alternative options. A copy of the investigation will be submitted to the Director General prior to the commencement of any bridge approach or embankment works in the vicinity.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	CoA B43
HF11	Batter stability will be assessed and sufficient room provided on both sides of the diversion to allow access for maintenance and to meet batter stability requirements.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF10)
HF12	Farm dams located within or partially within the project boundary will be acquired as part of the acquisition process		Pre-construction	RMS	Submissions / PIR (HF11)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.				
HF13	Potential impacts to farm dams located downstream of the project that are fed by catchments upstream, and that have a diversion of rainfall as a result of the project, will be considered during the relevant property acquisition process.		Pre-construction	RMS	Submissions / PIR (HF12)
HF14	Detailed design will consider flood access and evacuation for affected landowners including changes in stock access routes.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF13)
HF15	Appropriate span lengths of bridges will be specified during detailed design that considers the susceptibility of individual watercourse crossings to debris blockage.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF18)
HF16	Recommendations made in Table 8-8 of Working paper – Hydrology and flooding to minimise the flood impacts of ancillary facilities will be considered in the final location and layout of ancillary facilities.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Portion Manager Project Contractor's Project Engineer	Submissions / PIR (HF22)
HF17	Design objectives (for road flood immunity and flood management will apply during the detailed design phase. Where these objectives are not met, Roads and Maritime will work to either: • Achieve compliance thorough modified embankment or drainage design. • Achieve an acceptable level of mitigation of impacts through alternative design measures (e.g. raised access tracks) in consultation with the affected land owner.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF23)
HF18	The design of drainage structures across Chatsworth Island will be further reviewed during detailed design to enable the		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (HF24)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	most appropriate and cost-effective structures to be installed.			Pacific Complete Engineering and Design Lead	
HF19	Maintenance regime of drainage structures will be considered during detailed design.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF25)
HF20	The potential impacts of ancillary facilities and haul roads on cane drains will be further investigated and addressed when ancillary facility locations are confirmed. The design of these ancillary facilities will be developed in consultation with relevant cane industry stakeholders, affected landowners, and in accordance with the following principles: • Maintain conveyance characteristics of existing cane drains. • Provide adequate capacity in temporary drainage to prevent blockages.		Pre-construction and construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF15)
HF21	Consultation with affected landowners will be undertaken during detailed design and construction regarding flooding impacts on properties, residences and other structures.		Pre-construction and construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF30)
HF22	A suitably qualified and experienced independent hydrological expert, whose appointment has been endorsed by the Director General, will be used to deal with all hydrological matters and assist in negotiating feasible and reasonable mitigation measures.		Pre-construction and construction	Project Contractor's Environment Representative	CoA D15
HF23	Feasible and reasonable assistance will be provided to the relevant council and/or NSW State Emergency Service, to prepare any new or necessary update(s) to the relevant plans and documents in relation to flooding, to reflect changes in flooding levels, flows and characteristics as a result of the project.		Pre-construction and construction	Project Contractor's Environment Representative	CoA D16

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
HF24	Cane drain diversions will be designed and constructed in consultation with the relevant cane industry stakeholders and impacted landowners. This will consider the potential diversions detailed in the Working Paper – Hydrology and flooding and the additional assessment provided in Chapter 3 of the Submissions / Preferred Infrastructure Report.		Pre-construction and construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF3)
HF25	The need for design modifications to address changes in flood behaviour as a result of climate change will be considered in accordance with Roads and Maritime' Climate Change Plan (Roads and Maritime, 2012).		Pre-construction and operation	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF21)
HF36	A drainage structure with an equivalent capacity of the current Goodwood Street underpass will be installed for the duration of construction.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (HF16)
HF27	Any temporary infrastructure associated with the construction of bridges in the Clarence River, Clarence North Arm, Richmond River, Tuckombil Canal and Emigrant Creek will be secured or removed from the river and floodplain during flood events so not to create a debris hazard or blockage during a flood event.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (HF17)
HF28	All work within 40 metres of a permanent watercourse, crossed by the project, will be undertaken in accordance with the NSW DPI (Water) 'Guidelines for Controlled Activities' (2012) and industry best practice including maintaining where feasible and reasonable the geomorphic integrity and natural hydrological flow regime.		Construction	Pacific Complete Site Environment Officer Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (HF19)
HF29	The design of temporary fencing at culvert and bridge crossings will consider the potential for blockage and be		Construction	Project Complete Portion Manager	Submissions / PIR (HF20)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	designed and operated in a manner that does not result in impacts on flooding.			Project Contractor's Project Engineer Project Contractor's Environment Representative	
HF30	Waterway diversions will be designed in consultation with Office of Environment and Heritage, NSW DPI (Water) and DPI (Fisheries) so that the final diversion mimics, where feasible and reasonable, the characteristics of the waterway that is being diverted. Characteristics include flow regime, flow velocity, geomorphology, base material, vegetation and habitat for aquatic fauna.		Construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF7)
HF31	Revegetation of waterway diversions and surrounding areas will be undertaken in accordance with the following principles: • Diversions will be stabilised prior to the diversion receiving flows, in conjunction with the establishment of other scour and erosion control measures. • Diversions will establish appropriate vegetation communities along the channel bed and banks, using endemic native species.		Construction	Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	Submissions / PIR (HF8)
WATERWAY CROSSINGS IN OXLEYAN PYGMY PERCH HABITAT					
HF32	The Construction Flora and Fauna Management Plan will be referred to when carrying out works in Oxleyan Pygmy Perch Habitat.		Pre-construction/ Construction	Pacific Complete Engineering and Design Lead Project Contractor's Project Engineer/Foreman Project Contractor's Environment Representative	
HF33	Scour and erosion protection measures at temporary and permanent waterway crossings will be provided upstream and downstream of the highway, particularly within 50 metres of Class 1 waterways or within the range of the		Pre-construction	Pacific Complete Environment Manager	Submissions / PIR (HF6)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	Oxleyan Pygmy Perch as identified in section 3.9.6 of the Working paper – Biodiversity and the supplementary biodiversity assessment in Appendix E of the Submissions / Preferred Infrastructure Report. This will be undertaken in consultation with DPI (Fisheries).			Pacific Complete Engineering and Design Lead	
HF34	Velocities of flood flows through watercourse and floodplain structures (i.e. bridges and culverts) will be assessed during detailed design in areas identified as known and potential habitat for the Oxleyan Pygmy Perch and the Purple-spotted Gudgeon in consultation with Department of Primary Industries (Fisheries). The design of these structures will consider the predicted changes to velocities from the existing case due to the project. Crossings of waterways with known Oxleyan Pygmy Perch habitat will be designed to ensure that the water velocity of the final crossing structure is not more than 0.4 metres/sec under normal flow conditions, unless otherwise agreed by DPI (Fisheries) and DoE. Refer to Appendix B.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	Submissions / PIR (HF9) CoA B40, CoA B41
HF35	Detailed design will be undertaken to ensure that the project does not increase the afflux of waterways with known Oxleyan Pygmy Perch habitat by more than the relevant flood management objective in the documents referred to in CoA A2 for flood events up to the 1 in 100 year event.		Pre-construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	CoA B42
HF36	All crossings of Class 1 watercourses in known Oxleyan Pygmy Perch habitat shall be designed with a bridge or arch structure, unless otherwise agreed by DPI (Fisheries) and DoE.		Pre-construction and Construction	Pacific Complete Environment Manager Pacific Complete Engineering and Design Lead	CoA B40

6.2 Procedures

The Commonwealth and State ministerial conditions of approval (as modified) and the committed mitigation measures set out in the SPIR stipulate the requirement to implement various soil and water environmental control measures as summarised in Chapter 3. These can be broken down into the following procedures that must be adopted by all contractors.

A. Acid sulfate soil contingency and management control measures (Appendix A)

B. Oxleyan Pygmy Perch habitat waterway management framework (Appendix B)

C. Stockpile Management Protocol (Appendix C)

D. Tannin leachate management control measures (Appendix D)

E. Groundwater and soil salinity report (Appendix E)

7 Compliance management

7.1 Roles and responsibilities

The organisational structure and overall roles and responsibilities for Pacific Complete are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed below.

Suitably qualified contaminated land, flood modelling and soil conservation specialists will be engaged by either Pacific Complete or the contractor(s) as required to provide specialist services for the project work as described in Chapter 6.

7.2 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 management including:

- Existence and requirements of this sub-plan
- Relevant legislation
- Roles and responsibilities for soil and water management
- The location of potential or actual acid sulfate soils
- The location of potential contaminated land
- The location of all sensitive receiving waters including Oxleyan Pygmy Perch habitat
- Water quality management and protection measures.
- 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:

- Erosion and sediment controls
- Sediment and water quality basin construction. operation and maintenance
- Working near or in drainage lines and creeks
- Emergency response measures in high rainfall events
- Pollution incident response management planning
- Lessons learnt from incidents and emergencies
- Mulch and tannin management
- Spill response and incident management
- Stockpile location criteria.
- Identification of potentially contaminated spoil and fill material.

The full training, auditing and inspection requirements are specified in Chapter 6. Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

7.3 Monitoring and inspection

Regular monitoring and inspections will be undertaken in the lead up to, during and following construction. Monitoring and inspections will include, but not be limited to:

- Up and downstream of the project alignment water quality monitoring at nominated locations
- Groundwater monitoring, both level and quality at nominated locations

- Monitoring of groundwater dependent endangered ecological communities and Oxleyan Pygmy Perch habitat to evaluate health and vitality
- Construction sediment basin water quality prior to discharge
- Weekly and post rainfall inspections to evaluate the effectiveness of erosion and sediment controls measures in accordance with Section 8.1.1 of the CEMP
- Daily records of rainfall to determine if local rainfall events may trigger a wet weather surface water sampling event as required in Section 4.2 of the Water Quality Monitoring Program.

Monitoring requirements outlined in the Submissions/ Preferred Infrastructure Report are specified in Chapter 6. For details on the type, timing, frequency, methodology, assessment criteria and associated reporting requirements, refer to the Water Quality Monitoring Program (GeoLINK, 2015).

Additional requirements and responsibilities in relation to inspections are documented in Section 8.2 of the CEMP.

7.4 Licenses and permits

An Environment Protection Licence (EPL) will be obtained for relevant scheduled activities associated with the scope of work for the project. The EPL will prescribe water quality parameters to be measured and associated discharge criteria. They will also likely detail the monitoring and analytical requirements by reference to authority publications (eg Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (NSW Environment Protection Authority, 2004)). Any other relevant licenses or permits will be obtained in the lead up to and during construction as required (refer to Section 3.3 of the CEMP).

7.5 Weather monitoring

A network of automatic weather stations will be established in accordance with RMS specifications along the alignment for sections 3 – 11. The weather stations will be installed within the core areas of the work footprint, likely to be at the major ancillary facility and borrow site locations. The data collected from the automatic weather stations shall:

- Provide a more detailed early understanding of potential rainfall and other adverse weather impacts
- Provide the opportunity for proactive and early inspection and maintenance response to erosion and sedimentation and the effects of other adverse climatic conditions before pollution occurs
- Trigger weather alarms and messages to relevant site personnel to take action where appropriate
- Assess and validate the performance of installed erosion and sediment control measures against the design performance criteria, and
- Provide compliance data for statutory monitoring onsite.

Each station shall record rainfall, temperature, relative humidity, wind speed, wind direction and bathometric pressure. The rain gauge within each mobile automatic weather station will be of the tipping bucket type. Each station will conform to relevant standards for the location of such devices including compliance with RMS Specification R272 and shall be fully protected and secured.

Data from the automatic weather stations will be accessible via short message service (SMS) alarms or queries to a mobile phone and downloadable to a desktop console logger or laptop computer. SMS queries and alarms will be sent to the Pacific Complete project team and relevant Contractor representatives. The Environmental Representative will have access to the data at all times. Each station will download data to the internet and allow live views of

weather data by authorised users; which will include Environmental Representative. Each station will also be compatible with and communicate live data to Roads and Maritime's online weather station page.

In accordance with normal standard construction practices, weather forecasts will be used to guide work activities undertaken onsite. Forecasts will be checked at the start of each day and before any new work activity that may be affected by rainfall or adverse weather. Where weather forecasts predict conditions that may pose an environmental risk, site environmental controls will be inspected and secured to reduce erosion and sediment control impacts. Contingency planning to prevent spills will also involve monitoring for predicted flood events and the removal of fuels, chemicals and other hazardous chemicals from flood prone areas.

7.6 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this plan, Commonwealth and State conditions of approval and other relevant approvals, licenses and guidelines. Section 8.3 of the CEMP details the auditing requirements and provision of the audit schedule.

7.7 Reporting

Reporting requirements and responsibilities are documented in the Water Quality Monitoring Program, and Chapter 7 and Section 8.3 of the CEMP.

8 Review and improvement

8.1 Continuous improvement

Continuous improvement of the SWMP 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
- Make comparisons with objectives and targets.

8.2 SWMP 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 SWMP. This will occur as needed or in accordance with the specifications provided in Chapter 6.

Any revisions to the SWMP will be in accordance with the process outlined in Section 1.6 of the CEMP.

A copy of the updated plan 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).

Appendix A
Acid Sulfate Soil Contingency and Management Controls

A. Acid Sulfate Soil Contingency and Management Controls

The following conditions of approval and mitigation commitments are addressed in this procedure.

A1. Conditions of approval/mitigation commitments

Table A1 Conditions of approval/mitigation measures

Reference	Condition requirements
D26(c- vi)	[The requirement to prepare] an acid sulfate soils contingency plan, consistent with the *Acid Sulfate Soils Manual*, to deal with the unexpected discovery of actual or potential acid sulfate soils, including procedures for the investigation, handling, treatment and management of such soils and water seepage
SSW3	As part of the **Construction Environmental Management Plan**, a **Soils and Water Management Plan** will be prepared and include (but not limited to) **Acid Sulfate Soil Sub-Plan** issues (including from groundwater drawdown)
SSW15	Acid sulfate soil sub-plan issues (including from groundwater drawdown)
SSW24	Strategies to remove/reduce risks associated with acid sulfate soils will be identified. Stockpiles containing potential acid sulfate soils will be lined, bunded and covered in accordance with relevant guidelines
SSW25	An **Acid Sulfate Soils Management Plan** will be implemented in accordance with Guidelines for the Management of Acid Sulfate Materials (Roads and Maritime, 2005) and Waste Classification Guidelines Part 4: Acid Sulfate Soils (DECC 2008), where there is a probability of encountering acid sulfate soils during construction.
SSW46	The proposed management strategy to address potential impacts at type-A cuttings include preconstruction investigations: geotechnical investigations to determine groundwater condition (quality parameters: electrical conductivity, groundwater depth, geological information), presence of actual or potential acid sulfate soils, presence or potential of [saline soils], establishing groundwater monitoring sites, and gathering of other pertinent information.

A2. Legislation, regulation, guidelines and policy

This procedure has been developed by way of referring to the following legislation, regulation, guidelines and policy.

- Guidelines for the Management of Acid Sulfate materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulphidic Black Ooze (Roads and Maritime, 2005)
- Acid Sulfate Soils Assessment Guidelines (Acid Sulfate Soil Management Advisory Committee, 1998)
- Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998)
- Acid Sulfate Soil and Rock Publication 655.1 (Environment Protection Authority Victoria (EPA Victoria), July 2009)

- Waste Classification Guidelines Part 4: Acid Sulfate Soils (EPA. 2014)
- State Planning Policy 2/02 Guideline: Planning and Managing Development Involving Acid Sulfate Soil (Queensland Government, 2002).
- Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland (Ahern, C R, Ahern, M R & Powell, B, 1998
- Sulfate Specification for Structural Backfills (Reid, J M, Czerewko, M A & Cripps, J C, 2001)
- State Planning Policy 2/02 Guideline – Planning and Managing Development Involving Acid Sulfate Soil (Queensland Government, 2002).

A3. Work activities

The contractor will be required to prepare an environmental work method statement (EWMS) for each construction and work activity that potentially involves the disturbance of acid sulfate soils. Typically this will cover:

- Topsoil stripping
- Culvert and drainage work
- Dewatering and clearing
- Earthworks
- Stockpiling
- Water crossing work
- In-ground excavation work.

A4. Locations

Table A2 describes where this procedure will be applied and the factors that have led to its application in these locations. Locations where acid sulfate soils may be encountered have been mapped on the online GIS server SiteMap.

Table A2 Locations where the procedure applies

Section	Factors
Section 4, 5, 8, 9	High probability of encountering acid sulfate soils
Section 10	Low probability of encountering acid sulfate soils
Section 11	High probability of encountering acid sulfate soils

A5. Review

The procedure will be updated annually or:

- Following the confirmed uncontrolled disturbance of acid sulfate soils

- Following the confirmed release or generation of sulphuric acid or a resultant impact
- Following a change in legislation or permitting
- Following a major change in construction method.

A6. Procedure

Table A3 describes the acid sulfate material management controls that will be implemented to service the project's construction. All contractors developing their specific EWMS will adopt this procedure. More refined information describing the location of acid sulfate soil is provided in Appendix B. This too will be use to prepare the final report.

Table A3 Acid sulfate soil contingency and management plan

Ref	Task	Staging	Responsibility	Reference
A1	**Acid sulfate soil management plan guidelines** • All (potential or actual) acid sulfate soils will be managed in accordance with the: - Guidelines for the Management of Acid Sulfate materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulphidic Black Ooze (Roads and Maritime, 2005) - Acid Sulfate Soils Assessment Guidelines (Acid Sulfate Soil Management Advisory Committee, 1998) - Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998) - Acid Sulfate Soil and Rock Publication 655.1 (Environment Protection Authority Victoria (EPA Victoria, July 2009) - Waste Classification Guidelines Part 4: Acid Sulfate Soils (NSW EPA. 2014).	Pre-construction	Contractor	Various Condition of approval and mitigation commitment D26, SSW3 and SSW15
A2	**Acid sulfate soil management plan** • Each contactor working in an area of potential or actual acid sulfate soil will prepare an environmental work method statement (EWMS) in accordance with the above guidelines. Each EWMS will: - Map all areas where intrusive activities are taking place in suspected or confirmed acid sulfate material areas (see below) - Describe and justify the acid sulfate material handling and	Pre-construction	Contractor	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011) Condition of approval and mitigation

Ref	Task	Staging	Responsibility	Reference
	management controls - Describe the acid sulfate material treatment methods, controls and management strategies that will be employed as per section 7.4 of the Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011) - Describe the contingency measures that will be implemented in the event of a failure or non-conformance - Describe the sampling and testing regime that will be adopted to validate acid sulfate material before (and if required) during the work activity - Describe the proposed monitoring and supervision regime before, during and after any work is undertaken - Describe the delegation process for approving the removal, storage, management and disposal of acid sulfate materials - Describe how the delegated person will be trained and experienced in executing his/her duties - Describe the consultation program that will be implemented during construction - Describe the process for providing onsite inductions and training for all personnel to ensure unauthorised discharges are eliminated. • The EWMS will include procedures for investigating, handling, treating and managing potential or actual acid sulfate soils. This EWMS will be prepared in accordance with the Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998)			commitment D26, SSW3 and SSW15
A3	**Pre-work sampling** • All minor ground disturbance areas will be tested in accordance with section 6 of State Planning Policy 2/02 Guideline: Planning and Managing Development Involving Acid Sulfate Soil (Queensland Government, 2002) • A qualified soil conservationist will test all major ground disturbance areas in accordance with Guidelines for Sampling and Analysis of	Pre-construction	Contractor	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011) Condition of approval and mitigation

Ref	Task	Staging	Responsibility	Reference
	Lowland Acid Sulfate Soils in Queensland (Ahern, C R, Ahern, M R & Powell, B, 1998); Sulfate Specification for Structural Backfills (Reid, J M, Czerewko, M A & Cripps, J C, 2001); and State Planning Policy 2/02 Guideline – Planning and Managing Development Involving Acid Sulfate Soil (Queensland Government, 2002) • The sampling results will be included in a detailed report that: describes the sampling method and result; includes acid sulfate mapping; presents a risk assessment associated with each area; and provides a description of the treatment requirements to remove or reduce the risk associated with identified acid sulfate soils.			commitment D26, SSW3, SSW15 and SSW25
A4	**Treatment, management and risk assessment** • The risk assessment will identify and make provision for: residual impacts; the failure of any controls, management strategies and mitigation measures; the need to implement contingency measures; past project performance and effectiveness; and the risk that construction materials may be impacted by sulphuric acid • The risk assessment will also describe the methods for stockpiling, managing and disposing of potential and actual acid sulfate soil to limit and reduce any oxidation risks. This will include lining, bunding and covering all stockpiles, ensuring that all stockpile runoff and leachate is collected and that all material (including associated runoff) is disposed of via a licenced contractor • Finally, the risk assessment will describe the proposed management strategy to address potential acid sulfate soil impacts at type-A cuttings.	Pre-construction	Contractor	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011) Condition of approval and mitigation commitment SSW15, SSW24 and SSW46
A5	**Supervision, monitoring and mitigation** • Each EWMS will provide a clear description of the supervision and monitoring requirements for all minor and major ground disturbance work in identified 'risk' areas or involving identified 'risk' activities	Pre-construction Construction	Contractor	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011) Condition of approval and

Ref	Task	Staging	Responsibility	Reference
	• A qualified soil conservationist will monitor and inspect all minor and major ground disturbance work before, during and after the work. This will include: - Water quality monitoring - Inspecting material storage and containment practice - Inspecting treatment and management practices - Monitoring the effectiveness of acid sulfate material treatments (eg pH and the acid generating potential of treated acid sulfate material) - Auditing the effectiveness of design controls to address acid sulfate material. • Mitigation controls will be implemented in instances where there is an identified risk. This will include: - Activities and actions that are at risk of causing the oxidation via soil exposure to the air or as a result of dewatering - Controls to prevent the leaching, the dispersion or migration of sulphuric acid into surrounding environment - Controls to remove worker exposure risks during construction - Controls to protect any immediately adjacent ecological and human receivers - Management strategies to deal with type-A cuttings that are being constructed in areas of potential or actual acid sulfate soils.			mitigation commitment SSW15, SSW24 and SSW46

Appendix B
Oxleyan Pygmy Perch Habitat Waterway Management Framework

B. Oxleyan Pygmy Perch Habitat Waterway Management Framework

B1. Conditions of approval/mitigation commitments

The following conditions of approval and mitigation commitments are addressed in this procedure.

Table B1 Conditions of approval/mitigation measures

Reference	Condition Requirements
B7	High risk construction activities in known Oxleyan Pygmy Perch habitat shall not be undertaken during the Oxleyan Pygmy Perch spawning period, or on days when the relevant Bureau of Meteorology site predicts a 90% change of 10 mm or rain or more, unless otherwise agreed by DPI (Fisheries).
B8	Temporary bridge or arch structures in known Oxleyan Pygmy Perch habitat shall be used if the crossing is intended to be in place for more than 3 months.
B9	Where temporary crossings in known Oxleyan Pygmy Perch habitat are proposed with culverts or pipes, the Applicant shall, in consultation with DPI (Fisheries): c) Determine the size of the culverts or pipes to facilitate fish passage; and d) Identify the minimum size of clean rock to be used to ensure that rock material will not wash into the waterway in periods of high flows. Temporary culvert or pipe crossings shall be removed prior to the start of the Oxleyan Pygmy Perch spawning period.
B38	Watercourse crossings shall be designed in consultation with the DPI (Fisheries), EPA, DPI (Water) and DoE, and where feasible and reasonable, be consistent with the Guidelines for Controlled Activities Watercourse Crossings (Department of Water and Energy, February 2008), Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003), Policy and Guidelines for Fish Friendly Waterway Crossings (NSW Fisheries, February 2004), and Policy and Guidelines for Fish Habitat Conservation and Management (DPI Fisheries, 2013). Where multiple cell culverts are proposed for crossings of fish habitat streams, at least one cell shall be provided for fish passage, with an invert or bed level that mimics watercourse flows.
B40	Unless otherwise agreed by DPI (Fisheries), all crossings of Class 1 watercourses in known Oxleyan Pygmy Perch habitat shall be designed and constructed with a bridge or arch structure and, where feasible and reasonable, no supporting structures shall be installed within affected waterways.
B41	Where an Oxleyan Pygmy Perch habitat waterway is realigned or its stream profile is changed, or an in-stream structure is installed in the waterway (both permanent and temporary construction structures), the applicant shall ensure that the final design of that waterway does not result in water velocities exceeding 0.4 metres per second under normal flow conditions. The

Reference	Condition Requirements
	Applicant shall determine normal flow conditions to the satisfaction of DPI (Fisheries) through baseline monitoring of known Oxleyan Pygmy Perch habitat waterways.
B42	The applicant shall ensure that the SSI does not increase the afflux of waterways with known Oxleyan Pygmy Perch habitat by more than the relevant flood management objective in the documents referred to in condition A2 for flood events up to the 1 in 100 year event.
B73	The sites for ancillary facilities that are associated with the construction of the SSI and that have not been identified and assessed in the documents listed in condition A2 shall:
(a)	Be located more than 50 metres from a waterway (100 metres for a State Environmental Planning Policy No. 14 wetland or known Oxleyan Pygmy Perch habitat waterway)
-	The Applicant shall undertake an assessment of the facility against the above criteria in consultation with the relevant public authority(s) and the relevant council. The assessment shall be approved by the Environmental Representative and included in the Ancillary Facilities Management Plan required under condition D21.
B74	Ancillary facilities that have not been previously identified and assessed in the documents listed in condition A2, and do not meet the criteria set out under condition B73, shall be approved by the Environmental Representative prior to its establishment. In obtaining this approval, the Applicant shall consult with the relevant public authority(s) and the relevant council, and demonstrate to the satisfaction of the Environmental Representative, how the potential environmental impacts can be mitigated and managed to acceptable standards. The outcomes of the assessment shall be documented in a report and include, but not necessarily be limited to:
(c)	Outcomes of the assessment of the site against the locational criteria set out in condition B73
(d)	An assessment of the environmental impacts on the site and the surrounding environment, including, but not limited to noise, vibration, air quality, traffic and access during site establishment and operation, flora and fauna, heritage, erosion and sedimentation, water quality and light spill
(e)	Details of the mitigation, monitoring and management procedures specific to the ancillary facility that would be implemented to minimise environmental impacts
(f)	Demonstrated overall consistency with the approved SSI (including impacts identified in the documents listed in condition A2).
B75	Notwithstanding condition B74, ancillary facilities that that have not been previously identified and assessed in the documents listed in condition A2 and result in additional impacts to biodiversity, heritage, flooding and noise beyond those approved for the SSI, shall be approved by the Secretary prior to their establishment. In order to obtain this approval, the Applicant shall

Reference	Condition Requirements
	undertake an assessment of the ancillary facility in accordance with condition B74 and forward a copy of the assessment report to the Secretary, as part of the approval submission, at least one month prior to the establishment of the facility.
B76	The land on which ancillary facilities are located shall be rehabilitated to at least their pre-construction condition or better, unless otherwise agreed by the landowner.
(b)	Results in impacts to biodiversity, heritage, flooding and noise beyond those approved for the SSI, the Applicant shall seek the approval of the Secretary in accordance with condition B75.
-	The relevant approval shall be obtained prior to the establishment of the ancillary facility.
D12	The Applicant shall prepare and implement a **Water Quality Monitoring Program**, to monitor the construction and operation impacts of the SSI on surface and groundwater quality and resources and wetlands, prior to construction. The Program shall be prepared in consultation with the EPA, DPI (Fisheries), DPI (Water) and DoE to the satisfaction of the Secretary, and shall include but not necessarily be limited to:
(c)	Identification of works and activities during construction and operation of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways and known Oxleyan Pygmy Perch habitat
D21	The Applicant shall prepare and implement an **Ancillary Facilities Management Plan** to detail the management of ancillary facilities associated with the SSI. The SWMP shall be prepared in consultation with the EPA, OEH, DPI (Fisheries), DoE, and the relevant council, and to the satisfaction of the Environmental Representative, and shall include, but not necessarily be limited to:
(c)	A description of the plant, equipment and materials to be used and/or stored on the site, including dangerous and hazardous goods
(e)	A summary of the potential environmental impacts associated with the construction and operation of the facility
(f)	Demonstrate compliance with the locational and environmental criteria in condition B73(a)(n)
(g)	Details of the mitigation, monitoring and management procedures specific to the facility that would be implemented to minimise environmental and amenity impacts or, where this is not possible, feasible and reasonable measures to offset these impacts.
CCoA.3	In order to minimise impacts on the Oxleyan Pygmy Perch, the approval holder must undertake the action in accordance with NSW approval conditions B7, B8, B9, B13, B40, B41 and B42
HF6	Scour and erosion protection measures at temporary and permanent waterway crossings will be provided upstream and downstream of the highway, particularly within 50 metres of Class 1 waterways or within the range of the Oxleyan Pygmy Perch

Reference	Condition Requirements
	as identified in section 3.9.6 of the Working paper – Biodiversity and the supplementary biodiversity assessment in Appendix J of the SPIR. This will be undertaken in consultation with the Department of Primary Industries (Fisheries).
HF7	Waterway diversions will be designed in consultation with Office of Environment and Heritage, NSW Department of Primary Industries (Water) and Department of Primary Industries (Fisheries) so that the final diversion mimics, where feasible and reasonable, the characteristics of the waterway that is being diverted. Characteristics include flow regime, flow velocity, base material, vegetation and habitat for aquatic fauna.
HF8	Revegetation of waterway diversions and surrounding areas will be undertaken in accordance with the following principles: • Diversions will be stabilised prior to the diversion receiving flows, in conjunction with the establishment of other scour and erosion control measures • Diversions will establish appropriate vegetation communities along the channel bed and banks, using endemic native species.
HF10	Batter stability will be assessed and sufficient room provided on both sides of the diversion to allow access for maintenance and to meet batter stability requirements.
HF17	Any temporary infrastructure associated with the construction of bridges in the Clarence River, Clarence North Arm, Richmond River, Tuckombil Canal and Emigrant Creek will be secured or removed from the river and floodplain during flood events so not to create a debris hazard or blockage during a flood event.
HF19	All work within 40 metres of a permanent watercourse, crossed by the project, will be undertaken in accordance with the NSW Department of Primary Industries (Water) for Controlled Actions' and industry best practice including maintaining where feasible and reasonable the geomorphic integrity and natural hydrological flow regime.
SSW3	As part of the **Construction Environmental Management Plan**, a **Soils and Water Management Plan** will be prepared and include (but not limited to): • Protection of waterways
SSW8	Any necessary approvals will be obtained in accordance with Roads and Maritime [quality assurance] specification G36 [environmental protection] for permanent and temporary waterway crossings.
SSW27	Works within waterways will consider the need to maintain fish passage, in consultation with the Department of Primary Industries (Fisheries).

B2. Legislation, regulation, guidelines and policy

This procedure has been developed by way of referring to the following legislation, regulation, guidelines and policy.

- Department of Primary Industries Guidelines for Controlled Activities (2012).
- Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries, Cronulla, 16 pp (Fairfull, S. and Witheridge, G. (2003))

B3. Work activities

The contractor will be required to prepare an environmental work method statement (EWMS) for each construction and work activity that involves installing temporary and permanent water crossing and diversion and/or installing temporary structures or working platforms in or adjacent to watercourse.

Table B2 describes where this procedure will be applied and the factors that have led to its application in these locations.

Table B2 Locations where the procedure applies

Section	Factors
Section 3	• Pheasant Creek, Coldstream Creek, Black Snake Creek, Pillar Valley Creek, Chaffin Creek (and a nearby un-named creek near Mitchell Road and Bostock Road), Champions Creek (and a nearby un-named creek north of Champions Creek) and Clarence River • Giant Barred Frog habitat (potential habitat) (refer to the Flora and Fauna Management Plan (Appendix B2 of the CEMP)) • Key fish habitat
Section 4	• Clarence River (South Arm), Edwards Creek, and Shark Creek • Key fish habitat
Section 5	• James Creek, Nyrang Creek, Clarence River, Clarence River (North Arm), Serpentine Channel and Mororo Creek • Key fish habitat
Section 6	• Mororo Creek and Tabbimoble Creek • Giant Barred Frog habitat (potential habitat) (refer to the Flora and Fauna Management Plan (Appendix B2 of the CEMP))

Section	Factors
Section 7	• Tabbimoble Floodway No.1, Nortons Gully and Oakey Creek • Oxleyan Pygmy Perch habitat • Giant Barred Frog habitat (potential habitat) (refer to the Flora and Fauna Management Plan (Appendix B2 of the CEMP)) • Key fish habitat
Section 8	• Tuckombil Canal (becomes Evans River), Rocky Mouth Creek, MacDonalds Creek and Richmond River • Oxleyan Pygmy Perch habitat • Key fish habitat
Section 9	• Richmond River, Montis Gully and Eversons Creek • Oxleyan Pygmy Perch habitat • Key fish habitat
Section 10	• Tuckean Swamp, Tuckean Broadwater (upstream of Richmond River), Richmond River, Saltwater Creek and Randals Creek • Key fish habitat
Section 11	• Duck Creek and Emigrant Creek • Key fish habitat

B4. Review

The procedure will be updated annually or:

- Following site monitoring or auditing outcomes that identify any reported or observed non-conformances
- Following a change in legislation or permitting
- Following a major change in construction method.

B5. Procedure

Table B3 describes the environmental controls that will be implemented to support the installation of temporary and permanent water crossing and diversions during construction.

It also links to a number of supporting management plans including:

- Flora and fauna management plan (Appendix B2 of the Construction Environmental Management Plan).
- Ancillary facilities management plan

Table B3 Water crossing and diversions

Ref	Task	Staging	Responsibility	Reference
B1	**General provisions** • Each contractor installing temporary and permanent water crossing, diversion or a temporary structure/working platform in or adjacent to watercourse will prepare an environmental work method statement (EWMS) in accordance with G38: Soil and Water Management (Roads and Maritime, 2014). An EWMS will be prepared for all such work taking place within 50 metres of a surface watercourse (including ancillary facilities) and it will: - Describe how each crossing/structure will be designed, constructed and maintained - Demonstrate how it provides for the safe passage of fish and/or does not impact on Giant Barred Frog and Oxleyan Pygmy Perch habitat or SEPP14 coastal wetland - Confirm the materials specification needed for the appropriate design of temporary waterway crossings so as to provide hard substrate and prevent the release of fine sediment - Include erosion and sediment controls - Allow for securing or removing any temporary infrastructure, including bridge construction work taking place in the Clarence River, Clarence North Arm, Richmond River, Tuckombil Canal and Emigrant Creek • Each EWMS will describe a construction maintenance schedule to ensure that: - Pipe culverts are kept clear to avoid bypassing by storm flows less than the design storm event due to blockages from debris or sediment	Pre-construction Construction	Contractor	G38: Soil and Water Management (Roads and Maritime, 2014) Condition of approval and mitigation commitment B74, B75, B76, D21, HF9, HF10, HF11, SSW3, SSW8 and SSW27.

Ref	Task	Staging	Responsibility	Reference
	- Provide for gravel recovery to maintain a minimum depth of 200 mm - Ensure that the crossing is removed when it is no longer required - Allow for the area's stabilisation, rehabilitation and vegetation (including the provision of appropriate endemic native communities along both sides of the bank and in the channel bed). This will include the stabilisation of diverted watercourses, including the provision of erosion and sediment controls • Each EWMS will also include appropriate management controls to ensure that: - Oils or other potentially hazardous materials are not used in the area - Upstream and downstream flooding problems have addressed - Batter stability has been addressed to ensure there is sufficient room on both sides of any crossing/diversion to allow maintenance access - Activities that may affect water quality have been considered and addressed. **Note 1** Roads and Maritime (Environment Branch) will approve all temporary waterway crossings under its G36: Environment Protection specifications (Roads and Maritime, 2014) **Note 2** Additional or new ancillary facilities that have not been previously identified or assessed will need to ensure they meet the above criteria. The Secretary will approve the construction and implementation of additional ancillary facilities before they are established. This will extend to any change or extension to the boundary of any agreed ancillary facility. The following information will be provided and considered for any new ancillary facility: • A description of the plant, equipment and materials to be used			

Ref	Task	Staging	Responsibility	Reference
	and/or stored on the site, including dangerous and hazardous goods • A summary of the potential environmental impacts associated with the construction and operation of the facility • Details of the mitigation, monitoring and management procedures specific to the facility that would be implemented to minimise environmental and amenity impacts or, where this is not possible, feasible and reasonable measures to offset these impacts • A description of how the management and mitigation measures will be implemented on the site, and if not, justification for such decisions particularly on those sites assessed as having a high risk of flood impacts. **Note 3** High risk construction activities, such as the construction of waterway crossings, culverts or pipes, in known Oxleyan Pygmy Perch habitat shall not be undertaken during the Oxleyan Pygmy Perch spawning period, or on days when the relevant Bureau of Meteorology site predicts a 90% change of 10 mm or rain or more, unless otherwise agreed by DPI (Fisheries).			
B2	**Temporary waterway crossing designs** • Temporary bridge or arch structures in known Oxleyan Pygmy Perch habitat shall be used if the crossing is intended to be in place for more than 3 months. • All work within 40 metres of a permanent watercourse will be subject to a 'controlled action' approval under the NSW *Water Management Act 2000.* All work will therefore adhere to the best-practice provisions that will be included in the issued approvals obtained from NSW Department of Primary Industries (Water). • Temporary waterway crossings will be designed in accordance with section 5.3.4 of Volume 1 of the Blue Book: Managing	Pre-construction Construction	Contractor	Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004) Condition of approval and mitigation commitment B38, B39(a and b), B40, B41, B42, D12, CCoA.3, CCoA.4,

Ref	Task	Staging	Responsibility	Reference
	Urban Stormwater: Soils and Construction (Landcom, 2004) • The crossings will also be designed in consultation with DPI (Fisheries), EPA, DPI (Water) and DoE to be consistent with the Guidelines for Controlled Activities Watercourse Crossings (Department of Water and Energy, February 2008), Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003), the Policy and Guidelines for Fish Friendly Waterway Crossings (NSW Fisheries, February 2004), and the Policy and Guidelines for Fish Habitat Conservation and Management (DPI Fisheries, 2013). Where multiple cell culverts are proposed for crossings of fish habitat streams, at least one cell shall be provided for fish passage, with an invert or bed level that mimics watercourse flows. • Bridges will be used for all locations where Giant Barred Frog habitat and Oxleyan Pygmy Perch habitat occurs. This will extend to not include any supporting structures within the affected waterways. If this is not feasible or reasonable, then it will be demonstrated that upstream and downstream connectivity can be maintained. To support this, three years of monitoring will take place to confirm the habitat connectivity unless prior agreement has been reached with the Secretary in consultation with NSW EPA. • To demonstrate habitat connectivity the contractor will be required to: - Obtain baseline data that confirms the presence, nature and distribution of Giant Barred Frog population using a survey methodology that has been endorsed by NSW EPA - Obtain evidence that the Giant Barred Frog is still present upstream and downstream of the crossing point for the monitoring period, with periodic monitoring to occur at least biannually. If this species is absent then the contractor will			HF6, HF7, HGF19

Ref	Task	Staging	Responsibility	Reference
	be required to demonstrate (within one month of the observation) that the species' absence is not due to the work • In addition, the contractor will be required that ensure that a residual flow velocity of 0.4 m/s will be achieved in any location where either a change in an Oxleyan Pygmy Perch habitat watercourse alignment or profile will occur. This will include the provision of appropriate scour and erosion protection about 50 metres upstream and downstream from any temporary waterway crossing • Also, the contactor will ensure that the construction work does not affect any Oxleyan Pygmy Perch habitat watercourse afflux by more than a 1-in-100 year average return interval flood event. • Temporary culvert or pipe crossings shall be removed prior to the start of the Oxleyan Pygmy Perch spawning period.			
B3	**Bridge and culvert construction** • Bridges and culverts will be designed in accordance with Chapter 5 of Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004).	Pre-construction Construction	Contractor	Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004)

Ref	Task	Staging	Responsibility	Reference
B4	**Temporary water diversion structures** • Temporary water diversion structures will be designed in accordance with Chapter 5 of Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004). This will ensure that the structures provide appropriate vegetation protection, include water quality controls, mimic natural flows, maintain flow velocities, limit disturbance, allow for immediate re-stabilisation, and consider and assess downstream flow changes • Work will be programmed to minimise the extent and duration of disturbance to vegetation. This will include leaving clearing (undertaken by manual means) and initial earthworks in intermittent and permanent watercourses until subsequent works are about to commence • Where temporary waterways are to be lined with gravel or rock they will be designed, constructed and will be operated in accordance with section 5.4.4 of Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004) • Where chutes are to be installed they will be designed, constructed and will be operated in accordance with section 5.4.4 of Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004) • Where pipes are to be installed they will be designed and progressively constructed in accordance with section 5.4.4 of Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004)	Pre-construction Construction	Contractor	G38: Soil and Water Management (Roads and Maritime, 2014) Volume 1 of the Blue Book: Managing Urban Stormwater: Soils and Construction, (Landcom, 2004).

Ref	Task	Staging	Responsibility	Reference
B5	**Installation of working platforms in or adjacent to waterways** • Where required, each EWMS will detail how the work extending over or into watercourses will be undertaken to reduce erosion and minimise impacts on water quality and riparian fauna and flora. This will include: - Ensuring that earth and/or rock platforms for driving piles are constructed to minimise impacts on the direct water channel - Keeping vegetation clearing to a minimum - Constructing rock platforms for driving piles/girder erection only where necessary - Selecting the optimum rock size for platforms/haul roads to account for all issues including safety and environment - Using larger rock size and grades on the lower side of the works to assist in reducing failure risks - Addressing stormwater overflow design and pipe capacity - Enclosing platforms in geotextile fabric and appropriate erosion and sediment controls before clearance work starts.	Pre-construction Construction	Contractor	G36: Environmental Protection (Roads and Maritime, 2014)

Appendix C
Stockpile Management Protocol

C. Stockpile Management Protocol

C1. Conditions of approval/mitigation commitments

The following conditions of approval and mitigation commitments are addressed in this procedure.

Table C1 Conditions of approval/mitigation measures

Reference	Condition Requirements
D25	The applicant shall prepare and implement (following approval) a **Construction Environmental Management Plan** for the SSI, prior to the commencement of construction, or as otherwise agreed by the Secretary. An environmental risk analysis to identify the key environmental performance issues associated with the construction phase and details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the construction of the SSI). In particular, the following environmental performance issues shall be addressed in the Plan:
(vi)	Measures to minimise **hydrology** impacts, including measures to stabilise bed and bank structures as required
(vii)	Measures for the handling, treatment and management of **contaminated materials**
(ix)	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). Stockpile sites that affect heritage, threatened species, populations or endangered ecological communities require the approval of the Secretary, in consultation with the EPA, OEH and DPI (Fisheries).
D26 (c)	As part of the construction environmental management plan for the SSI, the applicant shall prepare a **Construction Soil and Water Quality Management Plan** to manage surface and groundwater impacts during construction of the SSI. The Plan shall be developed in consultation with the EPA, DPI (Fisheries), DPI (Water), DoE and the relevant council and include, but not necessarily be limited to:
(iii)	Management measures to be used to minimise surface and groundwater impacts, including details of how spoil and fill material required by the SSI will be will be sourced, handled, stockpiled, reused and managed; erosion and sediment control measures; salinity control measures and the consideration of flood events
SSW3	As part of the **Construction Environmental Management Plan**, a **Soils and Water Management Plan** will be prepared and include (but not limited to):

Reference	Condition Requirements
	Sedimentation basin construction and management
	Management of stockpiles
SSW10	Topsoil, earthworks and other excess spoil material will be stockpiled and managed in accordance with management Roads and Maritime Stockpile Management Guidelines (Roads and Maritime, 2011) and the of surplus material in section 3.9 of the SPIR.
SSW11	Where reasonable and feasible, stockpiles will: • Not require removal of areas of native vegetation • Be located outside of known areas of weed infestation • Be located such that waterways and drainage lines are not directly or indirectly impacted.
SSW12	Where practicable, stockpiles will be located away from areas subject to concentrated overland flow. Stockpiles located on a floodplain be finished and contoured so as to minimise loss of material in flood or rainfall events.
SSW13	Topsoil will be stockpiled separately and inspected for noxious weed seedlings at six monthly intervals and controlled with herbicide as required.
SSW14	All construction stockpiles will comply with the requirements of the NSW *Protection of the Environment Operations Act* 1997 and NSW Waste Avoidance and Resource Recovery Strategy 2007 for any waste activities that involve the generation, storage and/or disposal of waste and also consider the NSW Resource Recovery Exemptions as applying the storage of stockpiled material.
SSW15	Stockpiles containing potential acid sulfate soils will be lined, bunded and covered in accordance with relevant guidelines.
SSW16	Management of tannin leaching from vegetation mulch will be in accordance with [the] Roads and Maritime Environmental Direction –Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012).

Roads and Maritime Guidelines

Section 3.2 of G38: Soil and Water Management (Roads and Maritime, 2014) states that erosion controls and sediment capture measures will be established and regularly maintained to divert offsite stormwater, manage onsite stormwater runoff and stabilise stockpiles. These measures are to be implemented in accordance with Technical Guideline EMS-TG-010: Stockpile Site Management (Roads and Maritime, 2005) and Volume 1 and Volume 2 of the Blue Book: Managing Urban Stormwater: Soils and Construction (Landcom, 2004)

C2. Legislation, regulation, guidelines and policy

This procedure has been developed by way of referring to the following legislation, regulation, guidelines and policy.

- Technical Guideline EMS-TG-010: Stockpile Site Management (Roads and Maritime, 2008)
- Volume 1 and Volume 2 of the Blue Book: Managing Urban Stormwater: Soils and Construction (Landcom, 2004)

C3. Work activities

The contractor will be required to prepare an environmental work method statement (EWMS) for all stockpile activities. Typically this will cover:

- Locations where the following materials will be temporarily sorted:
  - Select material and fill, such as sand and rock
  - Topsoil, wood chips, mulch and waste vegetation
  - Virgin excavated natural material (VENM) and spoil, such as excavated material (ie sediment and clays)
  - Recycled Asphalt Pavement (RAP), rotomilled material
  - Concrete or asphalt, block material removed or excavated from pavement
  - Pre-coat aggregate
  - Asphalt, such as cold mix
  - Acid sulfate soils
  - Road base
  - Construction material such as Jersey Kerbs & traffic signs
  - General material such as timber, tyres, steel etc.
- Locations where waste materials less than 2,500 tonnes or 2,500 cubic metres will be temporarily stored; whichever is the lesser.

Definitions

- ***Temporary Stockpile Sites***: Temporary stockpile sites are generally project related with their use limited to the duration of a project. These stockpile sites will generally be established at the beginning of the project and used throughout the project period. Once the project is complete the site is usually de-commissioned and the land restored back to its original condition. Temporary stockpiles can be used for major development projects or works such as rehabilitation/ restoration.
- ***Permanent Stockpile Sites***: Permanent stockpile sites are not covered by this Procedure.

C4. Locations

This Procedure applies to the Woolgoolga to Ballina project.

C5. Stockpile location criteria

Stockpiles on the project will be located according to the following criteria:

- Be located at least 5 metres clear of all areas of possible concentrated water flow.
- Be located at least 10 metres from a waterway.
- Be located on land with slopes less than 10%.
- Do not impact on fauna connectivity structures or native vegetation leading to connectivity structures
- Have ready access to the road network or direct access to the construction corridor.
- On land that does not require the removal of threatened species, EECs or roosting habitat for listed threatened fauna species
- Be located on land that does not impact on heritage items.

If stockpile sites cannot comply with the above criteria additional mitigation measures will be implemented and approved by the Pacific Complete Environment Manager (or delegate) prior to implementation. The Pacific Complete Environment Manager will determine any consultation requirements with regulatory agencies or stakeholders prior to approval.

Construction contractors will be required to maintain a register of stockpiles used based in Table C3 to confirm these sites comply with the above criteria. Pacific Complete will maintain a collated register of stockpile sites which will be detailed in the online GIS server, SiteMap and will be revised when required.

Table C3 Stockpile compliance table

ID Name	Be located at least 5 metres clear of all areas of possible concentrated water flow	Be located at least 10 metres from a waterway	Be located on land with slopes less than 10%.	Do not impact on fauna connectivity structures or native vegetation leading to connectivity structures	Have ready access to the road network or direct access to the construction corridor	On land that does not require the removal of threatened species, EECs or roosting habitat for listed threatened fauna species	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	Complies	Additional actions and comments

C6. Review

The procedure will be updated:

- Where a routine site audit or inspection identifies any non-conformance
- Following and incident or emergency
- Following a change in legislation or permitting
- Following a major change in construction method.

C7. Procedure

Table C4 describes the environmental controls that will be implemented to ensure effective stockpile management during construction.

Table C4 Stockpile management controls

Ref	Task	Staging	Responsibility	Reference
C1	**Stockpile management** • For each activity that satisfies the conditions described in section C3, or as directed by the Environmental Representative, an environmental work method statement (EWMS) will be prepared in accordance with the Stockpile Site Management Guidelines (Roads and Maritime, 2008). Each EWMS will: - Identify where stockpile sites are needed and where they will be located - Include a map of all temporary stockpile - Include a risk assessment of all proposed temporary stockpile to confirm their suitability and/or the need for environmental management controls to be implemented - Define management, audit and inspection controls to ensure all stockpiles are managed to prevent erosion, sedimentation, leaching and runoff - Identify the key performance issues and the requirements of how environmental performance will be managed and monitored, especially with regards to spoil, fill, acid sulfate soils, mulch and material stockpile sites including details on handling, storage, reuse and disposal - Identify the controls that will be implemented to minimise hydrology impacts, the handling treatment and management of contaminated materials Each EWMS will address erosion and sediment controls. They will also refer to the traffic management provisions provided in Traffic and Access Management Plan (refer to Appendix B1 of the CEMP).	Pre-construction	Contractor	G38: Soil and Water Management (Roads and Maritime, 2014) Condition of approval and mitigation commitment D22 and D25

Ref	Task	Staging	Responsibility	Reference
	• Stockpile sites will be signposted to identify their locations. The signposts will be used to assist in identifying assets and where materials will be delivered and stored.			
C2	**Site selection** • Criteria will be included in the each EWMS to guide the placement of temporary stockpile and the management measures that would be implemented to avoid and minimise amenity impacts to surrounding residents and the associated environmental risks • The need for each stockpile will be justified in terms of the availability of existing sites in the area and the haulage costs (to existing sites) versus the environmental, social and economic costs of setting up new sites.	Pre-construction	Contractor	G38: Soil and Water Management (Roads and Maritime, 2014) Condition of approval and mitigation commitment SSW11 and SSW12
C3	**Environmental management** The following controls will be implemented before any stockpile is established to manage it use and operation during construction: • Noise pollution will be minimised by adopting the controls listed in the Construction Noise and Vibration Management Plan (refer to Appendix B3 in the CEMP). • Containment controls will be implemented to ensure runoff, leachate and sediment does not enter any watercourses). This will include constructing stockpiles on hardstand (impervious) bunded areas • Stockpiles will be managed to so as to minimise soil disturbance and erosion. • All stockpiles in place for longer than one month will be stabilised • Controls will be implemented to ensure that construction traffic working on stockpile sites does not track mud onto the wider road work or cause the spread of pathogens, diseases, or (noxious weed) seed stock in accordance with NSW Department of Agriculture (1999) Guidelines • Noxious weeds will be managed and treated in accordance with	Pre-construction Construction Post-construction	Contractor	Stockpile Site Management Plan (Roads and Maritime, 2008) Condition of approval and mitigation commitment D25, D26(c), SSW3, SSW10, SSW13, SSW14, SSW15 and SSW16

Ref	Task	Staging	Responsibility	Reference
	the Flora and Fauna Management Plan (refer to Appendix B2 of the CEMP) • Stockpiles will not be located within five metres of trees to be retained • Stockpile perimeters will be marked to prevent encroachment • The height of all stockpiles will be limited to prevent dust propagation and visual amenity impacts while all vehicle carrying stockpiled materials will be covered to prevent the spread of dust and malodours • All temporary stockpiles will be removed to ensure that no material is left onsite. The primary objective will be to reuse and recycle stockpiled material either under an exemption. Where this is not possible the stockpiled material will be (waste) classified, managed and treated accordingly. Where necessary, the material will be transported offsite using licenced contractors and disposed of to a licenced (waste management) facility • Topsoil will be stockpiled separately and inspected for noxious weed seedlings at six monthly intervals, and controlled with herbicide as required • Stockpiles located on a floodplain be finished and contoured so as to minimise loss of material in flood or rainfall events • Stockpiles containing potential acid sulfate soils will be lined, bunded and covered in accordance with relevant guidelines			
C4	**Material storage** - The quantity of material stored in each location will be determined in each EWMS. It will depend on: - The size of the stockpile site - Any height restrictions - Type of material being stored - The reason(s) or objective(s) for establishing the stockpile site(s) - What other activities will be taking place onsite.	Construction	Contractor Environmental Representative	Stockpile Site Management Plan (Roads and Maritime, 2008) Roads and Maritime Specification R44

Ref	Task	Staging	Responsibility	Reference
	In accordance with RMS Specification R44 stockpiles will: - be free from subsoil, other excavated materials, contaminated materials, refuse, clay lumps and stones, timber or other rubbish - be trimmed to a regular shape to facilitate measuring with a height not exceeding 2.5 m and batter slopes not steeper than 2H:1V - have their batters track rolled or stabilised by other means - be seeded in accordance with Specification Roads and Maritime D&C R178, to encourage vegetation cover. Seeding must be carried out progressively within seven days of completion of each 500 m2 of exposed batter face.			
C5	**Record keeping and monitoring** • Routine inspections will be undertaken of each stockpile site, the frequency of which will be determined by what is being stockpiled, the stockpile location(s) and the sensitivity of the receiving environment. The inspections will focus on the effectiveness of control measures in minimising environmental impacts • A checklist will be used to undertake each inspection. The checklist will consider: any impact on local environmental sensitivities; the effectiveness of the control measures; the integrity of the hardstand and bunding; the encroachment or storage of materials outside of the designated stockpile areas; any residential impacts or complaints; any evidence of illegal dumping; the height of vegetation growth (to ensure it does not present a visual amenity risk, fire risk or would be at risk of forming a protected habitat); and general housekeeping • A register will be maintained that records the types and quantities of all incoming material as well as where reuse and recycled material is being used. This register will be updated and maintained during construction • In instances of non-conformance, corrective actions will be	Construction	Contractor Environmental Representative	Stockpile Site Management Plan (Roads and Maritime, 2008) Condition of approval and mitigation commitment D25

Ref	Task	Staging	Responsibility	Reference
	defined and implemented. A follow-up site inspection will be conducted once the corrective action is implemented.			
C6	**Decommissioning** • All stockpiles will be decommissioned to reinstate the site to near-natural conditions. If illegal dumping has occurred measures will be taken to deter such activities post completing the construction work by including gates, fences, and/or planting and earth mounds. • Stockpile decommissioning will include: - Clearing all stockpile material from the site and recycling or disposing of it at a licensed facility - Stabilising the site by planting and/or landscaping the site - Removing control measures such as erosion and sedimentation devices once the stabilisation has occurred - Undertaking a site inspection - Informing the Environmental Representative and Roads and Maritime (Environmental Branch) of the site's removal.	Post-construction	Contractor Environmental Representative Roads and Maritime	Stockpile Site Management Plan (Roads and Maritime, 2008)

Appendix D
Tannin Leachate Management Controls

D. Tannin Leachate Management Controls

D1. Conditions of approval/mitigation commitments

The following conditions of approval and mitigation commitments are addressed in this procedure.

Table D1 Conditions of approval/mitigation measures

Reference	Condition Requirements
D26 (c)	As part of the construction environmental management plan for the SSI, the applicant shall prepare a **Construction Soil and Water Quality Management Plan** to manage surface and groundwater impacts during construction of the SSI. The Plan shall be developed in consultation with the EPA, DPI (Fisheries), DPI (Water), DoE and the relevant council and include, but not necessarily be limited to:
(vii)	A **Tannin Leachate Management Protocol** to manage the stockpiling of mulch and use of cleared vegetation and mulch filters for erosion and sediment control
(ix)	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 noncompliance can be rectified
(x)	Mechanisms for the monitoring, review and amendment of this plan
SSW3	As part of the **Construction Environmental Management Plan**, a **Soils and Water Management Plan** will be prepared and include (but not limited to): • Tannin leachate management control
SSW16	Management of tannin leaching from vegetation mulch will be in accordance with [the] Roads and Maritime Environmental Direction – Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012) (Refer to Appendix F).

D2. Legislation, regulation, guidelines and policy

This procedure has been developed by way of referring to the following legislation, regulation, guidelines and policy.

- Environmental Direction: Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012) (Refer to Appendix F).

D3. Work activities

The contractor will be required to prepare an environmental work method statement (EWMS) for each construction and work activity that has the potential to generate leachable tannins. Typically this will cover:

- All locations where vegetation would be cleared, mulched, stockpiled and/or reapplied/reused.

D4. Locations

This procedure will be applied to all areas of the work footprint involving vegetation clearance work, which would cover all sections of the work footprint.

D5. Review

The procedure will be updated annually or:

- Following any observed non-conformances during routine site inspections and audits
- Following the visual observation of tannin leachate forming around stockpiled mulch
- Following an incident or emergency
- Following a change in legislation or permitting
- Following a major change in stockpile management method.

D6. Procedure

Table D2 describes the environmental controls that will be implemented to support construction and work activities that may potentially generate or leach tannins.

Table D2 Tannin leachate management controls

Ref	Task	Staging	Responsibility	Reference
D1	**Tannin leachate management plan** • Each contractor undertaking any activity where vegetation would be cleared, mulched, stockpiled and/or reapplied/reused will prepare an environmental work method statement (EWMS) in accordance with Environmental Direction: Management for Tannins from Vegetation Mulch (Roads and Maritime, 2012) (Refer to Appendix F). Each EWMS will: - Cross reference the flora and fauna work method statements to ensure work mulch stockpiling is not at risk of impacting on	Pre-construction Construction	Contactor	Environmental Direction: Management for Tannins from Vegetation Mulch Condition of approval and mitigation commitment D26(c), SSW3 and SSW16

Ref	Task	Staging	Responsibility	Reference
	any sensitive ecological values - Confirm the process of establishing mulch stockpiles with appropriate controls in place before the main site clearance work takes place - Confirm the work staging to ensure that the mulch can be progressively moved to elevated, suitable stockpile locations - Ensure that mulch is removed and transported to a stockpile or reuse site on the day that it is generated - Establish compliance criteria - Demonstrate opportunities as to how the mulch can be reused onsite, given away to the community or otherwise used for bulk offsite disposal - Describe how the above measures will be monitored to ensure that the above actions and measures will be effective - Describe how the monitoring results will be recorded and reported and if required, how exceedances of the established compliance criteria will be detected, managed and corrected - Describe the processes by which the plan will be monitored, reviewed and amended.			
D2	**Stockpile locations and management** • Each EWMS will also ensure that: - All much stockpile sites are located on elevated ground within the work footprint, away from water and creek lines, and either 20 metres from a watercourse (if the stockpile will be in place for less than one month) or 50 metres from a watercourse (if the stockpile will be in place for more than one month) - It lists erosion and sediment controls to ensure that water is diverted up-gradient to prevent it from entering stockpile sites - Provisions are included for the management of mulched	Construction	Contactor	Environmental Direction: Management for Tannins from Vegetation Mulch Condition of approval and mitigation commitment D26(c), SSW3 and SSW16

Ref	Task	Staging	Responsibility	Reference
	material to maximise its reuse over stockpiling to limit the need to manage it as a waste material - Ensure there are suitable management controls in place to prevent leaching, nitrogen draw down and topsoil loss - Ensure that temporary erosion, sediment, containment, and management controls are implemented to prevent leaching and/or the risk of spontaneous combustion. **Note 1** The stockpiles will be inspected by trained staff each week for signs of tannin generation.			
D3	**High risk areas (large quantities of mulch, the mulching of high-tanning vegetation, close to a sensitive environment or tannins have been observed)** • Additional containment controls will be included in each EWMS for 'high risk' areas. This will include: - Installing a bund, installing a lining for all material stockpiled for longer than one month and ensuring there is temporary stormwater containment where materials is stored on a slope - Inspecting the integrity and level of water within the bund within one day following heavy rainfall and pumping out the water within five days.	Construction	Contactor	Environmental Direction: Management for Tannins from Vegetation Mulch Condition of approval and mitigation commitment D26(c), SSW3 and SSW16
D4	**Mulch reuse** • Each EWMS will ensure that the following controls are included for where mulch will be reused: - Do not place unprotected mulch sedimentation controls on concentrated flow lines where the mulch may be washed away - Protect the mulch by wrapping it in geofabric or other material to provide stable controls - Ensure temporary catchment dams that are constructed from mulch include a stable outlet and failure prevention controls	Construction	Contactor	Environmental Direction: Management for Tannins from Vegetation Mulch Condition of approval and mitigation commitment D26(c), SSW3 and SSW16

Ref	Task	Staging	Responsibility	Reference
	to minimise washout during heavy rainfall - Ensure mulch will only be applied to land for filtration or as a soil amendment material or used either singularly or in any combination as input material(s) to a composting process - Ensure that the mulch is provided in an 'environmentally responsible manner' before providing it to the community. As such, prepare a safe work method statement to identify potential risk and preventative measures to protect the community and site workers involved in any give away. **Note:** The managing and processing of mulch shall be to a standard that will allow the application of 'Resource Recovery Exemption: The raw mulch exemption 2014' under Part 9, Clauses 91 and 92 of the Protection of the Environment Operations (Waste) Regulation 2014. ensure that: • the raw mulch does not contain asbestos, engineered wood products, preservative treated or coated wood residues, or physical contaminants, including but not limited to glass, metal, rigid plastics, flexible plastics, or polystyrene. • the raw mulch is ready for land application prior to transport to a consumer.			

Appendix E
Groundwater and Soil Salinity Report

E. Groundwater and Soil Salinity Report

E1. Conditions of approval/mitigation commitments

The following conditions of approval and mitigation commitments are addressed in this procedure.

Table E1 Conditions of approval/mitigation measures

Reference	Condition Requirements
D26 (c)	As part of the construction environmental management plan for the SSI, the applicant shall prepare a **Construction Soil and Water Quality Management Plan** to manage surface and groundwater impacts during construction of the SSI. The Plan shall be developed in consultation with the EPA, DPI (Fisheries), DPI (Water), DoE and the relevant council and include, but not necessarily be limited to:
(v)	A **Groundwater and Soil Salinity Report** will be prepared should geotechnical investigations determine the presence, extent and severity of soil salinity within the SSI boundary, The report shall detail the outcomes of geotechnical investigations and identify and mitigate impacts to groundwater resources.
(ix)	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 noncompliance can be rectified
(x)	Mechanisms for the monitoring, review and amendment of this plan

E2. Legislation, regulation, guidelines and policy

There is no specified legislation, regulation, guidelines and policy that inform this procedure.

E3. Work activities

The contractor will be required to prepare a Groundwater and Soil Salinity Report should geotechnical investigations determine the presence, extent and severity of soil salinity within the SSI boundary. The report shall detail the outcomes of geotechnical investigations and identify and mitigate impacts to groundwater resources. More refined information describing the location of groundwater and soil salinity is provided in Appendix B. This too will be use to prepare the final report.

E4. Locations

As reported in section 4.2.7, the EIS concluded that there is a low likelihood of encountering saline soils. Saline and brackish surface waters occur in the following locations, with the assumption that the groundwater will also be somewhat saline in these areas given the hydraulic relationships described in the EIS.

E5. Review

The procedure will be updated annually or:

- Following observed dryland salinity during routine site inspections or audits
- Following a change in legislation or permitting
- Following a major change in construction and/or dewatering method.

E6. Procedure

This report will only be prepared by a suitably qualified expert and be based on detailed geotechnical investigations. It will be reviewed by Roads and Maritime and submitted separately for approval.

Appendix F

RMS Management of Tannins from Vegetation Mulch

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.

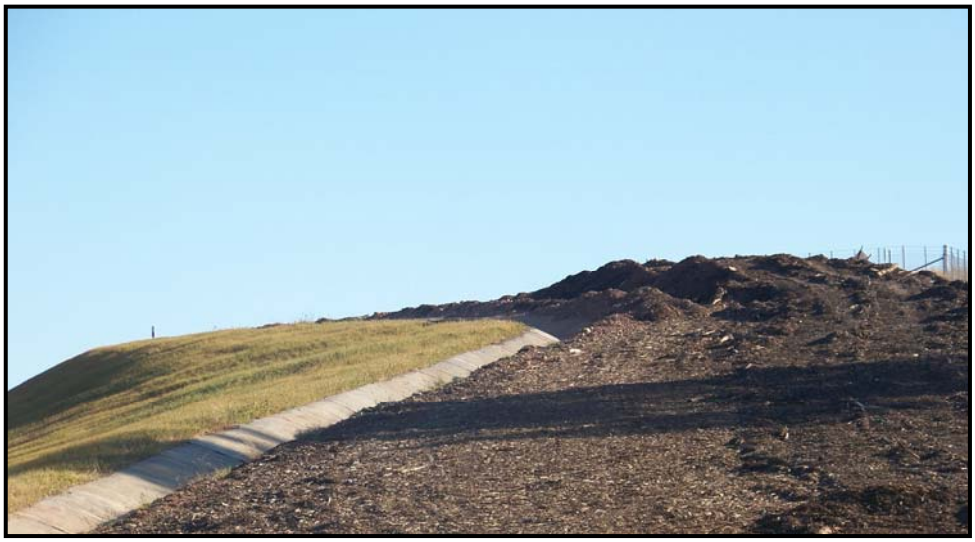

Plate 7: Mulch being placed as batter erosion control. Mulch should not be applied in layers more than 100 mm thick for surface stabilisation.

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.

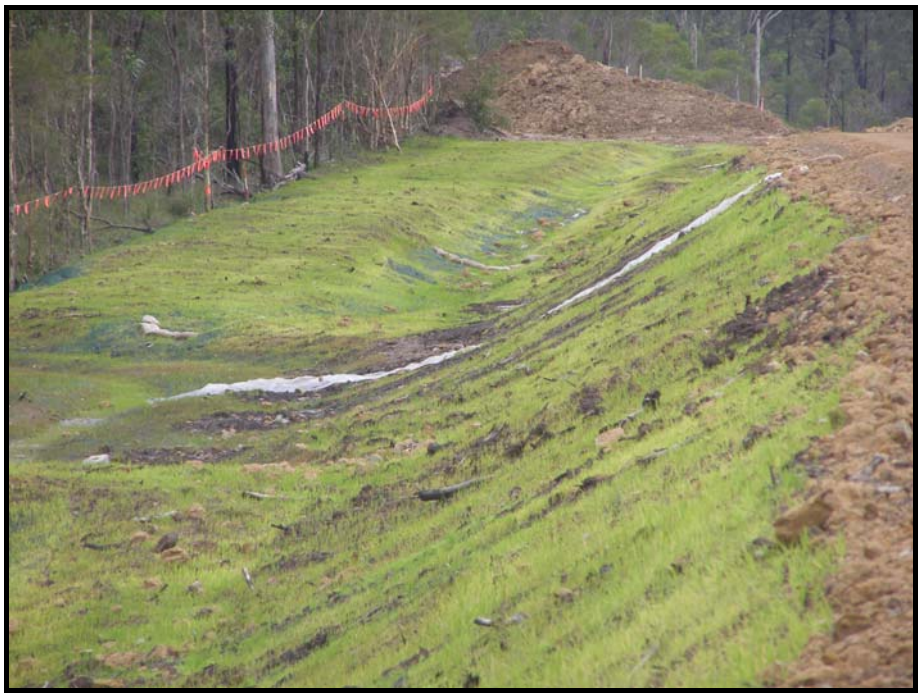

Plate 10: Successful establishment of cover crops on batters where mulch has been used with topsoil to assist temporary stabilisation.

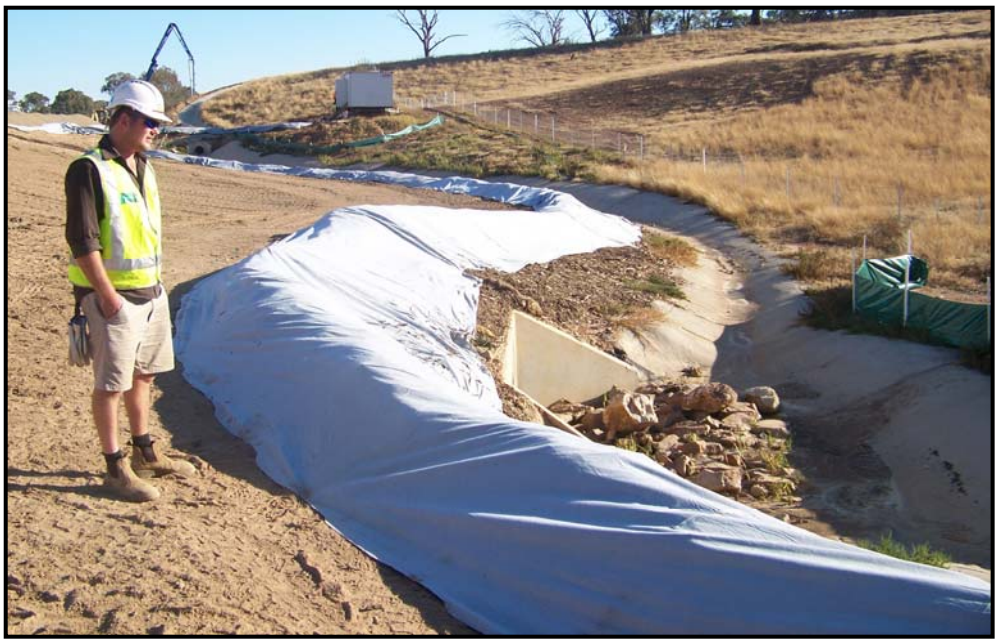

Plate 11: Geofabric wrapped mulch bunds used for sedimentation control

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		